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An integrated approach

PACSICOM co-sponsors:

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The authors are fully responsible for their submitted material and should be addressed for further information as desired.

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NOTE: In this document, the reader will observe that varying terms (and the corresponding acronyms, e.g. SICOM, ICZM, ICSM, ICAM and ICM) are used while referring to a similar notion: integrated coastal management. Each author's choice has been respected.

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FOREWORD

Coastal regions around the world face increasing demographic and economic pressure. Some of the Earth's most diverse, complex and productive systems are found in coastal areas, the resources of which are of utmost importance, particularly for food security.

Many African countries face serious coastal management and development problems, particularly as degradation of the coastal environment in many areas is causing a decline in the quality of life of local populations. Coastal erosion and desertification provoke biodiversity loss and drinking water problems. Local economies are adversely affected by over-exploitation of living resources, as well as by coastal development which often ignores ecosystem functions and interactions and by the pollution of coastal aquifers. Exploitation of mines, with no regard to the safeguarding of their sites, has resulted in the contamination of certain coastal areas by effluents containing heavy metals and various types of debris. The development of vast areas of monocultural crops has led to the disappearance of numerous species of plants and animals. The extension of the Global Ocean Observing System (GOOS) into the African coastal seas and the contiguous open oceans is needed on the continent by governments, industry, science and the public in order to deal with marine-related issues, including the effects of the ocean upon climate, the health of the oceans etc.

In order to deal with these and other issues, the Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM) was held in Maputo, Mozambique, 18-24 July 1998. It was organized jointly by UNESCO, the governments of Mozambique and Finland and the United Nations Environment Programme (UNEP). The conference was structured in three consecutive parts: (i) a series of technical workshops attended by specialists and dedicated to specific topics related to the conference theme, (ii) a brief session to bring to bear trans-sectoral issues, and (iii) a meeting of 41 ministers or their representatives. The reports of the technical workshops were submitted on 20 July 1998 to the ministerial meeting, along with a synthesis report and recommendations. Having considered these reports, the ministerial meeting adopted resolutions which also took into account political and socio-economic aspects of the sustainable integrated coastal management (SICOM) of Africa.

The present volume brings together contributions of all the workshops as well as summary reports. The Intergovernmental Oceanographic Commission (IOC), on behalf of UNESCO, is pleased to offer to the international community this unique compilation of information and thoughts that were shared at that important event in Maputo.

UNESCO has also published, as separate documents, the reports on the workshops on the role of communication and education (CSI Info No. 7), on capacity building for SICOM (IOC Workshop Report N° 160) and on GOOS Africa (IOC Workshop Report No. 152).

I would like to acknowledge and thank all the experts and UNESCO professional staff from the different Divisions that played a decisive role for the success of this Conference. On a personal note, I thank my colleague Robin Harger, who was largely the initiator of the idea to organize PACSICOM. It should be known that, in the last months prior to his retirement from UNESCO, Dr. Harger worked very diligently, and not without difficulty, to maintain the momentum which led to the successful launching of the Conference.

Also on behalf of UNESCO, I wish to thank the other co-sponsors of PACSICOM for their co-operation in this worthy undertaking. In particular, the Government of Finland, in addition to their contribution to the Conference itself, is acknowledged for their generous support in the publication of these Proceedings.

Patricio A. Bernal
Assistant Director-General, UNESCO
Executive Secretary, IOC

Workshop 1

CAPACITY BUILDING FOR SICOM IN AFRICA:

NATIONAL AND REGIONAL CAPACITIES

A Infrastructure and capacity building

AN OVERVIEW FOR AFRICA

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INTRODUCTORY REMARKS

Capacity building and SICOM are two broadly based and broadly defined issues. This makes the interaction between them even more complex. Let us start with capacity building which became a matter of concern in the field of marine and coastal research in Africa in the years of independence after World War II. Although there were few institutions or marine stations that date back to the colonial era, marine and coastal research has begun only, with few exceptions, during the last two decades. There was a severe shortage in manpower both in quantity and quality as well as in the balance between disciplines. To remedy this situation fellowships and training courses were offered by UNESCO and its Intergovernmental Oceanographic Commission (IOC), as well as by other UN and bilateral sources. UNESCO carried out a series of technical workshops to develop suitable university curricula in marine sciences, fisheries sciences and ocean engineering. IOC established in 1973 the Working Committee for Training, Education and Mutual Assistance in marine sciences (TEMA) to enable its developing Member States to become involved in the oceanographic programmes and activities of the Commission.

It takes a long time to build the human resources and it was reasonable to give priority to building a critical mass of marine and coastal scientists at the national level. However, it became apparent that the human power, however good, is not sufficient alone to make an impact unless it is backed by adequate infrastructure, equipment, and favourable policy. Integrating these elements in one package was the model of many UNDP projects implemented by FAO and UNESCO in fisheries and marine sciences. A typical project would contain three components: experts, fellowships and equipment. However, the relatively short duration of these projects (2 to 5 years) compromised their lasting effect.

Successful examples are found in partnership between two scientific communities such as the case of the Kenya-Belgium project which has had a longer duration, flexibility as well as coverage of most components required in the development process. The SAREC regional project in East Africa lends essential support to IOC Regional Committee for the cooperative investigation in the North Central Western Indian Ocean (IOCINCWIO). These are two excellent examples of donor's contributions. As a result of these developments, the use of "capacity building" emerged as a more appropriate term since it encompasses the essential elements of human resource development and infrastructure building as well as socio-political policy and planning based on national priorities and realistic economic and environmental return.

SUSTAINABLE INTEGRATED COASTAL MANAGEMENT AND CAPACITY BUILDING

The problem of coastal area development appeared in the early resolutions of the Economic and Social Council of the United Nations (ECOSOC) in August 1975. The obvious concern was the degradation of the coastal area because of the conflicting activities taking place without adequate planning. The most serious problems were found in developed nations, and it was hoped that developing nations could avoid such problems by learning the lesson and applying the principle of integrated coastal management in the early stages of developing their coastal areas.

However, 25 years after passing these resolutions we can see in Africa examples of badly managed coastal areas rather than bright spots of exemplary developed coastal area. The reasons include population pressure, over-crowding, over-exploitation of coastal resources and land-based sources of pollution. In short, rapid growth is overtaking good planning. Science (including marine and coastal sciences) offers solutions and alleviates problems. However it is the ability to apply science, not science itself, that is the key solution. Here capacity building becomes an essential element in achieving the objective of PACSICOM.

What kind of capacity building?

We have acquired over the years experience in capacity building in marine sciences. However, we realize from the experience of the last 25 years that marine research alone will not solve the problem of the coastal area. Marine and coastal research will remain the main component of coastal area management but it has to be combined with other sea-based and land-based disciplines in an interdisciplinary holistic approach. The concept of coastal area management appeared in the last two decades as an interdisciplinary subject that became recognized as a scientific field by some US and Canadian universities which offer degrees in coastal area management or in marine policy including this subject. This trend was accepted recently by some European and Asian universities. We should emphasise the fact that coastal area management was started and is still an interdisciplinary exercise, a dialogue and common language between the marine professions in the coastal area such as the oceanographer, the fishery scientist, the marine meteorologist, the coastal engineer, the surveyor, the urban planner, the economist, and the geographer. Coastal area management should take into consideration many socio-economic and cultural aspects as well. University degrees in coastal area management were mainly addressed to these professions active in the coastal area to create understanding and common language among them. However, a new trend is emerging to offer an M.Sc. degree in coastal management, a one year course to new university graduates, and to create a new profession: the coastal manager. It is my personal opinion that this is a simple solution that is not based on reality. In africa we have to guard against such an easy solution. Coastal area management is not a one-person job, but a team work, a joint exercise of several specialists. The need for highly qualified marine and coastal scientists and other relevant disciplines is a great concern for Africa. Finally, I wish to note that the problem of capacity building for SICOM is a broad subject open to many approaches and solutions. It is reasonable to expect in our meeting a wide range of views but it is necessary to come to specific conclusions and priority recommendations.

I should also draw your attention that sharing the platform of capacity building with us are four other workshops on Pre-university Education, Higher Education and UNESCO chairs, Communication and Public Awareness and Policy and Planning for ICAM. There are also special workshops on Data for SICOM, Water Resources and Earth resources. These are all elements in the overall capacity building at the national and regional levels. You may wish to highlight one or another of these subjects, leaving the details to these specific workshops.

WEST AFRICA

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INTRODUCTION

To most countries in the West African Sub-region, Integrated Coastal Zone Management (ICZM) is a fairly new concept and has therefore not been institutionalised as a management practice. Management of the coastal area is a diffused activity being undertaken by a myriad of institutions with interests and stakes in the coastal zone. These institutions and organizations, depending on the country, may include local government authorities in coastal districts, port and harbour authorities, shipping authorities, naval commands, tourist development organizations, fishery departments, native traditional authorities, including artisanal fishing groups, organizations overseeing gas and oil exploration etc.

Thus any initiative to develop and build capacity for ICZM must necessarily address institutional framework, structure and arrangements as a key issue in addition to human resources, material/finance and operational resource capacity building.

GOALS OF CAPACITY BUILDING FOR ICZM

ICZM may be defined as the management of competing demands for and use of resources in the coastal zone to meet short-term needs and ensure the long-term sustainable development of the coastal resources. Capacity building should therefore aim at developing and /or strengthening technical, institutional and human resources at all levels for efficient management of the coastal zone.

Specifically, the goals be:

- Enabling an environment that harmonises the general framework of national policies, legislation and regulations for ICZM.
- An institutional framework that allows close interaction between various administrative units and stakeholders.
- Planning and prioritisation of competing developmental actions and projects to enable decision makers to make choices between alternative actions and projects based on policies, environmental impacts and social and economic impacts.

INSTITUTIONAL CAPACITY BUILDING

In a majority, if not all, of the countries in the sub-region institutional responsibility for management of the coastal zone is fragmented and rests with various institutions and organizations. The management responsibility for each organization goes as far as meets the goals and objectives of that organization. In such a situation, there are bound to be conflicting interests. Apart from conflicting interests, limited cross-sectoral collaboration is a major constraint to sound and sustainable management of the coastal resources.

Another major institutional constraint is the limitation and inadequacy of existing laws that affect the coastal zone. Some of these laws are a colonial legacy, underpinned by the colonial ideology of exploitation. Most colonial legislation is aimed at facilitating the maximum exploitation and transportation away of the natural resources, especially the non-living resources, and not for ensuring a sound management of the environment and natural resources.

Consequently, many provisions are inadequate and have no bearing on present day realities and policy objectives. Furthermore, a multiplicity of laws to cater for sectoral interests has resulted in jurisdictional overlaps and confusion leading to non-enforcement of laws.

The other constraints are: lack of logistics such as equipment and transport: lack of awareness amongst the stakeholders and communities in the coastal zone of the inter-dependency of their activities and management actions; and lack of staff with the requisite skills and knowledge to undertake ICZM.

Institutional capacity building in the sub-region should therefore aim at:

- Harmonising existing laws that overlap or are in conflict with each other into a workable regulatory framework with provision for subsidiary legislation to respond to changing situations.
- Strengthening cross-sectoral collaboration at both national and district levels.
- Raising awareness amongst stakeholders and communities to the inter-dependency of their activities and management actions.

Human resource capacity building

Capacity building in human resources seeks to ensure a sustainable supply of adequate skills and knowledge to meet the changing challenges of ICZM. To attain this, there must be a conscious effort to develop a core of professionals, in the natural and social sciences as well as administrators, to implement policy actions aimed at ICZM, since ICZM is a fairly new concept in the sub-region. Reorienting already trained professionals and administrators to ICZM practices and training of newly recruited staff could achieve this.

A variety of instruments have been employed in the sub-region for human capacity building. These include: formal education at universities, polytechnical and technical institutes; short-term training courses, cruises and programmes organised on national, sub-regional or international bases; and in-service training programmes. Exchange programmes between institutes in countries in the sub-region have been useful in sharing knowledge and experiences.

At the fourth session of the IOC Regional Committee of the Central Eastern Atlantic (IOCEA) held in Las Palmas, Spain, the following recommendations were made on capacity building:

1. Assistance in the establishment of a degree course in oceanography at the University of Lagos, Nigeria.
2. Second IOCEA Cruise in the Gulf of Guinea.
3. Regional training course on the use and collection of sea level data.
4. Training workshop on Archiving and Transfer of Oceanographic Data and Information.

Some of the above have been carried out in the current inter-sessional period.

As part of an international seminar on the coastal zone of West Africa, organised by the University of Ghana in Accra in March 1996, a questionnaire on training and research needs for ICZM in West Africa was administered to the participants. Out of the 120 participants, 73 were from 8 West African countries. The results and recommendations of the questionnaire, which are considered to be still relevant, are worth recalling in the summary below:

Disciplines

Areas identified as needing special attention for training and research for the sub-region were biological and physical resources, remote sensing and geographic information systems, fisheries, erosion and pollution. Out of these, erosion and pollution of coastal lagoons were identified as priority areas where training and research are crucial.

Resources

An assessment of the status of resources available in the sub-region, both human and infrastructure for research and training, indicated that both personnel and equipment availability constitute major limitations.

In terms of personnel, the opinion was that these were generally available but grossly insufficient in number to cope with the research needs of the sub-region. Thus, there is a need for more trained personnel in the various disciplines identified.

Infrastructural facilities are also grossly inadequate both for training and research. Field equipment and laboratory facilities were judged as being poor.

Training and research

Institutional arrangements for training and research should include the establishment of national training centres, reference laboratories and a sub-regional centre of excellence. These centres should be networked and supportive of each other. An important area, which needs to be seriously addressed, is the sectoral approach to matters relating to development in the coastal zone. To this end, in-country workshops for target groups for the promotion of cross-sectorial dialogue are advocated for countries in the sub-region.

Further research and training in ICZM could be realised through regional collaboration either with or without foreign assistance. Where foreign assistance could be secured, the initiative should be taken and the opportunity utilised to the full. In the absence of foreign assistance, regional collaboration could proceed in the following two ways:

a) Scientists and experts could be mutually hosted in each other's laboratories. This is very important in the often too common situation in West Africa where no one laboratory in a country has the entire array of facilities and equipment for research.
b) Information sharing among institutions in the countries of the sub-region is seen as another way of collaboration. Here, a viable and properly established sub-regional centre of excellence should serve as the repository as well as dissemination point of information on ICZM.

Recommendations of the seminar

Currently, resources available for training in ICZM in the West African sub-region are diffused. To enable their effective use, there is a need to harness, strengthen, and properly coordinate them.

More importantly, there is the immediate need for the establishment of a formal training centre. This can best be done or started at a national level in a country with progressive ICZM policies and evidence of practical achievements in the area. Such a centre should later be developed into a Regional Centre of Excellence. West African coastal countries are split into two broad linguistic groups – the English-speaking countries, made up of the Gambia, Sierra Leone, Liberia, Ghana and Nigeria and the French-speaking countries comprising Senegal, Republic of Guinea, Côte d'Ivoire, Togo, Benin, Cameroon, Gabon and the Democratic Republic of Congo. On the basis of such linguistic dichotomy, it might be prudent to have two separate centres of excellence. Where funds are limited, however, consideration could be given to having only one.

In addition to the above recommendations, other instruments that enhance human resource capacity building include attendance at technical conferences, seminars and workshops and undertaking consultancies solely or in partnership with other local or external consultants.

A basic tenet of human capacity building is ensuring a sustainable supply of adequate skills and knowledge. Arrangements could be made for attracting and retaining human resources through attractive incentive packages and provision of training programmes to upgrade skills and knowledge to respond to technical advances and changes in ICZM and also to give job satisfaction to staff. Such measures should be given high priority in human resource capacity building.

Financial and operational resources for capacity building

The principles of financial and operational resource capacity building are closely linked. Whereas operational capacity, in strict terms, is a measure of the extent to which institutions and organizations can perform functions assigned to them within an institutional framework, their performance and output are a direct function of the financial resources made available. In the sub-region financial resources needed for equipment procurement and maintenance, monitoring programmes, research cruises, data collection, and general logistics for effective operational activities are generally lacking.

Capacity building in financial and operational resources for ICZM should look beyond traditional government budgetary allocations and means of harnessing funds on a sustainable basis. Some of the following options are worth considering:

- Developing a commercial market for data, services and adaptive research and studies undertaken by organizations and institutions;
- Instituting fees and charges for operating in coastal areas for lucrative activities such as gas and oil exploitation, management of ports and harbours, large-scale commercial fishing, tourist facilities etc. to support vital but non-income generating organizations in the ICZM chain;
- Encouraging effective and efficient use of existing skills, knowledge and expertise outside routine duties and functions; and
- Government or central authorities allowing line institution and organizations to earn and retain revenue from their services for operational activities.

Conclusions and recommendations

In this brief presentation some key issues pertaining to institutional, human resources and financial and operational capacity building for ICZM in the West African sub-region have been discussed. This discussion has been in the light of the fact that ICZM is a fairly new concept in the sub-region, and, most often, without the necessary institutional framework for its practice.

Suggestions and recommendations that were made addressed the following:

- an enabling environment to provide a general framework for implementation of national policies and effective enforcement or adherence to regulatory legislation and regulations;
- an institutional framework to strengthen cross-sectoral collaboration at both national and district levels;
- raising awareness amongst stakeholders to ICZM issues and practices;
- development and retention of human resources for sustainable ICZM implementation in the sub-region;
- ensuring sustainable financial and operational resource capacity for effective ICZM; and
- taking cognisance of the shortage of resources in the various components of capacity building in the West African sub-region, it behooves countries in the sub-region to collaborate and share resources for their capacity building efforts for a sustainable ICZM.

EAST AFRICA

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ASSOCIATED PROBLEMS

Constraints to marine science programmes in the East African region can be summarised as lack of national policy as well as inadequacy of infrastructure, maintenance, expertise, personnel development opportunities and incentives etc.

STATUS OF IOCINCWIO AND IOC/TEMA

Although some progress has been made since the formation of IOCINCWIO and the launching of WIOMSA, especially in the areas of information sharing and personnel development in marine biology and fisheries, infrastructural constraints remain major impediments. New technologies for data capture analysis, archiving and communication anchored on local capacity building will ensure sustainability.

COLLABORATIVE PROGRAMMES THROUGH RECOSCIX-WIO

Linkages have been established with several donor countries and agencies for support and partnership in relevant areas of capacity building activities. Several public education and operational activities were planned for the International Year of the Ocean and the Marine Science Programme in Eastern Africa 1997-1999.

PROBLEMS ASSOCIATED WITH THE MARINE SCIENCE PROGRAMME IN THE EASTERN AFRICAN REGION

The problems related to the development of marine science capacity building in the East Africa region are given below:

- lack of national policy on marine research,
- lack of infrastructure/equipment,
- lack of maintenance/spare parts,
- lack of trained scientists and technicians,
- lack of scientific literature and communication tools,
- insufficient participation in international scientific meetings,
- lack of indigeneous professional societies,
- lack of incentives for active research,
- insufficient income for scientists for full-time commitment, and
- insufficient monitoring of research quality and efficiency.

IOCINCWIO

Barely three years from the end of the century, it is instructive to review how the IOCINWIO region has faired:

- IOC and WIOMSA have prepared the marine science country profiles for Western Indian Ocean countries.
- More expertise now exits than at the launch of the comprehensive plan, but other than in marine biology and fisheries the region has yet to develop a critical mass of experts in marine science.
- Only Mozambique has an ocean-going vessel which can be adapted to research. In most of the countries infrastructure, including laboratory space and equipment, is inadequate.
- The initiation of IOCINWIO and the launching of WIOMSA have provided both the Governments and the scientists from the region with a forum for exchanging ideas and advice on planning.

The importance of communication and visibility

- We must attract decision makers through the use of appropriate terminology and we must make efforts to explain the issues;
- Leadership and communication (briefing, advice) are essential elements, ministerial or senior official levels should be used to obtain commitments;
- Projects must have a national base so as to ensure their self-sustainability.

Expectations for emerging countries from IOC/TEMA

- Provision of equipment after workshops;
- Funding IOC sub-commissions;
- UNEP linking with Regional Programme;
- Regional Seas counter-part;
- Promoting and advancing the educational, scientific and technological development in all aspects of marine sciences;
- Providing funds for meetings, seminars and workshops for the presentation of findings and experience on subjects related to marine sciences;
- Encouraging the support of marine research, development and educational activities undertaken by governments and private sectors;
- Disseminating scientific, technical and other relevant information in marine sciences;
- Promoting and fostering inter-institutional linkages within and outside the third world countries, with a view to sustained use, conservation and preservation of the marine resources of the region.

Cooperation

- Cooperation between regional bodies and donors must increase, and donors should contact regional bodies early on the project formulation and *vice versa*;
- The existing gap between fisheries people and ocean research people must be closed;
- Physical conditions and processes must be taken into account;
- The environment, including the marine environment, should be given the right priority, e.g. in relation to food (fisheries, aquaculture);
- There is a need for intersectoral projects;
- The conditions of marine environment, both from an environmental and ocean health point of view, are essential factors to be considered for fisheries managment and other living resources questions.

Implementing cooperative programmes

- RECOSCIX-WIO has promoted linkage between scientists and institutions in the region, in addition to providing useful data and information exchange services.
- Operational activities;
- Human capacity support;
- Communication and information dissemination, public awareness;
- Physical infrastructure;
- The IOC-SIDA (SAREC) programme is an operational example of TEMA capacity building linking training, education and research.

Partnership between North/South relationship with TEMA

In order to achieve the relationship in partnership the strategy is to be carried out as follows:
- Identification of available human capacity;
- Identification of human capacity building requirements;
- Human capacity building;
- Communication and information dissemination.

Cooperation in marine science in eastern Africa

- Sweden (SIDA SAREC);
- Norway (NORAD);
- USA (USAID);
- Netherlands;

- Canada (IDRC and CIDA);
- Britain (ODA);
- Japan;
- Germany and others.

TEMA IN THE INTERNATIONAL YEAR OF THE OCEAN

- expeditions with research vessels;
- education kits;
- internet for educational purposes;
- alternative TV/video programmes or CD/ROMs;
- exhibitions;
- concerts;
- festivals;
- music CDs;
- books etc.

MARINE SCIENCE PROGRAMMES IN EASTERN AFRICA 1997-1999

The marine science programme in Eastern Africa 1997-1999 as planned by IOC and SIDA-SAREC is as follows:

Operational activities

- Ocean science in relation to non-living resources (OSLNLR);
- Ocean science in relation to living resources (OSLR);
- Marine pollution;
- Support programme: developing and sustaining indigeneous human capacity;
- Support programme; communication,data and information.

Benefits

- Experiences of different donors should be recorded and used as an aid to the donor community at large in formulating projects that are responsive to the recipient’s needs.
- There is a need for more integration.
- We need to collect and put together the experiences obtained in different regions and donor programmes.
- Capacity building is a long-term process and is evolutionary.
- We must avoid donor-driven projects.

RED SEA AND MEDITERRANEAN

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THE FOLLOWING IS RECOGNISED:

- The Rio-UNCED event demonstrated the worldwide determination to protect the environment and promote conservation of environmental resources.
- Most governments are now aware of the possibility of undesirable side effects of large-scale development activities.
- Public awareness globally, regionally and locally has led to more stringent environmental legislation and regulatory measures.
- It became essentially important to adopt a well-designed systematic approach for addressing environmental issues during the development process.
- Concerning the coastal zone, the correct approach is an integrated coastal zone management programme (ICZMP).

Amongst many inter-related issues in ICZMP, Environmental Impact Assessment (EIA) is the backbone instrument.

- National and regional agencies were created to implement ICZMP and to take the responsibility for EIA studies and their evaluation.
- Governments, international agencies, world organizations and riparian nations are currently active in experience transfer and funding, to learn how to make EIA a practical management tool.

For the time being and within the above positive and constructive framework for attaining SICOM, it is obvious that the outcomes are still not on the same levels of either exerted efforts or money expenditure.

Experience in environmental management shows that capacity building is urgently needed in the following areas of CZM:

1. National Environmental Affairs Authority
Its role should be mainly as co-ordinator between all partners in the environment. With little technical staff, it is difficult to play an executive role.

2. Implemented CZM programmes and projects
The need is urgent to establish a mechanism to co-ordinate, communicate, disseminate and harmonise the present national and regional intensive activities.

3. Adopted coastal zone management plans
Some main issues are still not well defined (rights in coastal areas, legal power, enforcement right, relative importance to the country etc.) Decentralisation of decision-making mechanisms requires good planning and understanding at different levels.

4. Environmental management system
Strengthening the polycephalus trend for planning, following up and evaluation instead of the present monocephalus system.

5. Environmental impact assessments
Decentralisation is needed through supporting and enhancing the establishment of regional monitoring and enforcement coordination units (MECU) with stakeholders' self-management systems. Roles of the environmental authority could be limited to planning and evaluation.

6. Institutional arrangements

- Legal and administrative authorities need reliable measures to move and means to enforce. Also tasks, priorities and responsibilities are not clear.

- Governance arrangements are needed to solve the conflict between the conservation of the indigenous people and the modernisation through restructuring of coastal governance. Foreign tourists should give the example for environmental protection and conservation to the citizens during their stays.
- NGOs should be activated by giving active responsibilities in MECU management.
- Definition of matrices of land use planning, acquisition programmes and effective EIAs are needed.

7. Education and research

To be at the same level of increasing complexity of environmental issues, the following requirements should be considered:

- modernisation of education tools and courses in marine sciences,
- introducing applied science while strengthening fundamental disciplines,
- new system for integrating and co-ordinating research programmes in the universities and marine research institutions,
- implementation of complete data base for all inter-related environmental development issues to answer the usual question “who is doing what?” in the marine environment.

8. Training

The current training activities in CZM should be reviewed within an integrated policy based on actual needs and priorities. The main point is to ensure that trainers have appropriate experience in the CZM processes in which they are involved. Standardised training programmes on national and regional levels are required to cover CZM issues (rules and regulations, monitoring activities, marine pollution control technology, permitting and enforcement procedures).

9. Awareness

There is urgent need for a strategy and a mechanism for communication between different stakeholders in an environmental problem or within a region.

THE NIGER DELTA ENVIRONMENTAL SURVEY: A REGIONAL GRASSROOTS PARTICIPATORY MODEL

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BACKGROUND

Covering an estimated 40,000km^2-70,000km^2 in Southern Nigeria, the Niger Delta is one of the world's largest deltas and most extensive wetlands. Its mangrove forest, Africa's largest (and the world's third largest), fertilises the commercially important fisheries of the region's coastal waters and serves as a valuable spawning/nursery grounds for a wide variety of fish and a sanctuary for other living resources. It is Nigeria's richest region in terms of biological resources and also contributes more than 90% of the country's total export earnings from its vast hydrocarbon deposits.

Despite this enormous resource base and contribution to the Nigerian economy, the delta's potential for sustainable development remains unfulfilled. The region is generally in a parlous state, characterised by paucity of social infrastructure, poverty in the midst of plenty, social dislocation, discontent, conflicts over oil revenue appropriation/allocation and environmental degradation.

Initiated by the Shell Petroleum Development Company of Nigeria Limited in February, 1995, and now jointly funded by all oil-producing companies in the region, this Survey is designed to meet the urgent need of establishing an independent and reliable database on the delta's ecological and socio-economic characteristics, as a basis for sustainable planning and management and enhancement of the quality of life of the people.

THE PARTICIPATORY APPROACH

Founded on consultation with organised local and international interests on the region, the survey is run by an independent steering committee that is a balanced representation of the diverse stakeholder views and opinions. Region-wide consultations to enlist grassroots cooperation and participation were followed by stakeholder consultative meetings involving a cross-section of representatives of the region's interest groups for deliberation and endorsement of the survey's scope and terms of reference.

As a catalyst for harmony and sustainability in the region, the survey is predicated on a participatory and balanced construction of problems, challenges and consensually agreed solutions.

The spearhead of this approach is the Participatory Rural Appraisal/Participatory Learning and Action ("PRA/PLA") process. It preceded and was integrated with all the other sectors (scientific aspects) of the fieldwork. The PRA/PLA process involved an intensive interaction with a representative sample of the region's communities for a detailed analysis of their natural resource base as well as their social, economic and contextual environment, from their own perspective, in order to provide the framework for policies that would foster sustainable development and enhancement of quality of life.

IMPLEMENTATION

The Survey was structured for implementation in three phases:

- *The Preparatory Phase*, consisting of all the consultative activities leading to the endorsement of the survey's scope and terms.
- *Survey Phase One,* consisting of an evaluation of existing data on the Niger Delta, identification of gaps and major issues to be addressed and the preparation of a detailed work programme for Phase Two. Phase One Report, published in December 1997, is in

the following four volumes: volume one – Environmental and Socio-economic Characteristics; volume two – Evaluation of data gaps and the definition of a framework for database management; volume three – Indicative Work Plan for Survey Phase Two; volume four – A well-illustrated, easy-to-read summary of the report for wider stakeholder readership.

- *Survey Phase Two*, consisting of detailed field activities for data acquisition in the main survey sectors of PRA/PLA, biological environment and resources, human environment (socio-economic and human health assessment) and the physical environment (pollution and hydrology); incorporation of relevant information into a geographic information system (GIS) database and the preparation of an Indicative Niger Delta Management Plan. Details of activities in these sectors are presented in schematic summaries in the annex of these Proceedings. The Survey's mid-term report is ready for presentation to stakeholders but must first be endorsed by the steering committee before getting to the public domain and will therefore not be presented on this occasion, for the sake of good order.

The survey's output is at every stage subjected to rigorous peer-review by some of the most reputable local and foreign institutions to assure objectivity, independence and reliability.

Some data about littoral problems in Algeria

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Disparity between the north region (littoral) and other regions

- 4% of national territory but 2/3 of Algerian population,
- 55% of the industrial activities are localised in littoral,
- 70% from the best agriculture lands are located in littoral,
- Surplus of summer population is estimated at 12 million,
- More than 70% of utilized water resources are in littoral.

Environmental damages

- uncontroled evolution of great coastal urban cities: Alger, Oran, Annafa,
- consumption of fertile soils: (in littoral center: 12 000 hectares),
- intensive occupation of the coastal zone, Algeria Bay being about 95% occupied,
- flow of wastewater into the sea is about 1.5 million m^3, mostly untreated,
- dunes near large cities are degraded (about 1 250 hectares),
- abuse in sand exploitation (10 to 12 million m^3),
- coastal erosion: 80% of the beaches are in recession.

Main reasons

- The greater part of development actions has concerned the littoral regions.
- The development strategy is characterised by a sectorial vision.
- The planning instruments are inadapted.
- The traditional training is not efficient.

Some elements of the response to the littoral problems

1. Education and training

a) The old training programmes and networks are not adequate and consistent enough to give solutions for coastal problems.

b) In 1983, ISMAL (Institut des Sciences de la Mer et de l'Aménagement du Littoral) was created. Its mission: research and training in protection and development of coastal and marine areas.

c) Now two questions are considered:
  - What profile of manager is required for coastal problems?
  - What training programme relates to this profile?

d) The profile is coast planning engineer (Ingénieur aménagiste du littoral). The programme and contents consistent with this profile are structured in three principal groups of disciplines:
  - Training to obtain knowledge of the coast's physical environment;
  - Training for a multidisciplinary enrichment;
  - Training in methods and techniques for data processing.

e) The potential employers for the students are:
  - central administrations: ministries, national agencies;
  - Regional administrations: Wilayas (préfecture);
  - environment structures;
  - local administrations: districts;
  - private research organizations.

2. Institutions and instruments

a) In 1996, the Government initiated a study named “Schéma du développement et d’aménagement du littoral”. The issue is the determination of zoning of littoral regions, based on specific criteria :
   - urbanisation rate
   - environment sensitivity
   - resources and potentialities

b) In 1997, this study was extended to the interior regions, near the littoral zones (bassins versants).

c) Project of littoral observatory. The idea is to have an institution able to collect and study the data necessary to an integrated littoral management. This institution can take the role of a land agency for the coastal zone.

d) Project for a “Littoral law”: the idea is to have a legal document to organise and to normalise the coastal and littoral occupation and exploitation.

e) Algeria has initiated, with the Mediterranean Action Plan and its regional centres (CAR/Plan Bleu), a programme on coastal management (PAC-Algérie).

The preliminary study has been conducted in conjunction with the National Institute of Marine Sciences and Littoral Management. The area covered by the programme is about 5 270 km^2 distributed between marine and coastal zones with a coast line of about 150 km in three bays: Algeria Bay in the centre, Zemmouri Bay to the east and Ismail Bay to the west.

Many actions are proposed for the protection of the coastal environment. The objective is also to introduce the idea of integrated coastal area management in national and local development programmes.

The agreement for PAC-Algérie by M.AP. (Mediterranean Action Plan) and Algerian authority is imminent.

Training courses

First year

TCSN programme (core subjects)

Second year

Climatology - Hydrology
Mathematics - Statistics
Geology modules (crystallography, mineralogy, petrography, cartography – photo-interpretation)
Marine physics
Marine fauna and flora
Scientific English

Third year

Geotechnical scientific English
Coastal and marine geomorphology
Computers
Chemistry and marine geochemistry
Marine ecology
Coastal hydrodynamics

Fourth year

Coastal development I
Coastal pollution
Coastal topography
Hydrography
Environmental and development law
Acoustic geophysics (seabed surveying methods)
Scientific English

Fifth year

Seabed geology
Coastal development II
Coastal engineering
Marine law
Modelling
End of studies dissertation (six months)

B

Socio-cultural aspects of SICOM

Coastal sustainability concepts

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Definition of key concepts

(See figure on following page)

Sustainable

The concept of sustainability describes the main objective of this workshop, namely ensuring the continued existence of a healthy coastal environment, the resources from which can be continually enjoyed by the inhabitants of the region.

Capacity building

Capacity building is the broad-based enhancement of skills, knowledge and institutional capabilities to facilitate the achievement of sustainable development.

Integrated

The planning of integrated coastal management involves not only the impact of human beings on environment but also the occurrence of natural hazards, such as cyclones, floods and tides, in the context of the development needs and well being of the population concerned. Much data are often obtained sectorally, by separate specialists from different institutions or authorities. Similarly, planning and decision-making, now generally sectoral, are to become generally integral.

Coastal zone

Besides the usual flexible definition of a coastal zone as a fringe of land 20-50 km wide inland from the coast, it is useful to note that in the case of many small islands (Zanzibar, Seychelles, Comoros, Reunion, Mauritius, Maldives) the size of the island makes the entire island a coastal zone.

The hinterland outside the coastal zones, where major happenings such as agricultural run-off, erosion, rivers etc. influence the coastal area, must be considered, for management purposes, together with the coastal zone.

Management

Management is the art and science of ‘looking after’.

Let us recall some of the things happening to coastal zones these days:

- destruction of lands, destruction of natural habitats;
- upland water impoundment;
- degradation of coral reefs, pollution of lagoons, discharge of oil into the sea;
- dredging for sand, land reclamation;
- over exploitation of fish and other living marine resources, algal blooms, eutrophication;
- urbanization, high-rise construction, excessive tourism;
- stress on the quality of life, welfare, education, health, housing, recreation, occupation, income of coastal communities.

Each of these aspects requires looking after; however for sensible results these must be looked after in relation to each other, that is integrated management.

According to Atchia (1995) there are four main processes in ‘looking after’ or environmental management:

- environmental monitoring;
- environmental protection;
- environmental resources planning and development;
- environmental enhancement.

Information, education, communication

When a communicator (the sender) sends a message to another person or persons (the receivers) he or she may have several purposes in mind:

- information, namely that the receiver should be made aware of something;
- education, namely that the receiver should learn and understand something;
- communication, namely that the receiver should alter his or her attitudes and behaviour, be persuaded to do (or not to do) something.

Examples of these functions are given below:

- a radio weather forecast is pure information;
- a class experiment measuring heartbeat while lying down, sitting, standing and after a run leads to understanding a relationship between rate of heart beat and effort; this is education;
- an advertisement ("Drink Coca Cola!" "Keep Maputo Clean!"), an event (a baby crying to elicit a feeding response from its mother) or an observation (large waves with white crests at sea or the sound of thunder) all may lead the receiver to appropriate action regarding consumption, litter, child care or going out to sea; this is communication.

ECOSPHERE

The global ecosystem comprising the atmosphere, lithosphere, hydrosphere and biosphere as inseparable components

COASTS

As places of transition between land and sea, the coastal areas have played a vital role in the socio-economic development of mankind

PRODUCTIVITY

Coastal zones are areas of high biological productivity. About 90% of world fishery catches come from near-shore and reef areas while coasts serve as nursery grounds for other open-sea fish

ENVIRONMENTAL LITERACY

Can all the in-depth research and remarkable progress made during these last 3 decades of the 20th century be of any use in the long term unless transmitted in a systematic way to the environmentally illiterate and then to future generations?

Adapted from page 4 of Issues and Solutions, Atchia, M. and Tropp, S. (eds.), 1995.

The role of communicators, public relations officers and educators

The first assumption is that issues have been identified and solutions to these found. The role of communicators, public relations officers and educators is then to pass these on. The role of educator is of course deeper as it involves incorporating the knowledge, skills and desired behaviour into the make-up of the people they teach.

Ideally stakeholders together with communicators and educators take part in the process of issue identification and the development of solutions.

Then together they will select various media, plan intellectual as well as emotional communications, identify target groups, design communication packages, test them for retention and impact value.

Finally a campaign can apply these as required and as resources permit, and evaluate results.

SOME IDEAS FOR PROMOTING SUSTAINABLE INTEGRATED COASTAL MANAGEMENT THROUGH COMMUNICATION, EDUCATION AND PUBLIC AWARENESS

Environmental citizenship

Design and implement a campaign for different key target groups from coastal areas (from school children through tourists and tourism staff to decision-makers) to introduce this concept. Environmental citizenship involves both the rights to enjoy and duties to protect the environment by all citizens.

The precautionary approach

Principle 15 of Agenda 21 (1992) states that 'in order to protect the environment, the precautionary approach shall be widely applied' and 'when threats are serious or irreversible damage is being done, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent (further) degradation'. Each concerned group should discuss how to apply this approach to their immediate surroundings. Included here is the application of environmental accounting to all governmental, para-statal, institutional and corporate accounts.

Learning by doing

A basic and successful learning approach consists of learners actually doing things (e.g. cleaning beaches, replanting mangroves, putting up posters and bins, monitoring fish landing, doing field ecological observations and measurements such as salinity, temperature of water, species distribution, oxygen and *E. coli* in lagoon water etc.) as a means of obtaining first-hand knowledge, not book or electronic information.

Environmental reporting

The objective of environmental reporting is to train journalists, public relations officers and others to provide information to the public, special groups and the decision-makers about coastal zone events. There are many vehicles for effective environmental reporting, e.g.:

- State of the Earth reports
- environmental indicators
- Environmental Impact Assessment reports
- environmental audits
- printed press (newspapers, journalists)
- electronic media (television, radio, the Internet)

A strong recommendation is to have sound environment and development journalism in each member state, as a means of keeping coastal zone issues and solutions continually alive.

A workshop on 'What's Newsworthy' discusses the following: new elements, nearness, timeliness, importance, names, drama or conflict, variety, human interest, humour and the key element of interest/implications in people's lives.

Modelling scenarios and environmental games

One of the first environmental computer models (developed by Dennis Meadows) was about the relationship between size of fleet, intensity of fishing and fish catch of a given fishery. The modern versions are geographic information systems (GIS) which are computer hardware, software and procedures designed to analyse data spatially or geographically hence helping solve complex planning and management problems. GIS require a high level of equipment and training. Environmental models are now currently applied to complex integrated coastal zone management problems.

Global ideas about survival, human impact on the planet as a whole, global warming, sea-level rise, laws of the sea, protection of marine biodiversity, world trade and shipping etc. can be usefully discussed in the context of management of coastal zones in Africa. Introduction of the use of simple modelling, developing alternative scenarios and always doing impact assessment should become a 'way of life' for all environment and development in coastal zones. Production of simple guides (in print, poster form or electronically) will encourage this to happen.

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ROLE OF COMMUNICATION FOR INTEGRATED SUSTAINABLE PARTICIPATION

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FOREWORD

Development synergy

The intention of this presentation is to propose a communication system that allows the state and the public with its different components (grassroots communities, the private sector, the media, as well as international organizations), to setup a synergy in decision-making, information and evaluation. Also to establish the principles from the communication point of view, for the creation of an environment conducive to a stakeholders' partnership concerned with Integrated Sustainable Coastal Management (ISCM).

Why a communication component in ISCM?

This presentation will also attempt to introduce a platform for information, action and participation for the public and an opening for it to express its needs and confront – even object to – proposed solutions without having to go through the vertical scheme of decision-making that is prevalent today. This is important especially for those directly affected by degradation of their living conditions.

Communication model

Finally, this paper will put forward a paradigm of communication, development and participation (participatory social communication, see diagram on p. 33) that can serve to establish a two-way communication system with the national communities which are the recipients of social and economic development activities. In addition, it will propose a system for project management in which communication – seen here as a tool for social participation – constitutes an element for action and for coordination, in addition to its original role of a multiplier of inputs and resources.

WORKING HYPOTHESIS

State-public development synergy

A system which uses both aspects of communication – social and participatory, as ingredients in a development strategy is a necessary element – or a platform – to bring into being a synergy between the state and the general public. Such a system would represent an opportunity for both to undertake joint action designed to concentrate, rationalize and multiply the efforts made within a development process and in particular in ISCM.

BACKGROUND

Continuous adjustment of objectives

The rapid changes taking place in developing societies – in this case the degradation of coastal areas – require communication instruments to enable them to adjust their objectives, activities and programmes in an on-going way. In other words, a platform is needed to allow stakeholders to regularly adjust their actions and strategies to increase the impact of their programmes. Also, this is a *sine qua non* condition to ensure the participation of the public in the search for improvement in everybody's environment.

Top-down state policies

So far, the state forwards information about policies through the institutions responsible for the administration of the public wealth, or through intermediaries responsible for the distributions of commodities and services. Likewise it uses the media to explain and justify its actions. This one-way communication has limited results mainly because it is done in what we can call a 'vertical-pedagogical' method through the (mostly public service) media. This 'communication' is limited to a one-way, top-down flow, which evidences the lack of dialogue between the macro-economic structures and the recipient population.

MEDIA

Importance of the media and its limitations

This unidirectional, vertical-pedagogical process is the result of a technocratic or bureaucratic approach characterized by the fact that messages are sent by the state to the public to motivate it, through 'education', into active civic participation. These messages are limited in time and space (one or two media for a short period of time) because of their high cost and the state's limited resources for communication and information. This, nevertheless, does not mean that using the media for information campaigns is not a good strategy. Bad strategy would be to consider their use as the only and overall solution. Indeed, it is undeniable that the media, and radio broadcasting in particular, have an unparalleled capacity to penetrate society, therefore they are instrumental in increasing the impact of programmes and activities. It should therefore be understood that the media is an important element of any communication strategy, but by no means the only one.

INTERACTION

The need for a communication component

Many states have opted to develop a vertical-pedagogical communication method to explain their social and economic policies in an attempt to obtain public participation. However, it has yet to be proven that this type of (media) policy transforms society into an audience and therefore obtains the expected results. In the present case, it is illustrated by the population's apparent lack of knowledge of ISCM policies, even with the support of costly information campaigns. Interaction between the state and the public can only be established through a 'democratic-dialog'communication process in which it is ensured that the national stakeholders jointly design, implement and monitor conservation policies with the active participation of the public in decision-making and resource allocation.

It is therefore necessary to design communication systems that allow the public to actively participate in the production and transmission of messages which can be understood and translated into action by the state and its agents in both country-wide development policy and sectoral projects. Such a system would benefit both society – by allowing it to express its needs and aspirations, and the state – by enabling it to make coherent policy, evaluate the results of its actions and change policy when and where needed.

Cultural factor

Sustainability

Individual grassroots communities are often marginalized by mainstream national campaigns that do not take into consideration their individual character. So the state's action is reduced to the provision of goods and services without any guarantee of sustainability or appropriateness. As a consequence, social and economic development projects collapse as soon as state or external support comes to an end. Lack of reference to cultural background is usually a cause for disaffection to 'national campaigns', consequently it is in the interest of all stakeholders to place communication and information processes in a cultural context.

If we accept that communication is not simply a one-way process through the media, but is a complex web of modes covering inter-personal communication to information super-highways, its core is the cultural factor. It is this that will ensure effective public participation and continuity of any development strategy.

Retrieval of cultural values and practices

The cultural factor, defined in this context as an engine to foster participation, is a major element in the success of development strategies. Development strategies should be designed with an emphasis on the cultural dimension as well as economic theory.

Cultural diversity

Standardization of development solutions

States generally function on the principle of national unity, thus failing to take into account cultural diversity within a nation. This makes the role of the state, as the body responsible for nation-wide development strategies, difficult, particularly as multiculturalism is often not acknowledged in their development strategies.

Thus, any initiative to consolidate the development process should take into account that 'lowest threshold'policies, which propose only one vision of society and therefore one solution, are condemned to failure or to very limited success. That moreover, if cultural diversity is not recognized and each society's codes are not understood, any development will reach 'stale mate'. Likewise, integrated sustainable coastal management policies and strategies will fail if they do not decode the expression of the aspirations of the concerned communities and private stakeholders.

Suggestions for action

Need for communication and information coordination

The process of decision-action-information refers to the course of action followed by the state and other development agents (ministries, cooperation agencies, international organizations) in the selection of means of action for the activities to be carried out, in which, development strategies are defined, planned, executed and above all explained. Indeed, information campaigns undertaken by the state and with international cooperation are quite often, overlapping, redundant or even conflicting (i.e. environment vs. tourism, budget management vs. regional investment plans, health vs. industrial development etc.).

To counter these inconsistencies, development policies need a way to co-ordinate information from stakeholders and must develop human resources in the field of communication and information.

Development of participatory communication skills

An integrated coastal management system should therefore include a multimedia strategy to design, produce and disseminate materials, programmes and messages. It should also develop human resources and set-up a framework for the participation and mobilization of the general public. At the moment state information systems are virtually non-existent. Public relations officers and offices are usually not conversant with communication and information management. As such, they cannot deliver the information expected by the stakeholders who in turn do not feel involved in state policies.

To establish a communication system to enhance, execute and evaluate intersectoral and multi-disciplinary projects a few pre-requisites must be complied with:

- the creation of two-way communication channels between co-operating entities; state, private sector and grassroots communities;
- the creation of multimedia communication networks to transmit promotional messages and encourage educational activities;
- the development, at state level, of structures that provide contact points between the state and grassroots communities;
- the establishment of a participatory monitoring and evaluation system.

Evaluation system

Establishment of a permanent information flow

In order to respond to society's demands and establish priorities for action and allocation of resources, the state needs a constant incoming flow of 'manageable' information. Consequently, it needs constant diagnosis of the development strategies at the macro level. To this end most of them depend on institutional information or opinion surveys and polls. Unfortunately, none of these sources of information provide manageable information. These measuring instruments only provide results in the long-term and so cannot be used to correct errors as they are committed in the implementation phase of a project. Nor do they serve to systematize or establish models of 'wise practice'. Opinion surveys and polls only provide a 'snap shot' with wide margins for error. Gathering information is not generally considered as an essential element in the relationship between the state and the general public. Thus the link between decision, action and participation is not established.

A participatory evaluation and monitoring system complemented with a permanent two-way flow of information, represents the only viable solution, for it covers two essential aspects:

1. analysis of participation (quantitative information)
2. analysis of social initiative and satisfaction (qualitative information)

A participatory monitoring and evaluation system has to be designed as a holistic solution to information and communication needs appraisal, which can only be beneficial to all: the official sector, society, the private sector and associations involved in development work (see Figure on p. 33).

Need for a holistic view

The structure and modus operandi of an evaluation system is adapted to the volume of activities that it covers (from integrated sustainable coastal management to national projects). It is important, however, to suggest a few general guidelines:

Proposed methodology

In the first place, the *system's configuration*. It will have to include representatives of the state as well as of the grassroots communities, private sector and international cooperation institutions. Each will have a specific role in the design of the system's modus operandi, as well as in the collection and processing of information. Furthermore their interests have to be reflected in the presentation of the results.

Quality standards

The *impact criteria* (or success criteria) have to be validated by all the stakeholders. Empirical elaboration of indicators of success has proved inadequate to analyze real situations, considering that the communities' immediate environment is ignored. Nor does it take into consideration the multiple and complex relationships among the different stakeholders.

The *collection of information* should be a continuous process whose ownership should be placed with the grassroots communities on the basis of the above-mentioned validated impact criteria. Representative community networks for gathering survey information could be a solution.

The *systematization of information*. Wise practices are essential to create models for further application in other circumstances and other contexts. The process of evaluation-systematization-decision establishes quality norms that can be used in other projects. Systematization is necessary to allow standards of excellence to be compared across projects.

There are also three processes that can be derived from the proposed participatory evaluation and monitoring system (see Figure on p. 33):

1. *Evaluation-decision-action* is a key communication process to account for the repercussions of policies at the level of the state or other institutions. It refers to actions that directly affect the social, economic and political environment or have macro-economic repercussions which require more than administrative decisions.
2. *Evaluation-action-information* is a shortcut to introduce corrective action in the short term to avoid loss of or poor use of human and material resources. This circuit offers a permanent feedback loop to the state and concerned institutions (national and international), enabling them to take immediate corrective measures when needed and in some cases to carry out emergency information exercises.
3. *Evaluation-participation-proposal*. This process refers to constant feedback to the community to provide it with elements for reflection and action. It is necessary to establish parameters for the appraisal of the communities within the national context. In this case the evaluation system will provide manageable information to the communities to enable them to formulate their proposals in a wider context that takes into consideration the needs and aspirations of other communities.

Communities' identity

In conclusion, the participatory monitoring and evaluation system's objective is not only to passively measure the impact of development strategies and projects, but to serve as a constant monitoring system that will provide early indications of any problems. It will moreover feed a chain of analysis for decision-making and action.

PARTICIPATORY ORGANIZATION

Projects' ownership

Although proposals relative to structural questions for the establishment of the system will be discussed case by case and project by project, what is important is to establish the ownership of the initiatives within a participatory context. To improve popular participation in the achievement of the wide range of objectives defined in integrated sustainable coastal management strategies and projects the educational processes mentioned previously need to be rooted in the intrinsic quality of communicational skills. It is therefore necessary to link participatory communication with education and all those actions which contribute to valorize endogenous cultures and integrate them into the overall decision-making processes and into the design of development strategies.

With regard to the opportunity for dynamic participation, we need to know what is the capacity of society to participate in macro activities and what other institutional alternatives to communication and popular participation exist within a participatory process.

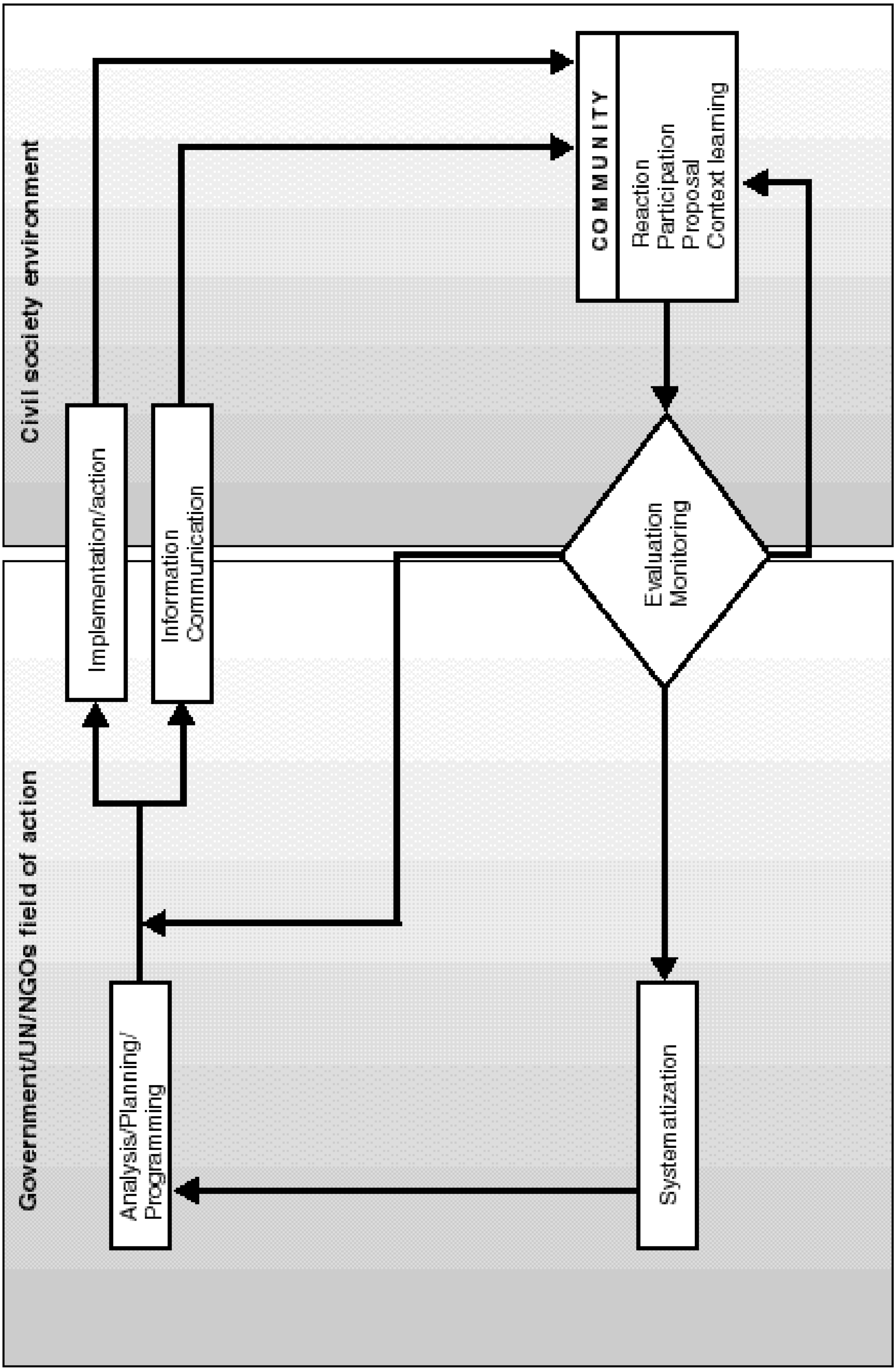
Cultural and historical heritage

Society's decoding of messages (actions and information) from the official sector are made through its own measuring instruments which are conditioned by the struggles of the various communities in terms of cultural, economic and social power. The state must therefore be conscious of the need to interact directly with the communities and their representatives in a spirit of equality.

The first task in the preparation of communities for the elaboration of their own vehicles of expression and communication, must include the recovery and awareness of its cultural- historical heritage in order to be able to place the community in a context of real participation. Moreover, this task must include the identification and prioritization of the community's needs in its cultural context. This is a condition if one wants to be able to evaluate and answer the state proposal to share its same codes in order to avoid the misunderstandings that has been the norm of the state-society relationship.

The information and communication strategic framework should therefore be placed to make use of the mass media, institutional information structures, the private sector as well as the concerned communities. It would be structured as bottom-up process with the participation of the agents of the state in the field as well as the communities.

Diagram for the information, communication and evaluation with regards to participation.



Annex 1. Integrated sustainable coastal management (ISCM) communication component

Development objectives

- To optimize and rationalize the state's and national and international institutions' resources throughout the involvement of the general public in integrated sustainable coastal management (ISCM) projects.
- To optimize the national resources devoted to ISCM through the establishment of systems of participatory evaluation that ensure that the social and economic development needs of the coastal areas of the region are met in the most efficient way.
- To enable society's participation at large in the national decision-making process to achieve its increased participation in efforts of endogenous development.
- To develop a dynamic for participation through the stimulation of new forms of expression on the part of local communities.
- To retrieve the cultural-historic heritage of the communities allowing a revalorization of their identities and therefore their action within the context of these projects.

Immediate objectives, results and activities

Objective 1
To improve human and technical resources of national institutions through education and rationalization.
Result 1.1. Capacity building in participation techniques.

Activity 1.1.1. Workshops and training courses in participatory communication, mobilization of people to participate in social and economic development project activities.

Activity 1.1.2. Technical assistance to communities to establish first contacts between state agents, leaders of popular organizations and community leaders as well as to establish fora for discussions and meetings.

Result 1.2. Organization of a national information system that concentrates talents and financial resources to substantially increase the quality and quantity of development information.

Activity 1.2.1. Technical assistance to design a common plan for the coordination of projects.

Activity 1.2.2. Technical assistance to draft flow diagrams of the system.

Activity 1.2.3. Training of project personnel on working and coordination methods with entities responsible for the project's management of information sources; looking at mechanisms for gathering and processing information and the criteria for editing and distributing information.

Activity 1.2.4. Elaboration of a multimedia support plan (radio, press, television) to maximize the impact of, and propagate, development information campaigns.

Objective 2
Improvement of mechanisms for analysing the social impact of strategies, plans and development projects to ensure that the social and economic development needs of the countries of the region are met in the most efficient manner.
Result 2.1. Creation of a participatory evaluation model specific to ISCM.

Activity 2.1.1. Elaboration of indicators and criteria of success for development strategies, activities and projects in cooperation with representatives of the state, public and private organizations and representatives and members of the popular organizations involved.

Activity 2.1.2. Elaboration of materials designed for permanent surveys and for making use of information received from popular initiatives.

Activity 2.1.3. Computerization of the organization(s) responsible for analyzing survey data and applying success criteria to the projects, with a view to optimizing resources and making project evaluation more complete.

Activity 2.1.4. Elaboration and adaptation of software for information processing.

Activity 2.1.5. Adaptation of information processing interfaces for use by organizations responsible for carrying out corrective strategies and actions.

Activity 2.1.6. Elaboration of manuals and procedures for processing and exchanging information.

Result 2.2. Systematization of information on selected actions and projects to facilitate its application, extension or generalization and to establish standards of excellence.

Activity 2.2.1. Establishment of a relational data base enabling the exploitation of information and experience acquired in projects.

Activity 2.2.2. Publication of the results of successful experiences to inform leaders, professionals and project officers of the possibilities of applying appropriate methodologies.

Activity 2.2.3. Development of data bases on projects. Elaboration of a data base designed to provide a detailed follow-up to each project.

Activity 2.2.4. Constitution of an automatic interactive network for the information of interested organizations on the adaptation and application of experiences.

Activity 2.2.5. Elaboration of proposals for the compatibility of equipment (optional), harmonization of work methods and forms of cooperation in the access and processing of information among the various integral units of the computer network.

Objective 3

Develop community organizations and the private sector to maximize their participation in ISCM.

Result 3.1. Development of a social dynamic for participation.

Activity 3.1.1. Workshops for community leaders to encourage cultural-historic recovery of the communities by the communities.

Activity 3.1.2. Organization of participatory community workshops to train community leaders and the private sector in participatory communication.

Activity 3.1.3. Creation of information offices and community organizations made up of members of the communities, state agents and the private sector to enable all partners to conduct external and internal communication activities.

Objective 4

Development of new forms of expression for the communities involved in economic and social development.

Result 4.1. Participation of interested communities in development activities and projects.

Activity 4.1.1. Establishment of mechanisms of participatory evaluation and systematization and of transmission channels towards the communities' own concerns and towards the state.

Activity 4.1.2. Consultation with local organizations directly linked with development activities, the state and external cooperation agencies.

Activity 4.1.3. Set up a mechanism of local participatory communication (printed matter, community radio and audiovisuals) with the support of national, regional and local media for promotion and development activities.

Objective 5

Recovery of the historic-cultural heritage of the communities.

Result 5.1. Revalorization of community identity and its role in the national community

Activity 5.1.1. Organization of socially productive workshops.

Activity 5.1.2. Organization of leadership and communication drama workshops.

HIGHER EDUCATION: UNESCO CHAIRS IN SUSTAINABLE COASTAL DEVELOPMENT

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SUMMARY

Africa's coastal regions are held back by many things, such as deterioration of the coastal environment, decline in the quality of life of local people, excessive use of natural resources, water pollution, falling productivity and diminishing biodiversity. This paper will cite various examples to show the part that higher level instruction – through education, training, research and communication – can play in promoting the sustainable development of the continent's coastal regions and small islands.

Education and training seem essential if we want individuals and communities to grasp the complexity of the environment and coastal regions in particular. The complexity arises from their physical, biological, social, economic and cultural characteristics. Applying sustainable development policies in coastal regions means coming up with multi- or cross-disciplinary approaches to developing human resources, taking into account the different cultural factors and the requirements of fair and rational ecological development.

The Cheikh Anta Diop University set up a Chair in integrated management and sustainable development in coastal regions and small islands on the initiative of UNESCO's CSI platform. The Chair deals with aspects of sustainable development backed up by pilot projects in the field. The cross-disciplinary approach has been stressed with courses, seminars and instruction covering not just natural sciences but also social sciences, the humanities, law, economics and anthropology. The practical work (remote sensing, use of geographical information systems (GIS), building computer models) and the field research, closely related to the pilot projects, have highlighted the aspect of sustainable development of coastal regions.

The Chair encourages dialogue between not only experts in marine and coastal environment, but also managers, decision-makers and non-governmental organizations (NGOs). Using this integrated and novel approach, the Chair wants to strengthen, at student level,people's understanding of the complex relationship between socio-economic development and sustainable development of coastal regions. Coastal communities, along with local officials and other parties involved, are associated with field programmes through pilot-projects. With this approach, which involves implementing intersectoral plans, sustainable and fair solutions can be worked out with the local people, who of course are the main beneficiaries of the research results.

The lessons drawn from field work have led to a constant concern among a range of researchers, students and administrators: the need to work out a list of 'wise practices' in the interests of sustainable development and management of the coastal environment and its natural and cultural resources.

A few examples of topics, suggested by teacher-researchers and the Chair's students as pilot projects in the coastal regions of Senegal, will show what I mean. These are:

- The Saloum Estuary and mangrove where researchers and students from the Chair work with the local population on integrated management of the biosphere reserve and on repairing damaged coastal ecosystems.
- The suburban coastal area of Yeumbeul, where the focus is on nitrate pollution, water quality and improving the hygiene and health of the local people. The work is being done in association with hydrologists and epidemiologists, the NGO Environment and

Development– Grassroots Economy (ENDA-ECOPOP), the local population and the Community Centre for Appropriate Technology in Health (CCTAS). We are now trying to present, as part of this research involving students from the Chair, some practical solutions which can illustrate 'wise practices' in the sustainable management of the Yeumbeul environment, at the same time as trying to improve things using local rather than outside resources (tests are under way for a project to remove nitrate pollution using local materials).

- The village and island of Yoff, with a focus on research into biodiversity and into nature conservation using local knowledge and cultural practices. Encouraging results have been obtained in the area of biodiversity, cultural diversity and sustainable development of coastal regions. Yoff is an opportunity to highlight wise practices.

Wise practices (sometimes called 'best practices') implies that lessons learned from projects in coastal regions and small islands can lead to sustainable development practices, so the question of communication is extremely important. It would seem hard to work anywhere without appropriate communication with local people to convey the most suitable message to encourage sustainable management practices. The main thing is to raise awareness and help local people understand the problems better.

Examples of 'wise practices in sustainable management of coastal regions' include the rehabilitation of damaged ecosystems in some estuaries and deltas in Senegal where the local population uses the mangroves as a source of firewood and building material, as a good place to grow rice, and for many other purposes. Add to this the effects of desertification which have afflicted Senegal for more than 20 years and seriously affected its environment and it is easy to see that the mangrove ecosystem along the country's entire south coast has been badly damaged by a combination of natural forces (salination of water and soil, acidification of the subsoil) and human actions.

So how do we restore these special and vulnerable ecosystems by working closely with the local population? Various experiments, sponsored by the Chair and by research programmes, have been launched both in the laboratory and in the field. The aim is to see how far the results in parts of the mangrove (including reforestation tests) can be passed on to the local people concerned.

It has become clear that sustainable management of ecosystems must involve local people and communities, if only to ensure long-term follow-up of efforts to restore such ecosystems, at least in the case of the mangroves. Also, the need to rehabilitate these environments must be understood from the beginning by the local population, which means working out suitable communication plans.

So from the start of our research programmes, we have had lengthy discussions with local people and community groups who have grasped the need for such rehabilitation. Local people already know what the mangrove ecosystems are for. But now they can understand better all the advantages they can obtain from them and therefore the need for their rehabilitation. These are ongoing field experiments involving students and university researchers. Depending on the results, they are used to illustrate the notion of 'wise practices'.

But we must also remember the need to incorporate a certain amount of local knowledge into the body of scientific data, which is why anthropological surveys should be carried out at the same time. An example is the cultural heritage aspect of preserving the heaps of shells, or tumuli, of the Saloum Islands, which have great historical and environmental importance and fits in with our concerns about sustainable management of coastal environments. There are many other examples, such as traditional uses of mangrove areas involving the local Diola, Nalou and Baga peoples all along the coast of West Africa, as far as southern Sierra Leone and beyond.

These examples show that an integrated research-training-communication formula is an important way to understand and manage better the natural resources of coastal regions, taking into account all the social parties involved – scientists and researchers, decision-makers and managers, local people, local communities and NGOs.

Equatorial Guinea: Communication and education in sustainable coastal development

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For those who know it only by name, equatorial Guinea is a small country in central Africa, in the middle of the Gulf of Guinea. One of its problems is that its regions are very scattered. There are seven islands (Bioko, Annobon, Corisco, Elobey Grande, Elobey Chico, Cocotero and Pemba) as well as the mainland territory of Rio Muni. The northernmost island of Bioko is 670 km from the one furthest south (Annobon), while the port of Bata, in Rio Muni, is 280 km from Malabo, the main town on Bioko.

This means that equatorial Guinea has extensive coastal regions and small islands. Also, as a developing country, it has huge problems communicating with and administering such areas.

The country is a big timber exporter, which puts it at the mercy of the industry's market fluctuations. The mainland coast is the area most affected by this.

According to a United Nations Food and Agriculture Organization (FAO) study in 1981, mangroves cover 20,000 hectares of equatorial Guinea. But lack of money and trained personnel as well as the absence of a broad awareness of their economic importance has meant that these areas have not been developed.

These are some of the reasons why my country is interested in the activities of Sustainable Integrated Coastal Management (SICOM), and in all UNESCO's programmes to do with the environment, small islands and integrated management of ecosystems.

We also favour drafting an overall plan for communication, education and training in coastal management.

Therefore, my country would like to implement, with UNESCO's help, an interactive communication programme which would set forces in motion resulting in an energetic and interactive relationship between the various social agents, with the help of the media and the national university. The aim would be to increase the involvement of the population and their commitment to the development process and to change the behaviour of people, groups and communities so as to improve the quality of life of these individuals and groups. An interactive communication programme could be a means of development and social involvement in sustainable management of equatorial Guinea's coastal regions and small islands.

Through its Conservation and Rational Use of Forest Ecosystems (CUREF) programme, the government is also committed to drawing up a plan for classification and rational use of land in the Rio Muni mainland. The plan outlines a desirable pattern of land use based on biological, physical, technical, economic and socio-cultural criteria, as well as on the government's policies concerning rural development, timber production and preservation of forest ecosystems.

Environmental training is provided at the national university with courses to train skilled public health workers and forestry experts.

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EDUCATION, COMMUNICATION AND SUSTAINABLE DEVELOPMENT IN COASTAL REGIONS

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INTRODUCTION

In the business of protecting the environment and promoting sustainable development, especially in coastal regions and small islands, education and communication are the most neglected aspects. Many projects link the physical state of the land and coastal and marine areas and the ecosystem with the aim of helping the growing population of such regions (two-thirds of the world's population) achieve sustainable development through thoughtful and efficient use of the world's continental shelf marine resources. But communication and education have not been emphasized enough by international organizations.

UNESCO has stressed the need for integrated management of coastal regions and small islands by noting the disruption caused by the sharp increase over the past century in the population of coastal regions and the destruction of the resources which drew people there in the first place. Such an observation raises questions about human responsibility and how the damage might be repaired by changing people's behaviour, habits, attitudes and knowledge.

In this paper, I want to show first the part played by communication in making people aware of coastal problems and then ways to increase knowledge and encourage new values, along with know-how and the desire to be involved. This is essential for sustainable development through IEC and its planned approach, which has the advantage of combining communication and educational approaches, as well as teaching.

I shall also argue that a composite model including teaching as part of an education plan is likely to produce better results than one where there is a very sharp divide between communication and teaching, as far as efforts to get local people more involved in sustainable development are concerned. Drawing up formal or permanently informal teaching programmes is only feasible or suitable if they are part of an overall programme of sustainable development in coastal regions and small islands.

1. COMMUNICATION FOR LOCAL AWARENESS

Historically and theoretically, communication appeared around 1995 as one of the main axes of the environment. The others are sustainable development, sustainable consumption (the responsibility of consumers and how to make them so), planning and the state of ecosystems and local people. Communication was presented as a tetrahedron, with each of its four sides a main axis (Vigneron and Francisco, 1998). 'Increasing restrictions to a maximum produces a barycentric area which takes the different restrictions into account,' with the base (communication) ensuring the tetrahedron's stability.

So the notions of environmental communication and then IEC gradually developed as indispensable ways to involve local people and get them to participate in working towards what is usually an improvement in their standard of living.

The invention of environmental communication

Environmental communication emerged from the notion of 'green communication' thought up by Thierry Libaert in 1992; although Paul Debacker discussed it in his book *Le Management Vert* (Green Management) in the same year. The book included so-called green management in a firm's overall planning. Libaert did the same, defining environmental communication as:

- protecting the environment;
- teaching people about the environment;

- publicity campaigns to mobilize people on environmental issues;

Such communication must take into account:

- the state of public opinion;
- the strategic aim of the message communicated;
- definition of the target audience;
- the goals of communication;
- the message and the means to convey it;
- how measures develop.

On this basis, Vigneron and Francisco came up with what they called the 'ten commandments' of environmental communication.

i. Environmental communication must take the complexity of the environment into account, especially the number of people involved, their status and the nature of the resources which define and drive human ecosystems.
ii. The individual is the vital element in environmental communication. Social models are overridden by cultural identities which link each person to his environment.
iii. Environmental communication seeks to involve the individual and relies on neighbourhood or even door-to-door communication. It uses dialogue, participationand partnership.
iv. The final effectiveness of environmental communication is judged by a permanent change in individual behaviour. The modern social trend towards individualism cuts people off from their bearings and their membership of social groups which means their behaviour is crucial in protecting the environment.
v. Time is essential for environmental communication, to allow people to reconsider and change their attitude towards the environment. Because this takes place over years, memory plays an important part in it, as a link between the past, the present and the future. Events are only important if they can be incorporated in a long-term strategy.
vi. Inside a firm, internal communication used in staff management defines environmental communication.
vii. Eco-tools (product labeling, ecological inventories, projects and charters concerning the environment) which rely on volunteer workers are the technological part of environmental communication. They also fit in with the growth of individualism by giving each partner a reference and a guarantee of the quality of a product or service.
viii. Environmental communication changes how societies work, with interactive networks replacing hierarchical pyramids.
ix. The role of education is constantly emphasized in environmental communication. The behaviour of tomorrow's citizens is shaped by their education.
x. Reference to ethics enables people involved in the environment to relate its local management to the stability of the global environment. Eco-citizenship arises from the need for each person to choose a morality based on universal values and a code of conduct to behave as a responsible consumer. Eco-citizenship, environment, sustainable development and citizen-run organizations are the basis of a new morality, which includes and completes environmental communication.

In this spirit, the UN Population Fund, at the end of the 1980s, encouraged the idea of IEC in its programmes.

Role of information, education and communication

Although a central part of a population programme, the limitations of IEC often make it a weak point. IEC is an action programme with three parts:

Information

The aim is to provide easy access for all sectors of the population to knowledge likely to improve their lives and fight mistaken beliefs or rumours which may adversely influence people's attitudes and behaviour. Information is often provided vertically corresponding to the Shannonian linear communication model which facilitates sending data and knowledge from a transmitter to a receiver through a channel.

Education

Teaching is conveying knowledge, but education aims at intellectual growth, along with physical, moral and aesthetic training. It includes everything that influences people throughout their life–things that come from their family, school or job, mass communications, religious, economic, social and political institutions which they are part of.

Communication. Communication is a process of active and interactive exchange between one or more transmitters and several receivers with the aim of getting people to adopt desirable and recommended attitudes and behaviour. Various methods, linguistic, computer, person-to-person, can be used.

IEC involves a wide range of action: the definition of a people's socio-cultural identity (their knowledge, attitudes, practices, beliefs, assets and limitations); the conception and execution of social communication programmes; the production and use of teaching materials and the spread of messages to persuade the population to change habits, attitudes, beliefs and practices that are considered unsuitable or harmful to sustainable development.

The IEC approach highlights: the aims of each sector, the institutional framework in which the activity takes place, the programmes carried out, and the assets and limitations of such programmes.

Aims of each sector

Two kinds of problems have to be tackled in coastal regions and small islands: a) those connected to geography, and b) those caused by human activity.

a) The geophysical situation of many small, poor island states puts them at the mercy of weather conditions, that involve the state of rivers and the sea, it also means they have trouble tapping water sources and conserving it efficiently.
b) Human action includes dredging estuaries and building dams and irrigation systems which may then deprive such areas of the silt and sediment required to fight natural erosion and may also destroy fishing areas or prevent fish migration. Deforestation upstream, by causing estuaries to silt up, may block ports, which require frequent and costly dredging, as in Douala, in Cameroon. Untreated wastewater piped into the sea creates unhealthy bathing conditions and encourages the growth of seaweed, which absorbs oxygen in the water, killing fish and other marine life.

The overall aim of IEC is to co-ordinate the activity of the parties involved in coastal development – such as industrial fishers, businessmen and agents, water boards, local authorities and housing and waste disposal officials – towards the goal of integrated management of coastal regions. In this, IEC is best for:

- setting up interaction between parties that have to work together, co-ordinating them within a structure which will guide and direct their activity so as to avoid the confusion seen in countries and regions without such a structure. Often IEC activity is watered down in a country programme amid the multitude of projects being pushed by various parties with opposing, contradictory or even hostile interests. The risk of this is greatest when things are seen from a broad social and regional angle;
- working out campaign strategies and arguments aimed at various groups (such as women, the private sector, government officials, young people and community associations) in each coastal or island state to encourage people to change their behaviour and attitudes to fit in with sustainable development.

Institutional framework

These days, UNESCO's policy towards coastal regions and small islands is a clear step forward towards achieving these aims. But we need to go beyond that and come up with a global programme, which builds a structure in each country and island to co-ordinate activities and interested parties affected by the problem of sustainable coastal development. Setting up neighbourhood communication, which recognizes people's culture, requires institutions that will be accepted by communities, thus legitimizing their activity. Such institutions must be basically national and include all the local bodies which will be involved in carrying out the programmes conceived at an international level and implemented at national level.

Programmes carried out
Activity will be concentrated in the following sectors:

- Making people aware of water problems. UNESCO reports that very few people in small island states know much about water resource problems. Demand for water is sometimes unreasonable as demand rises in worsening drought conditions. There is a need to change ingrained cultural habits. However, the relative smallness of an island and the undispersed nature of its population make education and raising public awareness easier.
- Agreements between islands to pool their experience and technical knowledge about how to manage fresh water supplies. Several such accords already exist. Some go beyond just islands to include developed countries as part of bilateral and multilateral aid. Many projects to improve water supply have been successfully completed in the Caribbean (from 1979) and the Pacific (from 1986). Broader and more permanent programmes must now be drawn up.
- The point made in 1993 by Michel Ogrizek that building a dam, a port or a motorway can damage the environment and arouse the opposition of ecological groups and local officials. Each project of this kind needs to take environmental concerns into account because the effects of such projects can be harmful.

Assets and limitations of programmes
Many projects around the world aimed at benefiting people lack a firm sociological basis. They are implemented without a feasibility study, without taking cultural differences into account or even checking whether they make sense. They are often followed by bigger programmes that are equally ill-conceived. Sometimes it is a matter of placating bureaucrats by making them feel important and convincing voters that politicians are doing something.

Sustainable development projects in coastal regions and small islands have been called into question by UNESCO's observations on the difficulty of gathering data on the situation, whether about lack of water or how far the environment has been damaged by geophysical or human action. No communication work is possible unless we first look at how local people see themselves in their surroundings as manifested by their behaviour, beliefs, attitudes and habits. The process of communication is not the action of a subject (humans) on an object (the environment) but of a subject (humans) on the perceptions other humans have of themselves, as shown by their behaviour. Communication is not about repairing the damage humans have done to nature, but about persuading humans to stop harming it through changing the way they look at it.

Communication has its own limitations, just as education has in reserving to schools the responsibility for imparting knowledge at a time when mass communications are competing fiercely with them. So we need to work out a composite model with teaching again as part of the education section of IEC.

Mixed nature of the information-education-communication model

The design of the Technical Workshop to study the role of communication and education shows clearly that these subjects do not have to be connected. They can be completely independent, complementary or completely opposed to each other. This mirrors the real-life distinction between schools and the media, but it also makes them hard to deal with because of the great rivalry these days between the media and the classroom. Without going into detail, we just need to remember how much information inundates people today – pictures, sounds and written matter – which undercuts and throws into question what is taught in school. Television, films, advertising, the press, radio and posters have expanded people's horizons to the whole planet, even to the universe: we can now witness distant events at the very moment they happen. The distinction between communication and education raises at least two problems:

1. It conflicts with the idea of IEC we have proposed as part of communication to encourage sustainable development in coastal regions and small islands. We regard teaching as part of the education component of IEC.

2. It makes communication and teaching complementary only by mental association of the two concepts because their real-life conflict seems so established.

I think we should consider including teaching in IEC through monitoring strategic planning and looking at a few concrete examples.

1. Strategic planning

IEC's strategic planning respects the spirit, if not the letter, of Vigneron and Francisco's 'ten commandments' of environmental communication. It has eleven stages:

i) The aims. To distinguish between general and specific goals of the strategy;

ii) The target groups. Four are usually mentioned:
   - leaders, religious figures, decision-makers;
   - community leaders, social educators;
   - parents and other influential family members;
   - couples and others, such as very young mothers and single women.

iii) The changes needed for each target group to achieve the goals of the programme;

iv) The key factors determining whether or not a target group participates;

v) IEC activities needed to bring about the desired changes (seminars, campaigns, arguments, educational talks);

vi) Appropriate messages and how to make them decisive;

vii) The most suitable combination of communication channels, such as press, radio, television, posters, religious or traditional ceremonies, the theatre, group discussions, lobbies;

viii) The kind of organization and management needed to implement the programme (local, national and international level, integration and coordination);

ix) The cost of the programme;

x) The timetable for the programme;

xi) Assessment. Things which must be eliminated or which can cause the revision or approval of the strategy.

Teaching figures in the fifth stage as an IEC activity. According to the problem to be solved and the kind of public targeted, it can involve drawing up a programme of formal teaching or on-the-job or one-off training modules. Such programmes must of course match and connect to the strategic aims, even where diploma education is concerned, and must contain all the stages set out above, as well as the messages passed by the mass media to a wide range of social structures.

Stages (v), (vi) and (vii) above raise the question of the need to adapt activities, messages and back-up to the targeted sectors of the population. Radio messages are different from posters and do not aim at the same audience. So teaching is the extension of action directed at a group of people to whom it is hoped to give responsibility in the fairly near future. Experience in Africa clearly shows the need to treat different activities, messages and target groups in different ways.

2. Range of strategies – concrete examples

Warren Parker (1997) shows how in South Africa what he calls action media have helped promote health education, the other way round from the linear communication-message-recipient pattern. The action media is an approach that requires the production of suitable material to bring together the interests of the communicator and the target group.

The method includes:

- listing the aims of health education: prevention of AIDS, STDs and unwanted pregnancies in teenagers and young adults;
- listing homogenous groups in different geographical areas, such as schoolchildren and suburban youths;
- cooperation between parties to arrange meetings between teachers, administrators and health workers;
- recruiting 15 to 20 volunteers to take part in a series of three-hour seminars with educational groups for high-quality discussions. Activities include play, singing, short plays, handing out contraceptives and showing how to use them.

David Kerr (1997) reports how plays were used in the country areas of Malawi to make people aware of the basic requirements for good health. Along with Fandyroy Moyo (1997) in Zimbabwe, he concludes that this method had definite advantages:

- unlike other methods, it enables people to learn while enjoying themselves;

- it is easy to incorporate local languages and cultural aspects such as songs as dances;
- it encourages people to take part in discussions.

But it can also lead to the cultural parties involved becoming professional, marketing their talents and popularizing their culture in a way that makes it look ridiculous.

Lynn Dalrymple (1997) shows how the AIDS awareness programme known as Dramaide has helped fight the disease in a campaign aimed at schoolchildren in South Africa. The programme uses expressive local forms (plays, songs, poems, dances and posters) as well as workshops and community days to build a social movement around the personal choice to live a healthy life.

All these examples show the importance of adapting the activity and message to the target group. IEC offers a pleasant and deep-rooted method, in which the action media, the theatre and things like Dramaide can complement sermons, official speeches, legislation, special clinics, educational discussions and campaigns. Brought together in an institutional framework tailored to each coastal country or small island, these activities can promote sustainable development.

Conclusion

The argument for a global information, education and communication plan, with active elements in each part of the programme, highlights the advantages of a mixed model (information-communication, education-teaching) to promote sustainable development in coastal regions and small islands.

The choices available to such regions in their fight against the whims of nature are very limited and encourage human interference with the environment as part of a quest for quick economic and political profit. The detrimental effect of such activity on soil quality, fresh water resources, the state of the sea and the availability of fish and other marine products calls for a range of responses. They include information (traditional and modern media), communication (information campaigns and personal contact) and education (teaching in schools, families and through modern and community media), along with a broad combination of other channels, such as Sunday sermons, traditional ceremonies, markets, songs, story-telling, poems, plays, radio talent contests and street banners, as well as arguments tailored to target groups.

Training by colleagues, such as women or fishermen, plus the training of those responsible for carrying out an IEC programme is part of the communication side. But before this happens, international organizations need to promote better understanding of basic data about the behaviour, attitudes, beliefs and habits of local people, as well as helping to develop means of communication in islands to make the programmes sound plausible.

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Importance of communication and education in the protection of coastal and marine ecosystems in Cameroon

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Everyone these days knows about the economic and socio-cultural importance of coastal and marine ecosystems. But in most of Africa, they are under constant attack as industry develops and unthinking use of natural resources increases. In Cameroon, for example, the coast and sea are afflicted by serious ecological problems.

Such areas are much in demand because of the copious natural riches they contain, so there are environmental conflicts over the gathering and use of resources such as fish, oil, minerals, timber and farm products. Land disputes are especially acute in port cities such as Douala.

The conflicts are usually limited to Cameroon itself but sometimes they spill across national borders.

Disputes about maritime pollution are quite common along the coast of Cameroon. One example is the conflict, in the southwestern province, between the local population and officials of MINEF and MINEPIA over the use of chemicals by inshore fishermen. Another is between the wealthy people of the province and the oil companies, which have polluted the waters of the Rio del Rey, which are often used for domestic purposes. Then there are the ongoing battles involving local fishermen angry at low prices for their catch and the trawlers that sometimes destroy their nets.

The natural resources themselves are both over-exploited and affected by many kinds of pollution.

The growth of ports also brings with it several kinds of pollution from the wharves, from ships, dredging operations and from contamination by urban sewage.

The main effect of such pollution, and silt deposition, is cloudiness of the water, which reduces production of phytoplankton. The ocean floor environment is also changed by sedimentary deposits and waste material. Human health is affected too. We have some foul-smelling beaches which threaten the health of local people because they spread intestinal diseases like cholera and hepatitis. Shipping movements and related activity are also sources of pollution. About a tonne of copper ends up in the sea every year as a result of big ships repainting their hulls.

Recommendations

Human activity is one source of the enormous amount of material that gets dumped in the sea. This includes metals (mercury and lead), phosphates, nitrates, organic material, hydrocarbons, viruses and microbes. These chemicals are very concentrated and pollute the marine environment affecting most seriously the coastal ecosystem, particularly estuaries and mangrove areas. Fish stocks are particularly exposed to them because 90% of fish live along the coast.

Therefore, the following major causes and instances of pollution should be monitored constantly:

- coastal development with its tendency to destroy habitat;
- eutrophy, or excessive growth of vegetation in the water which kills off animal life;
- bacterial contamination of seafood and beaches;
- accumulation of tar on beaches;

- increasing presence of chlorinated hydrocarbons in the sea.

If such pollution continues, the sea will eventually no longer be able to perform its many functions. Thus its protection is absolutely vital to our survival.

Protection should be based on sustainable development, which simply means that existing resources should be safeguarded for future generations. To do that, we need a global approach and a general view of the future.

A global approach to protect the marine environment means that choices for its protection should take into account the good and bad effects of such steps taken in other environmental sectors.

A general view of the future means that protective measures and marine environmental management programmes must take heed of general local environmental problems because the sea is an integrated global system. Thus we need marine environmental protection plans based on scientific data from specialized institutions such as the research centres in Cameroon and elsewhere.

The public must be increasingly informed and made aware of the short and long-term harm done by polluting the sea and should also be involved in decision-making along with the authorities.

Such an approach has already borne fruit: wherever marine environmental protection plans have been drawn up with the help of broad participation, they have been a success.

There are hardly any national environmental regulations specifically concerning the sea and coastal regions however. For the moment, their only protection under the law lies in the international treaties which Cameroon has signed.

These steps could remedy the situation:

- legislation on maritime pollution;
- special measures to protect mangrove ecosystems;
- steps to encourage the kind of development which does not excessively harm the environment;
- making it compulsory to carry out preliminary studies on the possible effects of any activity likely to harm coastal areas and their resources.

COMMUNICATION AND EDUCATION IN A PARTICIPATORY APPROACH

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This paper does not pretend to answer all the questions about integrated management of coastal regions, but it hopes to raise awareness, as far as communication and education are concerned, of the importance of participation in sustainable management of a coastal environment.

African societies have their own way of looking at their surroundings which stretches back through legends, religion, oral tradition and long-established know-how. In the West, human beings aspire to be the 'owner and master of nature,' but in Africa, as Eric Dardel has pointed out, 'the world is seen as a unity of which human beings are an integral part – as individuals are of a tribe, as the internal blends in with the external. It's a world of participation where humans seek out their likeness in the world's creatures and find themselves by reference to the universe. In Africa, humans live on through plants and animals, through the earth and the sky, through the vital spark, which drives the wind and the stars, the sprouting and the maturing of things, the tides and the rain. It's the same life which they feel in their own bodies'.

The strength of African countries is the involvement of their people in development programmes. This implies involvement in the conception and execution of a project and in safeguarding its achievements. In this respect, participation is at the heart of integrated sustainable management of coastal regions.

To better understand, we can imagine a situation in which communication and education remain a monopoly of official bodies, with no regard for the eventual beneficiaries. That would make it impossible to achieve the set goals, much less inclusion of the beneficiaries and long-term use of the resources.

In the Comoros Islands, for example, the ministry of fisheries provided fish aggregating devices. But because nobody trained local people how to use them properly, some fishermen unfastened the equipment to re-use the rope it contained. In some coastal villages, however, fishermen organized themselves independently of the authorities to protect sea turtles and the rare coelacanth fish and to oppose practices which were destroying marine resources, such as the use of fine-mesh nets, poison and dynamite.

Participation provides only advantages and opportunities. We must come up with flexible ways to include people, suitable methods of communication, appropriate topics and training methods and ways to solve the tricky problems which come with involvement, such as how to make decisions and how to implement environmental laws and programmes.

But people do not realize how serious the problems are. As far as communication and education about the environment are concerned, the main obstacles are:

- ignorance of how important the environment is;
- lack of skilled people;
- lack of infrastructure and funding;
- shortage of teaching equipment and organization;
- shortage of integrated, co-ordinated programmes which are reasonable, needed and sustainable;
- very slow growth of the New World Information Order to replace the present one dominated by powerful Western societies;
- 'dependence' of African media on those of the West.

Every country is different, however, so we need to encourage research and action to understand the problems better and perfect the means of communication and education. In the Comoros, for example, it would be risky to rely on government institutions. Local television stations are everywhere, but a national station has not yet been set up. Experience shows that traditional places – village or town squares, mosques, Koranic schools and community centres – are still the best ones for communication and education. The goal is a development approach adapted to local socio-cultural conditions and based on strengthening capacities. To do this, we think the priorities are to:

- develop integrated and interactive communication and education;
- encourage the use of local languages, especially in grassroots communication and instruction;
- emphasize development of human resources and awareness of the importance of the environment and the sustainable management of natural resources;
- encourage the setting up of local and national media organizations in Africa which are diversified, viable and professional;
- strengthen the capacities of the private sector and local communities;
- build networks of communication and information;
- reconcile the needs of the environment with those of the economy (such as tourism) and employment;
- develop socio-cultural factors and add modern scientific and technical knowledge to them.

Integrated management of coastal regions is a laborious process. The ultimate aim is to consider a new approach to communication and education which allows everyone, from political decision-makers and agents of change to those who finally benefit, to be involved in the sustainable integrated management of coastal regions. The goal should be to find a good balance between the formal and informal in the field of communication and education as it applies to the environment.

UNIVERSITY OF THE INDIAN OCEAN – TRAINING, RESEARCH AND COMMUNICATION FOR THE ENVIRONMENT

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A PILOT PROGRAMME OF THE COMMISSION OF THE INDIAN OCEAN AND THE EUROPEAN UNION

The 'University of the Indian Ocean' (UIO) was launched in January 1998, following a survey and evaluation carried out on the higher education and research capacities existing in the five Member States of the Indian Ocean Commission (IOC). The fields in question were the environment, management of companies, and new technologies. The conclusion was that in the member countries – Comoros, France (Reunion), Madagascar, Mauritius and the Seychelles – the identified training needs could be met.

Guiding principles of UIO

- To exploit and enhance the existing potential, rather than create new structures, and
- To promote regional cooperation in higher and technical education as a means of facilitating regional integration.

How it functions

With its head office located in Reunion (France), UIO is a regional programme financed by the European Union and implemented by the Indian Ocean Commission (IOC). Its Administrative Board, with a rotating presidency, also serves as a scientific advisory board. The Board's members are representatives from the participating higher education and research institutions of the Member States plus representatives of the EU. As well, national correspondents are designated in the IOC Member State institutions to be responsible, in their respective countries, for coordinating and representing UIO's programme activities and for providing the necessary expertise.

Cooperative nature

The endeavours of UIO in the field of environment will further synergies with other programmes, for instance the IOC's Regional Environment Programme (PRE-COI), as well as with other regional programmes and NGOs such as Environment and Development in the Third World (ENDA). Cooperative activities also involve environmental databases developed with the support of the AUPELF-UREF and with French cooperation.

PROGRAMME OBJECTIVES

General

- Contribute to the development of the member countries by enhancing human resources;
- Improve the competence of both the providers and the recipients of training.

Specific

- Develop a network of training and research institutions cooperating in the domains of the environment, management of private enterprise, and new technologies.

Results expected in UIO's three-year pilot phase

- Improvement in the information exchange between existing establishments.
- Promotion of access for students and the private sector to information on regional training programmes, to be accomplished particularly through exchanges of students, teaching staff and researchers.
- Hopefully, the reinforcement of less-favoured institutions' capacities.

Planned activities

Based on a transversal analyses of needs in the five countries and at the request of the latter, specialized and advanced training is being planned by UIO, in its initial phase and in partnership with the cooperating institutions, as follows:

- environmental impact studies
- waste water treatment
- management of small and medium-sized firms
- MBA, bilingual (English and French)
- university degree in energy and the environment

A special tasking

While results from the afore-mentioned survey and evaluation indicated that the training capacities existed in the region, an effort was deemed necessary to develop training programmes corresponding to the sub-region's specific needs. UIO is embarking on a programme of actions based on certain criteria. The efforts should:

- be applicable to at least three if not all five countries,
- concentrate on the development of existing institutional and human resource capacities,
- consider potential future employment as a priority factor,
- focus on activities that can be developed dynamically and carried out in the medium term and
- be realistic *vis-a-vis* the budget (approximately two million Euros) and time limits (three years).

Training envisaged

Short and specialized courses

- Waste water treatment: 3 weeks, under the guidance of the University of Mauritius.
- Environmental impacts: 3 weeks, guided by the University of Antananarivo.

Long-term training

- Degree in environmental impacts.
- University diplomas in energy environmental management, including urban environment; under the guidance of La Reunion University.

Inter-programme training

Between two IOC programmes: Regional Environment Programme and Regional Tourism Programme. Subjects to be included are coastal erosion, sampling of coastal materials, ICZM, coastal pollution etc.

Special research priorities

Renewable and alternative energies; environmental economy and compatibility.

Study grants

Available for a limited number of candidates.

Language

Instruction etc. is essentially in French, sometimes in English (especially for the Seychelles and international institutions).

Communication plan

In addition to the traditional communication means (e.g. information bulletin), UIO is developing a regional database that will become an important source of information on regional training and research institutions. This essential tool, developed using NTIC, will eventually be used to monitor the regional demand for training and research. IOC is developing a website (http://www.coi-info.org) where some information about UIO is available.

COMMUNICATION AND EDUCATION IN SUSTAINABLE COASTAL DEVELOPMENT: A GENDER PERSPECTIVE

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INTRODUCTION

Communication is an essential act of life. Effective communication determines the extent to which knowledge is transferred. While the acquisition of knowledge is a pre-requisite to socio-economic and technological change, information is an essential catalyst and product of this process of transformation. Recent global events illustrate the contribution of information to development. This is witnessed by the fact that in spite of heavy investment in scientific research and technological innovation as mitigating factors towards unsustainability, little progress has been made in the area of practical application. The gap between the availability of technologies/scientific knowledge and their subsequent under-utilization largely appears to be due to the complex nature in which such information is usually presented. Clearly, the missing link is that of communication.

Alongside this has been a marked growth in the realization that past delivery mechanisms of development (mainly the top-down approach) largely ignored host recipients, who are custodians of much variable indigenous knowledge, technology and skills (or the so-called traditional knowledge and practices) which, communities have used over many millennia to adapt to and manipulate their environment sustainably. The majority of these are women. Indeed, the contribution of women in the provision of sustainable livelihoods for rural and urban dwellers is now widely acknowledged. However, this has not matched women's contribution to and involvement in gathering, processing and disseminating information for the attainment of sustainable development. These shortcomings are attenuated by a general lack of coordination and collaboration between the various stakeholders in the development process.

The outcome has been an escalating deterioration and unsustainability of the natural and built-up environments, which has not spared the coastal regions and small islands. These areas which for a long time had not succumbed to the wrath of human interference have lately started to show signs of unsustainability as manifested by erosion of the shoreline; decline in fisheries production and in water quality, degradation of coastal ecosystems and resource use conflicts, (Mwandotto in UNESCO, 1997). This is not surprising due to the variety of interests, and complex nature, of the key players in coastal development, who include the government, the private sector and the local communities. This paper thus argues that designing a communication and education strategy that would amply address sustainability in coastal development will need to take into account the varying interests and motivations to conserve, protect or manage the resources among the stakeholders. A common denominator in addressing this strategy is an understanding of the influence that the gender variable impacts on communication, education and information, which will form the thesis of the paper.

BACKGROUND

Perspectives in gender studies relates to people's rights to influence and control their own lives and the conditions under which they live. Contrary to the strongly held perception of gender as involving women's issues, an analysis of the gender variable helps to broaden the knowledge base of roles and interactions of men and women and the constraints they face in their quest to survive. Various gender studies (Southeimer 1991; IDRC 1995; Picark 1994; Sigot et al. 1995) have shown that women and men play different roles in society which implies that their information and communication needs are different, though synergistic in effect.

Similarly, the distribution of knowledge within a given community is affected by the gender factor among others like age and occupation. There is thus a need for communication educators to be aware of the fact that when gathering or disseminating information about developmental issues (in this case coastal and small islands development), knowledge is distributed differently within the same social group. Among the Mbeere people of Tharaka Nithi in Kenya, for example, research has found that older women know more about small annual herbs; herd-boys about the range of wild edible fruits; while, honey collectors scored highest on knowledge of the local flowering sequences (IUCN 1993).

We shall now address the principle spheres of analysis for conducting an inquiry on gender and communication. These are:

(i) Gender relations

Within any social unit of analysis, there exist gender-based disparities in access to and control over resources, decision-making and socio-economic opportunities. One of the most valuable resources that any community could possess is information since it is a powerful mechanism through which social and economic progress is achieved. Access to information empowers communities and social groups to monitor policy, lobby, learn, collaborate, campaign and react to issues. It can therefore rightly be said that democratization of society (democracy here means awareness of choices and making decisions) largely depends on the quantity, quality, and accessibility of information. This principle is crucial in addressing the roles of communication and education on sustainability of the coastal regions.

Prevailing situation regarding gender relations and communication

Within the African context, most societies are patrilinear and exclude women from ownership of resources. In terms of access to and control of resources and decision-making, women are marginalized in terms of inputs and benefits. The content of information made available to women is usually determined without their advice or consent. As the International Development Research Centre (IDRC 1995) notes:

'Women are caught up in a web of political and economic dependency on the men in their lives: their fathers when they are children; their husbands when they are married; and their brothers if they are widowed.'

Relative to men, women have little power at the local, national and international levels of society and let others (read the male voice) decide what is important for them, but with what consequences? Women end up being mere receivers of information, which often is irrelevant and inappropriate to their needs and aspirations.

Implications of gender relations to the communication and education strategy

The modes through which information is accessed require expenditure, no matter how little, from the simplest – by word of mouth which may require transport costs, telephone costs, purchase of newspapers or other printed matter, radios, televisions – to the more complex information and communication technologies (ICT). Within the patriarchal societies prevalent in Africa, fewer women than men are empowered financially to meaningfully exercise their right of access to information (collection, processing and dissemination). Even when these gadgets are available, the women may have no guarantee of access to, or even control over, the type of information they should get since participation in decision-making and socio-economic opportunities are dismal.

Designing strategies to strengthen the role of communication and education in sustainable coastal development raises a number of issues related to the principle of gender relations. These revolve around the broader theme of the 'rule of rights' as defined by the various stakeholders. Some of these are:

- *User needs*: Women and men have different information requirements based on their life experiences. The process of developing information services should thus be gender-sensitive and participatory right from needs identification, through system design, implementation to evaluation.

- *Access and systems control*: Access to information should go beyond the traditional gender-biased forms where women, especially those in rural areas, have limited access to and fewer channels to information relative to men. In instances (which are quite few) where access is gender-balanced, many women are illiterate and cannot benefit from printed matter or advanced technological developments in communication such as the ICTs. This calls for the identification of:

  a) existing and emerging institutions that can best respond to this challenge, for example those that would or, are repackaging information;

  b) institutional links that would ensure the information flow and transformation is gender-sensitive.

In whichever way these issues are addressed, the choices lie between the mainstream media (mass media which includes radio, television and newspapers), alternative media (folklore, puppet shows, musical programmes, street plays) and the more current information superhighway – the ICTs. The question that each should tackle is whether communicators are adequately prepared to handle the coastal issues reliably and sustainably using the right format and delivery mechanisms, when we consider the technically complex nature of environmental issues.

I shall now elaborate on the second principle sphere of gender analysis.

(ii) Gender roles and responsibilities

In Africa, men and women have distinctive roles and responsibilities, largely based on social customs and norms. Cultural diversity and social orientation in the division of labour imply that men and women assume distinct socially and culturally defined responsibilities and tasks, both within the household and in the wider community. While the men are primarily concentrated in the productive sector, women perform the triple roles of reproduction, production (women account for 80% of agricultural production), and community service. The knowledge and experience gained from undertaking these roles, as well as their requirements lead women and men to have different needs and aspirations.

Prevailing situation regarding gender roles and communication

In the African context, women bear the responsibility of production and community service. By virtue of their gender roles and responsibilities, women continuously experiment, observe and learn from the environment. In the process, they acquire specialized knowledge and experience in managing resources sustainably. They are thus custodians of valuable indigenous knowledge which in most cases has a ‘scientific orientation’.

In performing many of their vital productive roles, for example water supply and management for the family, women have learnt about the types of areas where they can locate high quality, reliable local water sources. Women are therefore the pillars of the traditional African family and should play a vital role in the development process by contributing knowledge and information on the same. Unfortunately this contribution is often ignored and excluded from the communication process. The value of women’s local knowledge and expertise is unrecognized and considered of low status. When their knowledge is recognized as crucial, they tend to lose ownership of it. Even in the traditional leadership set-up and decision-making, women are rarely involved.

The traditional labour burdens borne by women have other effects that exacerbate their marginalization in the information and communication arena. Education opportunities at the formal level for women are usually compromised which leads to the observed low levels of female employment in the formal sector (high ranks). This means fewer women than men are empowered financially to meaningfully enjoy the rights of access to information (costs of media gadgets). Low literacy levels among women is one big factor impeding their ability to equally share the benefits of information and communication technologies (ICT) yet, the advances in ICTs are having an increasingly profound effect on the landscape of human activity. In this day and age ICTs have the power to change the world through their effect on economic growth and production. That women have so much to offer and benefit raises the questions of their absence in this field and the mechanisms through which these imbalances could be addressed.

Implications of gender roles to a communication and education strategy for coastal management

Identified gender-based constraints as a result of gender roles include traditional and cultural influences that are often gender-biased and lead to women's subordination to an extent that they (women) internalize their marginalization and are demoralized into lacking self-confidence, have low self-esteem and an internalized poor self-image. Another major constraint is time considering the labour burdens borne by women. In fact, women can hardly claim time, because it only exists in the service of their community and more specifically in the service of men. When thinking about the 'whens' and 'hows' women can actively participate within the communications strategy, the development work needs to take this into consideration. Take for instance radio programmes; which is the most appropriate airtime for women? Other constraints include women's poverty – roughly 75% of the world's population are poor, and women make up the majority of the poor (Dankelman and Davidson 1988) – and lack of women's power and participation in policy and decision-making.

The principle of gender roles and analysis raises pertinent issues, which the Communication and Education strategy should address:

- *Indigenous knowledge*: Women play a vital role in informal education as custodians and transmitters of indigenous knowledge and culture. Communication strategies should recognize the value of women's local knowledge by promoting its use through documentation and dissemination among community groups from the grassroots to high office.
- *Education and training*: There is need to develop and expand appropriate education and training services for women in the information and communication fields.
- *Best practice*: Though largely unknown, there exists some successful women's information and communication activities which should be identified, documented and promoted including those addressing ICTs and gender issues. Local capacities and mechanisms for adapting ICTs to women's needs should be identified.

From the foregoing discussion, it is apparent that, despite the constraints, there is great potential in women as community educators and the gender variable should form the basis for an effective communication strategy for coastal development.

Recognizing some of these highlighted fundamental hurdles to their full contribution in the development process, women have devised various ways of tackling them. One underlying and recurrent trend has been that of organization. Whether spontaneous or sponsored, the number of women organizations has been on the swell. Indeed, recent years have seen an escalating number of women's groups, which display great diversity in scope of activities, group composition and access to resources. The existing and upcoming structure of women's organizations offers a starting point for enhancing women's role as community communicators.

I shall now attempt to elaborate on the general status of such groups in the information and communication arena.

Women's groups participation in gathering, processing and disseminating information

Women's groups play an important role in collective and personal development. On the one hand, the members are able to express their needs more effectively; groups satisfy social needs, help pool resources, and define development paths (Kabutha 1992). Secondly, members of the group help one another in times of need or hardship and also help the community meet its needs. Although diverse in scope and structure, most groups are formed to address common needs of which the most prevalent are lack of access to resources, credit and information. Lack of this critical input impedes development and is largely a result of the social, economic and political climate prevailing in each country/region.

A concept of the group structure and one that relates to an aspect of information is the way these groups communicate. Their communication modes range from the very simple face-to-face, to complex networks through cyberspace; all having an influence on the communication process. Furthermore, since groups are formed with the intention of meeting certain specific needs and objectives, they clearly reflect women's perceptions of the development process; that of participation and collective responsibility.

March, quoted by Mathangani (1989) advocates the usefulness of a women's group approach in the development of a communication strategy thus :

'Because women groups typically coalesce purposively, an understanding of the kinds of functions, around which women commonly organize, can help inform us on their needs and the ways in which they seek to satisfy these needs. Analysis of these functions can be useful determining the issues around which projects are to be organized' (p. 312).

The group approach develops a sense of solidarity that overcomes class and cultural divide, which build members' self-esteem and self-confidence and which consequently empowers women through their collective contribution to the decision-making process.

It is not the scope of this paper to discuss specific groups; but from the literature reviewed, a number of key issues can be identified in the way women's groups participate in gathering, processing and disseminating information. Pertinent among them are:

- Formal information systems and services exist at different levels depending on the local context. Those in urban areas tend to be of a more complex nature than those in rural areas. At the higher level, several research and training units exist within the group organizational structure. However, most of the data collected is not organized in a retrievable form. Most of the groups, especially the rural-based, lack essential data-gathering devices such as current journals and published reports and computers for easy retrieval. This renders useless important information that the women's groups collect. A few like the Mangelete in Kibwezi-Kenya use radio listening groups to share experiences on audio tapes.
- Participatory video which is a valuable medium for women to record their experiences and hence help in information gathering is rarely used. For the literate groups, print media and published reports are a common feature. Such groups possess a wealth of magazines, research reports and journals.
- What comes out clearly is that the existing information systems, with libraries as the norm in data management, further marginalize the majority of the women's groups. Low literacy rates and lack of time prevent women from using these resource centres.
- Dissemination of information is mainly through educational and training seminars, workshops, personal discussions and the mass media. These strategies of information dissemination are however hampered by the various constraints identified earlier.

Suggestions to improve the current status of women's involvement in information gathering and dissemination

- There is need to investigate the contributions in terms of effectiveness of the information disseminated for and by women's groups. Liasing with research institutions and then identifying various methods of repackaging information to suit the needs of development projects would be a move in the right direction.
- In data organization and management, there is need to identify delivery mechanisms most appropriate for each women's group, which accounts for cultural and time constraints.
- There is need to identify the structures and informal communication networks that could be used to improve women's contribution to the information society.

In conclusion, communication educators and key stakeholders in coastal development should note that successful research is of little value if the findings are not shared with concerned stakeholders and converted into action. Priority must be given to capturing new knowledge systematically and to finding appropriate ways of bringing it to the broader audience. To this end, the communication and education strategy should be based upon action-oriented research, addressing the many neglected areas of practical and strategic concern in the information-communication field.

Suggested areas for research that build effective communication are:

- Identification of specific gender issues and biases that influence control, access and rights associated with information systems along the coastal regions and across the various stakeholders;
- Documentation of information activities and their effectiveness in bringing changes in attitudes and behaviour towards use of coastal resources along gender lines;
- The extent to which ICTs can be adapted to meet local needs and their role in ensuring effective participation by all stakeholders in coastal development; and,
- Identification of avenues for gender-balanced participation at the policy formulation process in the design and management of all development information and communications initiatives.

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Communication and education: UNESCO chairs and community support

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UNESCO should be commended for incorporating the component of communication and education at the planning stages of establishing a UNESCO Chair on 'Integrated Management and Sustainable Development in Coastal regions and in Small Islands'. Practitioners in development now recognize the significance of communication and education, particularly at the community level, and the environmentalists firmly believe in this in Kenya, as demonstrated by the training workshops at community level and among the media.

In my opinion, the most critical factor in the formulation of a communication and education strategy for any development effort is that the community should drive it. This is based on the realization that without the participation of the community, the sense of ownership and responsibility will be lacking. This has severely compromised many development programmes and projects related to sustainability. Any communication and education strategy must therefore begin with a community development and participatory approach.

This highlights the importance of the audience in the strategy. A comprehensive needs assessment should be undertaken as the first step and address the following questions:

- What do members of the community feel about sustainable development in respect to coastal regions?
- What factors have resulted in the degradation of coastal regions?
- What is the level of awareness among the community on sustainable development?
- Is there a repository of indigenous knowledge and practice that promotes sustainable development in regard to the coastal regions?
- What are the existing communication networks and systems?
- What are the preferred channels of communication?
- How can information on sustainable development in the coastal region be packaged in a simplified, interesting and palatable manner that will interest the community?

The needs assessment will assist in the planning of the strategy because audiences should be segmented and specific for effective communication. Further, available avenues of communication, such as radio-listening groups where they exist can be tapped into and utilized, thus reducing the cost in terms of acquisition of communication channels.

The strategy should be both long-term and short-term. The long-term strategy should be aimed at developing a sustainable communication and education system at the community level: ultimately, the Chair can be envisaged as a technical arm which provides relevant information as demanded by the communities. The advantage of this is that such information will be specific to particular areas and communities and will be based on their priorities, leading to their ownership and active involvement because they will determine how the programme will operate. This also means that feedback mechanisms should be efficient, effective and significant to the process.

The mass media can be considered as a possible tool to raise awareness and for advocacy. Most media studies indicate that the mass media are most effective in raising awareness and to lobby for policy changes among decision-makers and opinion leaders. The radio and newspaper for instance can be used to inform and educate this category, who can be encouraged to incorporate messages of sustainable development in their meetings such as barazas, and even in religious gatherings.

Interpersonal communication has been found to be highly effective in political communication, particularly where the mass media is somewhat curtailed. Other development agents such as social development workers and community development officers can be targeted, to enable them to include messages on sustainable development in their contact with community members. The strategy on the whole should be multidisciplinary and it should use a multimedia perspective to enable the planners to reach a variety of audiences effectively and to reinforce the most crucial messages. At the formal level, the school system can be used as the child-to-child communication method has proved to be of great impact in the health sector. This will involve using the educational structure and integrating a component of sustainable development into the school curriculum.

At the university level, institutions of communication and journalism can be targeted to enable the Chair to instill messages of sustainable development in the media and to develop their interest and solid knowledge in the topic. Training workshops can be an effective method in sensitizing this cadre of workers: it can also be extended to those in the teaching profession, community development officers and those in social work.

This summarizes my idea of what the workshop should address. I hope to participate actively in the planning and implementation of the programme.

Sustainable coastal development: Communication and education in the coastal areas of Kenya

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Introduction

In 1995 the Integrated Coastal Area Management (ICAM) initiative in Kenya based on the National Environment Action Plan (NEAP) and other international protocols brought together hoteliers, researchers, planners, resource managers and relevant university departments to profile the problems confronting the coastal residents outside Mombasa town. To consolidate the issues in the study area and endorse strategies to address them, other stakeholders had to be included to complete the evaluation and make a comprehensive list of suggestions. These were administrators, boat operators, mangrove traders, fishermen and tourism service providers. A lead institution for co-ordinating the effort was identified.

Through this participatory process, the issues to be addressed were identified as rapid urbanization, decline in reef fisheries and water quality, erosion of the shoreline, degradation of other coastal ecosystems and use conflicts. Both short- and long-term strategies to solve the problems were also evolved and synthesized in a 'strategies' document to be implemented by various pertinent institutions/people based on mandate, experience and technical/fiscal capability. To start with, some demonstration projects are being put in place to show off the real value of ICAM as a tool to manage coastal resources. To sustain the efforts, voluntary technical working groups on the various issues were put in place and will execute and oversee the implementation of the various strategies on behalf of a secretariat and a multi-institutional Coastal Management Steering Committee (CMSC). As a Coordinator of the project for the last four years I would like to share here my experience with colleagues in the region.

Formal education

Formal education empowers and fully integrates an individual into his immediate and global community. The level of formal education in the majority of our coastal communities is low. As a result, the environment and the biology of the resource base is not fully appreciated nor are conservation principles for sustainable use. For example, local stakeholders do not know that coral is a living organism that requires certain conditions for its continued growth and development. Their educational status also excludes stakeholders from knowledge of alternative uses of coastal products or substitution of other products to avoid overexploitation. The status also reduces risk taking in adopting new, appropriate and still affordable technologies. Fortunately, with the type and amount of research information available on the study site, the challenge to raise awareness and encourage participation in implementing specific development strategies is a feasible one.

Cultural education and experience

Cultural education and experience is knowledge that has been accrued over the generations by practice and habit. This cultural practice is therefore proven and it is definitely sustainable. Modern approaches to coastal management have to accept this information base and interweave the cultural experience with modern science in order to achieve the desired results. Custodians of cultural education tend to be resistant to parting freely with their knowledge. Appropriate incentives need to be evolved to reward the sharing of indigenous knowledge when it is sought for incorporation into planning development programmes. Such knowledge exists in boat making, sailing, night fishing, seasonal movements of pelagic fish schools, upwelling, selective fishing etc.

Communication

The success of coastal projects will be largely determined by how good a working rapport is established among all the stakeholders including government and the beneficiaries/supporters of the projects. When bad communication/publicity is given about our coastal tourism, for example, appropriate communication should be given to correct the record in order to sustain an industry which accounts for up to 60% of total national tourism. Translation of policies, strategies and priorities into various local languages should be encouraged even though in Kenya we are united by a national language that originated from the coast. Our experience has been amply shared through national radio and international conferences and our strategy document has been put on the Internet by our collaborators at the University of Rhode Island. The proposed codes of conduct for our conservation areas and the environmental impact assessment procedures to be incorporated in the government environment policy are highly articulated. On-the-job training, training of trainers and refresher courses appear to be the most efficient methods of communication with target groups already engaged in specific enterprises; it updates the workers on the latest technologies and methodologies. The benefits cut across generations as you make future leaders aware of coastal problems early in their lives.

Capacity building

Another determinant of the long-term success of the ICAM process is the development of a critical mass of trained personnel, a functional national framework and a sustainable financing scheme tailored mainly from within individual countries. This development will guarantee intensification, expansion and nationalization of the ICAM pilot projects. Continued sharing of experience and extensive use of technical expertise from elsewhere is encouraged. In this way, national efforts will be regionally and internationally integrated.

COMMUNICATION AND EDUCATION: A MAURITIAN POINT OF VIEW

Marylène François,
'Week-End'Newspaper, Port Louis, Mauritius

Can news – fleeting information – help people to understand better the notion of integrated management of coastal regions in a context of sustainable development? Definitely yes. Because the media, mainly the independent written press, is the last resort for those who have been pushed aside by a development project which has taken scant notice of the socio-economic and ecological factors involved. There, they can express themselves and even vent their anger about it. This jars with the idea of integrated management which should be shared by everyone involved in coastal development.

Mauritius is an island of coastal tourism, which uses up an enormous amount of coastal resources such as beaches, important natural geological sites, lagoons and coral reefs and other aspects of the landscape. The tourist industry is an important part of the country's economic development and brought in US$ 459 million in revenue in 1997, making it the third biggest source of income after agriculture and manufacturing. The 1.1 million people of Mauritius welcome 600,000 tourists each year and the number is expected to reach an annual average of 845,975 by the year 2002. All of the 90 registered hotels are on the coast, where tourist facilities take up 41.9 km of the 322.5 km of the coastal zone of the 1,860 km^2 island.

But the tourist industry may collapse if these resources are not managed in a way that co-ordinates the activity of interdependent elements with a view to sustainable development. It is significant that after years of unregulated development, people are now starting to talk about sustainable tourism. This famously fast-growing industry also affects the inhabitants of the coastal areas and their environment; conflicts often find their way, when all else fails, into the columns of the island's newspapers.

The need for sustainable development of the environment was first mentioned in the Mauritian press in 1990, though the concept had been launched by the Stockholm declaration in 1972, when tourism in Mauritius was taking off in a big way. It came up in the reporting by the newspaper *Week-End* of a scandal over construction of a hotel, started in 1989, at Balaclava on the north-west coast, which has the only bay in Mauritius where 90% of the coral is still living. The coral reefs at this unique spot, which has been ear-marked as the site of the island's first underwater park, were bulldozed to build a water-skiing lane. The outcry led to a new environmental protection law in 1991 which requires all new tourist projects along the coast to undergo an environmental impact assessment before getting the go-ahead.

But another crucial part of sustainable development – the social aspect – was not dealt with. Once more through *Week-End*, exasperated fishermen protested in 1993 against the dredging of a lagoon at Trou d'Eau Douce, on the east coast, to build an artificial island for the Sun Resorts hotel group. The dredging permanently changed the water currents and jeopardized the inshore fishing, which was one of the local community's main economic activities.

The upshot of the media protest was that the hotel developer recognized the harm the project had done to the community and the fishermen were paid compensation. But the lagoon's ecological balance has still not been restored and the fishermen, with the help of the money they got, have turned to other work related to tourist development.

An overall awareness of what sustainable development is about has steadily gained ground and the part played by communication, using the written press, is very clear. Examples of it are increasingly cited by the newspapers and there are now opportunities for discussion and analysis leading to awareness of its importance, especially where integrated management of the island's coastal areas is concerned. The press helps with reports, interviews and big articles, in non-technical language that is easy to understand and supports people's concerns about the environment.

FROM COMMUNICATION TO EDUCATION

At a deeper level, the spread of information about the environment along with a greater involvement of education in sustainable development programmes leads finally to people understanding that natural resources are limited and that it is the job of all of us to look after them. So starting with the agents of communication and with journalists, we have to know the scientific facts about the ecosystems and how human activity affects them.

The press is a powerful and essential tool in creating this awareness, especially at decision-making level, either in government or the private sector. Just like the media, sources of informal education such as bookshops, nature reserves and parks, training courses and research centres fit in with the aim of educating people to manage the environment. But messages from various sources can confuse things.

The news can help the cause, as we have shown, but there needs to be greater involvement through specialized training. The task of education in sustainable development programmes in coastal areas is to encourage economic activity and behaviour that is consistent with sustainable development by increasing the know-how and knowledge of the ecosystem and natural resources. So alliances should be made among community groups, non-governmental organizations, industries and those involved in formal and informal education.

Sustainable coastal development: Communication and education in Namibia

Augustinus Ucham,
Ministry of Environment and Tourism, Namibia

Introduction

I am an Information Warden employed by the Ministry of Environment and Tourism in Namibia, stationed at Swakopmund in the Erongo Region.

My main duty as Information Warden is to provide a link between my Ministry and the various communities in the Erongo Region. This is done in order to fulfill and achieve the Ministry's objectives as stated in its mission statement.

The following methods are used:

- educational tours to coastal and rural areas to visit communities, community leaders and schools to give educational talks, making use of audio-visual equipment such as films, slides or videos;
- radio and television presentations;
- clean up campaigns;
- use of ceremonial and festive periods such as World Environment Day, Arbor Day etc. to get the message across.

In the Namib-Erongo Region, the Integrated Coastal Zone Management Project is funded by DANCED. It concentrates on the management of the area, giving support to the Ministry of Environment and Tourism.

As part of this DANCED has funded an environmental awareness project to address the major conservation issues related to the coastal zone.

The major conservation problem along the west coast is the threat to various endangered species and to the ecology, caused by an increase in recreational activities, especially off-road driving. A desert environment is fragile and once it is destroyed it may never recover. People think they can drive where they like; Quad bikes and 4x4 vehicles are a major problem in the area. It is difficult to enforce legislation.

The following draft copy of the pilot project awareness report from the Coastal Zone Management Project provides more information.

Public awareness

Introduction

A public awareness programme was conducted over a 2-month period with the Ministry of Environment and Tourism (MET) as the principal stakeholder organization responsible for the protection of the environment, together with other major stakeholder institutions involved in the integrated coastal zone profile.

The principal objective of the programme is to make an analysis of awareness needs related to the coastal zone profile, and in response to this, produce an awareness campaign central to the coastal zone profile.

Definition

Public awareness in this instance is understood in its broadest sense to encompass any means through which information is disseminated to a given public. This includes talks, speeches, meetings, workshops, newsletters, press releases, information displays, pamphlets, posters, fliers, magazines, booklets, books, the use or production of radio, television, video, newspapers, the use of the Internet, as well as theatre, dance, art and public performances.

Overview

In the project area, the stakeholders consulted have expressed enthusiastic support for the concept of integrated coastal zone management and have agreed that public awareness is an important ingredient to its success. They also support the need for better communication and cooperation between institutions in order to address issues that are common to all.

The public in general and particularly the increasing number of tourist and recreational users on the coast remain relatively unaffected and ill informed about the need for protection of the natural environment and unaware of the damage that they are causing to the fragile desert environment with their quad bikes, four wheel drives, dune skiing, jet skiing etc.

The lack of information is not simply an awareness problem. Part of the problem stems from the fact that there is a good deal of ambiguity as to what people should or should not do and what kinds of messages ought to be disseminated to the public.

However, very few stakeholder institutions have taken the responsibility to educate the public about these matters. There are no media departments and few information or awareness personnel amongst stakeholder institutions. Similarly, these institutions are poorly equipped to mount awareness campaigns or to produce the kinds of technical resources (pamphlets, information signs, videos etc.) needed to tackle major public issues.

Recommendation

As coastal zone development increases, so does the need for better public information and better communications. Awareness must be seen as an important tool in the management of the coastal zone.

Awareness and the ministry of environment and tourism

MET has been active in providing consistent and effective environmental awareness and educational programmes in the Erongo Region. Public awareness is seen and practiced as an essential and important part of the work done in the region.

However, the Ministry has few trained staff, limited access to funds and few resources.

Education programme

Tertiary education slide talks

MET conducts occasional classes with slides, talks and outdoor visits with trainee student teachers from the local college. They also provide similar sessions for a tour operators' course.

Schools programme

Officers give talks including slides and videos in coastal and bush schools. They also provide half-day excursions to places of interest, e.g. lichen fields, salt works, dunes and the Swakop River.

During the last four months an information officer has visited up to 30 schools in the region. (Some of these bush schools are up to 500 km away.) Usually he gives a talk to the whole school followed by more specialized work with student environmental groups. Similarly, he has conducted clean-up campaigns on the coast.

Public lectures

Most nights over the Christmas period, from 15/12/97 to 2/2/98, an information officer conducted a series of public lectures and video screenings along the coast at Jakkalsputiz, Mile 72 and Mile 108. Usually there are about 30 to 50 people, filling the tent to capacity. There is a need for new programmes.

These kinds of awareness programmes require considerable time and dedication especially since most of the work is done outside normal working hours.

In the past, MET has used a large and heavy video projector. The acquisition of a light portable video projector for use in schools and for public meetings would be a great help.

Signs, flyers and pamphlets

Although some very effective informational materials are produced by MET, there is need for more.

National parks

There is a tourist drive in the Namib section of the Namib Naukluft Park with numbered attractions and an accompanying pamphlet. The pamphlet works well.

The natural stone and timber signs in the park work well and fit with the natural environment.

INFORMATION, EDUCATION AND COMMUNICATION STRATEGIES FOR SUSTAINABLE MANAGEMENT OF NIGERIA'S OIL-PRODUCING AREAS

Gina Daka-Osika,
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INTRODUCTION

Sustainable development is a long-term development, realistic in implementation and formulation to bring about positive and long lasting impact on the populace for which it is intended. In this paper, the discourse will be on how to attain a sustainable development in oil-producing areas of Nigeria using information, education and communication (IEC) strategies.

The IEC strategy is the effective use of education and communication designed to achieve specific goals established in advance. Only a few countries have explicit national IEC strategies. Such good examples show the direction and what I call the road map to the future.

Major problems associated with coastal regions in Africa:

- flooding and coastal erosion caused by deforestation, poor engineering construction, sea encroachment, dredging etc.;
- sedimentation and siltation, related to the narrowing of creeks, reduction in creek depth, increase in intertidal zones, farming and dam construction;
- degradation and depletion of water and coastal resources related to industrial effluents, oil pollution, salt intrusion, industrial waste and invasion of aquatic weeds;
- health problems, related to gaseous emissions from a variety of sources and poor management of hazardous wastes;
- biodiversity depletion, as a result of population pressure, urbanization and over population;
- land subsidence, in connection with geological changes, oil exploration and other mining activities;
- noise pollution and light problems posed by seismic operations;
- lack of, or weak, community participation traceable to general ignorance, illiteracy and poor capacity to implement programmes;
- socio-economic problems related to joblessness, poverty, loss of farmland, inappropriate compensation measures, poor housing, infrastructural/amenity base and human settlement difficulties, lack of sustained commitment to rural implementation, coordination and resource assessment; and
- weak or non-existent laws and regulations relating to weakness and biases in political and legal frameworks which govern economic and environmental policies and actions, including failures in regulating and enforcement capabilities and the list continues.

As stated earlier, this paper is all about sustainable management of coastal regions using IEC strategies. We will therefore put into operation these two words 'management' and 'communication'as they are vital to this discussion. Management can be defined as a process of getting things done by making efficient use of people and resources. The Collins English Dictionary defines it in one breath as administration, skillful use of means. It is important to note that the key to successful management is people. This same dictionary also defines communication as 'passage or means of exchanging messages between places', however for the purpose of this discussion, we will be viewing communication here as synonymous with information, education, and communication to include inter-personal communication, community mobilization and the mass media. This paper also discusses methods of sustained coastal management since what to do does not seem to be the problem but how to do it is. Therefore I would say that this is a 'How to' paper.

This workshop talks about coastal regions but the topic of this paper is oil-producing areas. This is so because some coastal regions in Nigeria are also oil-producing areas, specifically the Niger Delta, in the central part of southern Nigeria. The Niger Delta is Africa's largest delta, covering about 70,000 km^2 with a population of about 7 million. The area consists of a number of distinct ecological zones which are characteristic of a large river delta in a tropical region: a coastal ridge (barriers), mangroves (the Niger Delta is the third largest mangrove forest in the world), fresh water swamp, forest and low land, rain forests etc.

Need to act

The oil-producing area of Nigeria, the Niger Delta, is the largest producer of oil in Africa and among the world's top ten; it produces over 90% of Nigeria's foreign exchange earnings. The more than 7 million people living in the region bear the brunt of the environmental impact of oil production and pollution from other human activities which include fishing, agriculture, forest resource exploitation and demographic change. Concerns have been growing in this region both nationally and internationally.

In spite of the Delta's resource endowment, the region is in a parlous state: constantly under threat from deteriorating economic conditions and social tensions which are not really being addressed by current policies and behaviour patterns. A recent World Bank study raised the alarm on the urgent need to implement mechanisms to protect the lives and health of the region's inhabitants, and its ecological systems, from further damage.

Even without a note of warning from the World Bank, there is no doubt that considerable change is occurring in the Niger Delta, both naturally and as a result of coastal zone modifications, upstream dam construction, oil production and urban growth. In recent times, public perception of environmental matters has clouded some very important issues concerning the impact of these factors on the ecology and peoples of the coastal region. Events in the region have also created an urgent need to formulate strategies that will reconcile industry environment and community interest,taking into account all factors relevant to managing development that is sustainable and contributory to the achievement of industrial and community stability.

Action through information, education and communication strategy, stages and processes

We have talked about operative or working titles like communication and management. The exercise here is about how to change the behaviour of policy makers, community dwellers, corporate organizations and so on toward their environment especially in the coastal region. In an environmental campaign for example, a communicator's objective will involve altering the way people think or behave about a particular environmental issue. But before embarking on this, he or she must first find out what people in the target audience, be they government, oil companies or individuals, feel and know about the problem; such background research helps to ensure that appropriate strategies are adopted from the start.

In addition to understanding the attitudes and behaviour of the target audience, communicators or facilitators must have a fair understanding of the general dynamics of human behaviour change, factors that motivate people to change the way they think. These are some factors that can influence change of attitude in people:

- *physical stimuli* – based on the person's current physical state as well as fear of future pain and discomfort or memory of past pain;
- *rational stimuli* – based on knowledge and reasoning;
- *emotional stimuli* – based on a person's intensity of feeling of fear, love or hope;
- *skills* – based on a person's capacity to adopt and continue a new behaviour;
- *family and personal network* – based on influence from family and peers; and
- *social structures* – based on the impact of social, economic, legal and technological factors on the daily life of a person.

The steps to behaviour change according to theorists are knowledge, approval, intention, practice and advocacy.

Having learnt about factors that affect behavioral change in people, we can now settle down to the specific strategies that will help to bring about sustainable management in the oil-producing areas of Nigeria. For our use here, I consider the ‘P’ process most suitable. The ‘P’ process is a framework that tells one, step-by-step, how to develop a strategic communication programme. It was developed in 1982 by the Johns Hopkins centre for communication programmes and was initially intended only for strategic health communication programmes. The ‘P’ process has been revised, over the 15 years since its inception, to reflect better the needs of the field and improvements in knowledge and to broaden its scope. The revised ‘P’ process emphasizes national communication strategies; positioning of products, practices and services; and more effective message development using the 7C’s of communication: command attention, cater to the heart and head, clarify the message, communicate a benefit, create trust, convey a consistence message and call for action.

The ‘P’ process has five steps for the implementation of effective IEC strategy. In order they are:

1. analysis;
2. strategic design;
3. development, pre-testing and production;
4. management implementation and monitoring;
5. impact evaluation.

When these steps are correctly employed in addressing communication problems, the chances are that the task will become easier, for example:

Step 1: Audience analysis

To analyze the audience or environment of study, one needs to ask the following questions: What is the communication problem? What programme resources should a communication planner consider? Which audience segment should the communication intervention focus on? What characteristics of the audience segment can be targeted to make the environmental campaign more effective? To answer some of these questions one must look at the big picture by being aware of the total situation such as programme strengths, weaknesses, opportunities and threats. Select an audience according to the communication situation. Draw up a profile of this audience so as to understand factors that could help in designing the most effective environmental communication.

Step 2: Objective and message design

In designing a campaign, it is necessary to come up with well thought out objectives as they provide the foundation for intervention. Objective = a goal, strategy = a plan. All campaigns should follow the smart rule that every objective should be specific, measurable, achievable, realistic and time bound. This can be achieved by ensuring that communication programmes are designed so that the target audience has a clear perception of how it might benefit from a change in behaviour. Consider the secondary audience – who it is and how may it be affected by the message. Planners should always answer the following questions in SMART: What is the purpose? Who is the primary audience? What is the key promise/ benefit? What are the support points? What is the desired action response?

Step 3: Message and materials

The third step deals with message and materials development, pre-testing and production. The planner develops the message concept by developing materials (scripts, story boards, posters, brochures etc.), designs the message based on the concepts, revises the message and most importantly follow the 7Cs of effective communication. Note the final pre-test should be conducted with a test target audience to ensure message clarity and appropriateness.

Step 4: Management of information, communication, education programmes

Good management is often said to be essential to the success of any communication campaign. It also follows that good management can mean the ability to start, change or stop which implies that managers can start desirable activities, change plans when necessary and halt unproductive activities. The key tasks of an IEC manager are setting the project going, establishing working procedures, managing people, problem solving and decision-making; overall creating a productive working climate through good communication. The management task also involves accomplishing tasks effectively through planning, organization and control. In carrying out these management tasks wise IEC managers appreciate the benefits of securing the participation of others by allowing joint/shared ownership of ideas and plans from the start of the project.

Step 5: Impact evaluation

Impact evaluation tells us whether or not a programme met its objective by changing the knowledge, attitude or behaviour of intended audiences or by influencing policy making. Programmes that are not evaluated waste time and resources and have little impact on future development. By identifying the effects of different activities on different audiences, sound programme evaluation can support programme advocacy, stimulate programme improvement and guide cost-effective funding allocation in the future. Some key elements of evaluation include early planning, use of behaviour change models, employment of different evaluation methodologies, qualitative and quantitative cost effectiveness and the dissemination of evaluation results to others. The next steps after the evaluation process of a successful project are to plan for its continuation, scaling it up, advocating similar projects elsewhere etc.

An example: Pollution in the Okrika region

Having discussed the ‘P’ process at length and how it can be used to address sustainable management problems of coastal regions, I shall present an example of an oil-producing area in Nigeria to show how the ‘theory’ is applied.

Area: Okrika in the Rivers State of Nigeria.

Problem: Regular oil spillage, air pollution, gas flaring, acid rain, emissions from a variety of sources and water pollution.

Audience segment profile: Local citizens of whom 80% are illiterate; multinational companies that promise contracts and youth employment (but often do not fulfill their promises) and that pay occasional, inadequate compensation to chiefs; local government.

Leading organizations: WNC (Wakirike National Congress), KEDEF (Kirikese Environmental Educational Development Fund), Sakabari Masquerade Society etc.

Having applied step one of the ‘P’process, it is obvious that to bring about sustainable development in the area using IEC strategies, a tripartite action involving industry, the community and government will be necessary.

Industry: Industrial managers could be approached by environmental non-governmental organizations (NGOs) and local dignitaries. Specific seminars that clearly present the subject of discourse using audio-visual aids can also be of immense help. Media advocacy campaigns, e.g. jingles, sponsored programmes in the electronic media and newspaper columns with well designed messages will serve as constant reminders to multinational industries (especially the oil companies which are the major agents of pollution in the area) of their responsibilities. Other materials that could be used to give simple, clear and direct messages are billboards, posters and stickers.

Community

The community could be educated through social mobilization activities such as rallies by NGOs, the use of drama sketches at community gatherings, sensitization and mobilization of women’s associations, on simple hygiene, e.g. boiling water before drinking, going for medical checks as a way of addressing some of the health problems. Youths could be encouraged to employ communal efforts in effecting some positive changes in the environment, e.g. building public pit latrines instead of using the sea shore as is the common practise in the region today.

Some other environmental health hazards could also be reduced or prevented by dissuading fishermen in the coastal areas from using chemicals and dynamites to fish by educating them on the short and long-term health dangers posed by them. Small trade groups and others should be encouraged to form co-operative societies to enable them to access soft loans from the Family

Support Programme or the Family Economic Advancement Programme. It is important to note that a broad-based representation of CBOs, NGOs and individuals is necessary in carrying out a number of these activities.

Government

Government can play its part by enacting enforceable legislation to deter environmental pollution and degradation. Government should also collaborate effectively with industries in oil-producing areas to set up cottage industries to alleviate unemployment. Government needs to persuade industry to show more interest in and commitment to their host community by compelling them to re-train people who have lost their jobs as a result of industrial pollution.

Government should compel the companies to adhere to the country’s recommended environmental standards. This could be achieved by close monitoring of the industries by government and concerned individuals. Government environmental agencies should be made relevant to the community by giving them more autonomy and greater powers.

Recommendations

Nigeria has long been known as a source of strategic minerals from the heyday of coal, iron, ore, columbite and tin through to the oil boom. Yet environmental laws are either weak or non-existent. Despite the problems of pollution and disruption of the nation’s ecosystem, the problem of environmental pollution and lack of physical planning can be addressed by delineating appropriate jurisdictional boundaries to facilitate effective monitoring, evaluation and enhancement of the state of the environment and elements within it.

An appropriate institutional framework to facilitate efficient and effective performance of environmental regulatory and management functions needs to be designed. Adequate planning systems to ensure that environmental resources will be used in an optimally efficient way and to promote public enlightenment about the consequences of environmental pollution and virtues of environmental cleanliness should be established. African states, and Nigeria in particular, must undertake measures to ensure the optimal exploitation of natural resources which must necessarily be conditioned by ecological limitations. Therefore, the government as a regulatory body must seek to ensure an ecologically sustainable economic development through proper environmental management attainable with the aid of the IEC strategies presented in this text.

Conclusion

Much has been said about the oil-producing areas, but now is the time for participatory action and intervention to mitigate a looming crisis. Creation of a viable community-based economy to address poverty and human misery is a sure step on the road to attaining sustainable development in the coastal region. Using IEC, a policy framework founded on strategic regional planning, urban design and integrated rural development should be formulated.

It is to be hoped that by the time African leaders converge in Maputo at the end of the technical workshops to discuss this subject, they will find the information put together by this workshop invaluable and act promptly on it so that in no distant future, prosperity will begin to replace poverty and cooperation replace conflict for the realization of global peace and harmony.

Recap of the basic principles of the ‘P’process

At every stage of the ‘P’ process, the following basic principles apply:

- *Strategic thinking*: Identifying communication as continuous, direct and a major influence on behaviour and policy. Mobilize and deploy the power of communication at all levels to promote and support good health practices;
- *Leadership support*: Build support among national and local leaders continuously from the initial assessment to the sharing of evaluation results. Allow political, religious and community leaders to share credit for programmes when accomplished;
- *Audience participation*: Encourage your audience to be actively involved at every stage,

assessing their needs planning the strategy, carrying out local activities, assisting in monitoring and evaluation as well as engaging in advocacy. Develop key messages around the needs of the audience and the benefits to the audience;

- *Interdisciplinary approach*: Work with people from different disciplines and backgrounds including health personnel and other relevant professionals to secure the diverse skills and technical expertise required;
- *coordination with service providers*: Design communication programmes to identify and reinforce facilities to promote access and quality;
- *Public/private partnerships*: Build partnerships among government agencies, NGOs and the corporate world to enhance reinforcement of communication programmes and learn from one another;
- *Multiple channels*: Set up a lead agency and channel to carry the message and reinforce it with other appropriate (mass, community and inter-personal) media as the case may be. Use the medium that will best reach the intended audience to achieve the most effective programmes;
- *Inter-educational approaches*: Employ entertainment to reach and persuade audiences, especially young people. Develop and adapt entertaining materials for mass media and community distribution;
- *Training and capacity building*: At every step train individuals and build institutional capabilities to carry out effective programmes. Use educational sessions and on-the-job training to create a critical mass of communication experts;
- *Monitoring and evaluation*: Plan for evaluation from the start to measure changes in the intended audiences and to know whether objectives are achieved, monitor project outputs regularly and make necessary adjustments, share funding widely to improve future programmes; and
- *Continuity and sustainability*: Plan for continuity from the start with activities that can become sustainable over time. Expand programmes, service activities and coalition as appropriate to build a larger base for advocacy and community support.

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EDUCATION AND SUSTAINABLE COASTAL DEVELOPMENT

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INTRODUCTION

In presenting my perspective on the role of education in sustainable coastal development, I shall focus on Nigeria's coastal region, drawing heavily on the findings on the Niger Delta environmental survey of 1997. But before doing that I will briefly review the concepts of development, of sustainable coastal development and of education as the basis for establishing a linkage between the concepts.

KEY CONCEPTS

Development is a concept whose definition varies according to the thrust of the person defining it. The economist emphasizes increase in gross national product. The political scientist stresses democracy and stability of government. The educationalist focuses on the tapping and utilization of all available human resources. In general, however, development simply means the tapping and utilization of potential human and material resources of any community or nation to increase its productivity as well as equitable distribution of the products in order to improve the quality of life of the people. The emphasis or ultimate goal is good quality of life which is characterized among other things by:

- food security;
- adequate and affordable health care;
- available potable water;
- manageable family size;
- high life expectancy;
- health and a sustainable environment.

These indicators often serve to categorize nations as 'developed' or 'developing'. Nigeria is one of the developing countries.

The term 'development' is now being qualified with 'sustainable' to draw out the fact that some development may not be sustainable. Sustainable development means that type of development, which in the course of tapping and use of resources does not destroy the very ecological foundations that support it. Behind the concept of sustainable development is rationality in production and use with the future in mind. Sustainable coastal development therefore refers to the development of our coasts in a pattern which encourages the maintenance of the ecology of the coasts while utilizing and benefiting from their vast resources.

Education is the process of helping one to acquire desirable knowledge, skills and attitude for effective life in today's society and in the future. The process may be informal – when there is no organized or prescribed content, or formal – when a scheme of learning activities, conditions and duration are prescribed as is the case in our school system. It is non-formal when learning outcomes are known but conditions and procedures are rather fluid in order to suit the conditions of the learners who are often adults. Most adult education programmes for updating skills and knowledge or modifying attitudes is non-formal. It is necessary to draw the distinctions so as to understand the various educational pathways which can be used to achieve sustainable coastal development. What actually are the common coastal development problems?

COASTAL DEVELOPMENT PROBLEMS

The coastal regions of the world have similar geography. They experience similar environmental conditions and development patterns – that is, a relatively stable and balanced ecological system turning to a rapidly changing and destabilized system due primarily to human development activities.

Nigeria's coastal region, especially around the estuaries of the Niger and Benue rivers and the Atlantic coastline, is known to be experiencing serious development problems that threaten the sustainability of this region. The inhabitants of this coastal region make their living from fishing and farming, they sell their products to others thereby contributing to the food security and economic development of the nation. Unfortunately, developmental activities in this region, especially the oil industry and associated industrial establishments, have created ecological problems of immense dimension. The ordinary citizen is able to observe several ecological changes:

- changes in the rhythm and patterns of atmospheric/weather conditions such as rhythm of tidal waves;
- changes in the variety and ubiquity of organisms as exemplified in the type, quality and quantity of the fish harvest;
- reduced vitality and increased human health problems associated with pollution, e.g. of water;
- depleting natural resources such as drying-up of oil wells and deforestation;
- lowered soil fertility and agricultural production.

It is concern over these observations and other socio-economic problems that influenced the government, the oil companies, the oil-producing communities and other stakeholders to set up the Niger Delta Environmental Survey (NDES). The goal of NDES is 'to establish the causes of ecological and socioeconomic change over time and induce corrective action... to improve the quality of life of the people and achieve sustainable development in the region'. The survey findings which were published in 1997 identified fourteen major environmental problems, which are:

- flooding and coastal erosion;
- sedimentation and siltation;
- degradation and depletion of water and coastal resources;
- land degradation;
- air pollution;
- biodiversity depletion;
- noise pollution;
- light problems;
- lack of community participation;
- health problems;
- low agricultural production;
- socio-economic problems such as unemployment, poverty;
- weak or non-existent laws and regulations;
- improvement in the well-being of the population.

Each of these problems can be categorized as naturally occurring, development-induced or socio-economic. Examples of naturally occurring coastal problems are erosion and flooding of coastal river banks, sedimentation and siltation, the invasion of such plants as water hyacinths. Education will serve to inform the public on what each phenomenon is, explain the process, show how to manage it and inculcate the right attitude to it. The subject matter should feature in the curricula at formal and non-formal levels. When people are equipped with correct information on the growth and activities of water hyacinths for example, they will be less scared and be more able to seek ways to combat the invasion. Interest in research into such phenomenon can be generated through education and public awareness.

Development-related problems include land degradation/loss of soil fertility, decline of forest reserve, depletion of biodiversity especially fish, oil spillage and gas flaring, sewage and waste disposal into water. Given that these problems are development induced, they have been traced to ignorance and illiteracy and sometimes to the selfish interests of the perpetrators. So well-packaged education programmes for youths and adults of formal and non-formal kinds will provide opportunities to learn the causes, management and prevention of these problems. A topic such as 'the oil industry and our environment' that will expose the activities of oil companies, the economic benefits and the environmental problems created.

A curriculum that includes sustainable coastal development is necessary to provide people with relevant knowledge, skills and attitudes towards sustained development. In this regard the Project 2000+ on Scientific and Technological Literary for All is appropriate. Project 2000+ encourages the development and introduction of appropriate in-school and out-of-school opportunities and programmes and curricula towards achieving responsible and sustainable development. In a recently concluded training/writing workshop on Project 2000+ for Africa, held in Accra Ghana, environmental issues featured prominently in the expected supplementary reading series for Junior Secondary Schools. In short, education has an important role to play in sustainable coastal development by development and implementation of a curriculum that includes coastal environmental education.

The NDES document also outlines some socio-economic spin-off of coastal development activities. These include unemployment, poverty, conflicts, decay of societal values, non-participation of the community in major decision-making. These problems can be easily addressed by providing the young with wide access to education and training. Education is the most important investment in people. Education to eliminate illiteracy will help the young to gain employment, to rise above poverty, to join the class that makes decisions, to reduce and/or manage conflict, to seek the enforcement or provision of laws and regulations etc.

Community partnership which is vital to proper coastal development and management will be successful when the community has a critical mass of educated men and women who understand the complexities of development.

Nigeria's education initiative on environment

In addition to the establishment in 1992 of the Federal Environmental Protection Agency (FEPA) whose mandate was expanded to cover conservation of natural resources and biological diversity, the government is trying to inculcate environmentally sound beliefs and practices through education. The government charged the Nigerian Education, Research and Development Council (NERDC) with the responsibility of developing an environmental education programme for schools. The project document states 'to assist government to build institutional capacity and make operational its education and environment policies of achieving an environmentally literate citizenry, empowered sufficiently to deal with current environmental problems such as sustainable development'. An environmental education programme for junior secondary schools has been developed and approved by the National Council for Education (NCE).

Characteristically, the programme adopted the infusion approach whereby themes in environmental education were infused into the curricula for English language, social studies, health education, integrated science and agricultural science. The infusion is based on five themes: ecological foundations; human environment/ development; environmental change/impact; sustainable development.

It is expected that if the innovation takes off successfully other levels of education will be included. However, some universities and colleges in Nigeria are already offering certificate and diploma courses in environmental education/ management, while some have degree programmes and postgraduate programmes that focus on the environment. It is within these programmes that emphasis on sustainable coastal development will feature.

From the non-formal education angle, there is not much happening that can impact sufficiently on the attitude of people towards sustainable development. Public awareness campaigns using every means are urgently needed to achieve the desired sustainable coastal development. It is one thing to develop a curriculum or plan intervention programmes, and another to successfully implement them. There are often obstacles and problems.

Problems in implementing environmental education programmes

- Poor preparation of teachers. In Nigeria, as in many countries, teachers are trained to specialize in one or two subjects with the result that such a teacher is unable to teach the interdisciplinary concepts that characterize environmental issues.

Environmental education demands the use of a variety of methods which will not only provide knowledge but serve to modify learner behaviour/attitude to the environment. Methods which have been found to be suitable are practical, interactive ones such as group discussion; field trips; debates, role-plays; demonstration; projects and practical experiments such as testing water quality; pictures/sketches and audio-visual representations.

- Lack of funds and support for field trips to environmentally degraded areas such as the Niger Delta zone in order to provide learners with first hand experience of environmental problems. A learner who experiences continuous gas flares, or the thick layer of oil on the surface of a river after an oil spillage or devastation of farmland arising from oil exploration, will be permanently sensitized and committed to deal with issues of sustainable development.
- Near absence of culturally relevant texts on the Nigerian coastal environment at primary, secondary and non-formal educational levels.

Solutions

Firstly, we need greater cooperation between education systems in various African countries and also with appropriate international bodies. The Commission for Biology Education (CBE), an arm of the International Union for Biological Sciences (IUBS), has made efforts and continues to work on environmental education, curriculum and teaching. A well planned education programme will serve for advocacy, awareness raising, information, dissemination, capacity building, informed decision-making, attitude change, problem solving towards sustainable coastal development.

Secondly, we have to develop appropriate curricula on environmental education at all levels. We must accommodate indigenous knowledge.

SUSTAINABLE COASTAL DEVELOPMENT IN THE SEYCHELLES: ROLE OF EDUCATION

Michèle Martin,
representing the Ministry of Education, Seychelles

During the past four years there has been much discussion in the Seychelles about sustainable coastal development and integrated coastal zone management. Various stakeholders, including representatives from education, have been involved in an array of sometimes unrelated national and regional workshops on the subject. Inevitably, one of the outcomes of all of these meetings is the recognition of the vital role education must play in the development of a society able to live sustainably in coastal areas.

As the Seychelles is an archipelago of small islands, most of its land area can be considered to be coastal, and most human activities have a direct impact on the coastal environment. For example, as new roads and housing developments cut into the hillside, rain washes loose red earth into the sea where it settles on sea grass beds and coral reefs. Pesticide and fertilizer runoff from agricultural activities eventually finds its way to the sea. Sewage from faulty domestic septic systems along hillsides and on the coast seeps into rivers and is then washed down to the sea. Most industrial developments are along the coast, where their effluent poses a potential hazard to coastal and marine life. The dumping site on the main island of Mahe is located on reclaimed land (coral fill) along the coast where leachate seeps into the adjacent sea. Environmental education activities that seek to address these problems all potentially could have a impact on sustainable coastal development.

Since the early eighties, the Seychelles Ministry of Education has placed a strong emphasis on the environment in the national curriculum at primary and secondary school levels. Since this time, Seychellois pupils have learnt about the sea and coast in a range of subjects including science, English, art, French, Creole, and geography. More recently, the Ministry of Education brought out an environmental education policy, outlining its commitment to further development of environmental education in the national curriculum from Crèche (nursery) to Polytechnic. In 1997 a curriculum guidelines document was produced which details a series of environmental learning objectives to be integrated into the national curriculum; it includes a strong focus on the marine environment. At present a new unit on coastal environments is being developed for the primary school science programme, and another is planned for secondary school geography.

Part of the Ministry of Education's strategy to further integrate environmental education into the curriculum is to provide training in environmental education (EE) for in-service and pre-service teachers. Since 1993, short workshops on various aspects of EE have been offered every year for primary and secondary school and polytechnic teachers. In addition, in 1994 the local teacher training institution introduced a popular optional module on environmental education for pre-service primary and secondary school teachers. Teacher training initiatives aim to provide teachers with opportunities to learn more about the local environment and ecology, environmental problems, and provide them with first-hand experience through field trips and project work.

However, due to several constraints, schools at present are limited in their capacity to provide students with opportunities to participate actively in projects related to sustainable coastal development as part of their timetabled lessons. It is rather in the context of co-curricular and extra-curricular activities that students are being more actively involved in coastal and marine conservation education.

For example, each year in the Seychelles, the Ministry of Tourism collaborates with diving centres and the Ministry of Education to organize a festival of underwater photography, the ‘SUBIOS’ festival. Included in the annual programme of activities are art and creative writing competitions for schoolchildren, which are taken up as co-curricular activities by art and language teachers. This popular event provides an excellent opportunity for students and teachers to get involved in learning about coastal areas. In addition, SUBIOS guest speakers (internationally renowned underwater photographers and marine biologists) make presentations in schools on a range of topics related to the marine environment.

A local non-governmental organization, Wildlife Clubs of Seychelles (WCS), works in close collaboration with the Ministry of Education to co-ordinate a network of extra-curricular environment and wildlife clubs in schools. WCS organizes training sessions for club leaders to familiarize them with local wildlife and conservation issues. Many of these clubs work on activities pertinent to sustainable coastal development, such as monitoring coastal wildlife, visiting coastal habitats, tree planting along coastal areas, visiting marine parks, cleaning beaches etc. In June, 1998, in recognition of the Year of the Ocean, all the wildlife clubs joined together for a march through the capital to promote the protection of oceans and marine life. More recently, clubs organized and performed a variety show for the general public, which focused on the protection of the marine environment. At present, WCS is working on a coastal and marine activity book for children, which will include a variety of indoor and outdoor activities to help children learn about the marine environment and participate in conservation.

The Ministry of Education also works in partnership with the Division of Environment (DOE), which is mandated to co-ordinate environmental education initiatives targeting the general public. The DOE works alongside the media (television, radio and newspapers) to produce regular articles, and television and radio programmes, which often focus on coastal development issues as well as school environmental initiatives in this domain.

In general, the situation in the Seychelles at the moment is conducive to environmental education initiatives, particularly in primary and secondary schools where there now exists a network of committed and enthusiastic teachers. The Ministry of Education’s close partnership with the Division of Environment and Wildlife Clubs of Seychelles is producing results: we are slowly beginning to see the development of a new generation of youth concerned about, and committed to, sustainability, including sustainable coastal development.

However, there still remains room for further development and new initiatives, particularly in terms of strengthening our cooperation with other small island states. Through our participation in the technical workshop in Maputo, Mozambique, on ‘Sustainable Integrated Coastal Management: The Role of Education and Communication’, we hope to establish new contacts with other individuals and organizations so that we can learn from them and share our experience.

SUMMARY OF VIEWS AND EXPERIENCES: SOUTH AFRICA

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Some 15 years ago, the National Department of Environmental Affairs and Tourism (South Africa) identified, through a series of workshops along the coast of South Africa, the need for a co-ordinated national approach to communication and education for coastal management. This led to a programme within the department known as the Coastal Management Advisory Programme, commonly known as CMAP. The programme was run by the Council for Scientific and Industrial Research (CSIR) on behalf of the Department until 1995 when it was expanded to include two national co-ordinators, one from the department and one from the CSIR.

Today the programme has expanded into an effective national information exchange, educational and capacity-building programme and is known as CoastCARE. It is now co-ordinated from within the department's Coastal Management Office on a full-time basis.

The objectives of CoastCARE are:

- to promote optimum awareness of the coastal zone so that its resources can be managed and developed in a sustainable way;
- to play a dynamic role in the exchange of information amongst all interested and affected parties;
- to facilitate the education of our diverse coastal communities through individually designed projects;
- to form a bridge of communication between scientists and other role players; and
- to co-ordinate relevant associated projects to promote consistency and integration on a national level.

CoastCARE initiates, co-ordinates and manages projects that centre around the participation of a diverse range of interest groups. These include: local, provincial and national authorities; local residents; coastal communities; subsistence and recreational resource gatherers; property developers; industry; scientists and researchers; national and international tourists and holiday makers; young people; students; environmentalists; conservation officials; politicians; law enforcement officers; the legal fraternity; non-government organizations and community-based organizations.

CoastCARE makes use of diverse means to reach these people, including courses, workshops and seminars; multi-media displays; educational videos; a variety of publications; radio; print media; a technical manual and interpretive signage.

As a result of severe manpower and budgetary constraints, CoastCARE is very dependent on strong partnerships with a variety of organizations and other role players. These include the private sector, (they fund most of the specific projects co-ordinated by CoastCARE); government and non-government organizations; research and academic institutions and private consultants.

Specific projects in various stages of development and implementation under the CoastCARE umbrella include:

- A national needs assessment and prioritization for all educational and training needs in the field of coastal and marine management is being done in cooperation with the South African Network for Coastal and Oceanic Research (SANCOR) and will lead to a more co-ordinated approach with certain minimum standards in place for all training in this field. A lot of *ad hoc* and individual short training and educational courses are run by a variety of organizations in South Africa, but to date there is no cooperation and coordination in this field; this often leads to expensive duplication of effort and sub-standard information being conveyed. The needs assessment will be completed by the end of 1998; thereafter an implementation strategy will be developed and implemented when the funding needed becomes available.

- A technical manual for coastal management in South Africa is being compiled with the possibility of extending it into a manual for East Africa in cooperation with the Secretariat for Eastern African Coastal Area Management (SEACAM). The manual is at a stage where a first draft is currently being reviewed and will be completed and published early in 1999. This manual is the result of a national survey which identified such a document as a high priority for coastal managers in local and provincial authorities as well as coastal engineers, town planners, developers and other decision-makers in this field.
- There is an ongoing educational programme at the Two Oceans Aquarium in Cape Town aimed at school groups and the general public (approximately 1 million visitors per annum). This programme includes multimedia interactive computer displays, interactive learning methods like puppet shows etc., murals and other displays about the coast. It is run by two full-time educators.
- A series of educational videos is being expanded and will ultimately be distributed to schools, institutions for tertiary education and coastal communities.
- An information booklet series on the coast including topics like ‘Estuaries and Lagoons’, ‘Rocky Shores’ etc. is being made available through the CoastCARE office free of charge to the general public, schools and conservation agencies. This is accompanied by a CoastCARE poster, which can act as an interactive learning tool in itself.
- An Internet web site is currently being developed which will contain information on the national coastal management office, CoastCARE and general information about the coast.
- A national implementation strategy and implementation plan for the coordination of interpretive signage along the coast of South Africa has been developed in close cooperation with a wide variety of role players in South Africa and will be implemented over three years as soon as funding becomes available.

These are a few of the major CoastCARE initiatives in various stages of development and/or implementation.

It is important to note that all of these projects are being developed and implemented in close cooperation with a wide variety of other role players, interest groups and organizations as CoastCARE strives for effective exchange of information instead of the usual top-down government approach which tends to alienate people. Strong partnerships have emerged over the years and CoastCARE is looking forward to extending its local involvement to the rest of the continent as we believe there is a lot of scope for working together with similar international and regional programmes.

SUSTAINABLE COASTAL DEVELOPMENT: COMMUNICATION AND EDUCATION ISSUES IN TANZANIA

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Efforts to curb environmental degradation have been stepped up in recent years because of the generally fast deterioration of the environment at large. This is mostly due to the human activities, which are surpassing their bounds day and night. It must be pointed out however that, because of the fast growing exploitation of the environment, man has been forced to revisit his activities, albeit the need for natural resources is practically on a daily upsurge. And by revisiting we actually mean trying to strike a balance between man's daily needs from nature and the degradation of the environment so as not to deny the coming generations their right to nature.

The danger lingering over our heads is that of finding an inhabitable world as a result of uncalculated exploitation of the environment. Since the days of Charles Darwin, man has seen this danger. It is because of this fact that we are today forced to wage campaigns for the preservation of nature and rational exploitation of the environment. This is actually a call to mankind to maintain ecological harmony as a precondition for life on earth.

Environmental degradation or rather ecological disharmony has become such a serious problem that it is no longer possible to expect positive results without the participation of society as a whole. For any quantifiable results to be registered in the struggle to curb or rather reverse the situation, it should be borne in mind that no government in isolation, however rich and powerful it might be, can succeed without involving the whole of society from the grassroots up. Governments and experts can help in systemizing the reversal process but community participation is probably the only way to see to it that friendship between man and the environment is maintained.

Environmental degradation is a widespread phenomenon. But, for the purpose of this paper, I will confine myself to degradation of the coastline. For many years, people inhabiting the coastline, not only in Tanzania, but I presume all over the world, and especially those in developing societies, have been dependent on natural resources from the sea and the shore. Their dependence can easily be verified by studying their lifestyle, that is, their shelter, food, recreation etc. It is not surprising therefore that what we have now been witnessing practically all along the coastline is ecological disharmony. On the one hand this disharmony can be attributed to a drastic change in climatic conditions (quite natural and probably beyond man's control), but on the other hand we are also witnessing serious environmental degradation due to mankind's unreasonable exploitation of nature along the coastline. Coastal erosion, extinction of rare but ecologically very important natural vegetation and pollution of the coastline and subsequently of the sea are but a few of the aftereffects of man's unfriendly relationship with the environment. The overall result is nothing less than desertification of the coast lines.

Human activities also adversely affect coastal areas due to over-exploitation of living resources, especially fish, and coastal development, for the construction of tourist hotels without taking into consideration ecosystem services. These give short-term economic gains, which often times do not take into consideration long-term effects on the environment. In other words most of our projects along the coastline are executed without a proper cost-benefit analysis on the side of the environment in the long run.

That is why communication and education are important in this respect in helping to raise the awareness of the people and make them understand the issues and problems involved.

Education and communication are also important in efforts to develop the knowledge, attitudes and skills required for participation in sustainable development of coastal regions. In other words, people should be enabled to make decisions. They should be helped to do so only after proper cost-benefit analysis as regards the pluses and minuses of the pending activity. As a rule people tend to look at immediate economic gains (most of which are short-term); they should be armed with tools to enable them to look critically at the environment and forecast the effects of a project, adverse or otherwise, before implementation.

In that respect, information, through education in all its forms, is informal and formal and at all levels is one of the basic prerequisites for achieving the needed levels of consciousness to help people in decision-making. It is imperative to point out here that the intention is not to create a bank-client relationship but to create a thinking person, one of dialogue, of communication. That is why this information has to be communicated by all means, for example, interpersonal discussions, theatre, newspapers, radio and television, but the bottom line should be to arm the consumer with tools of analysis to help him/her in the cost-benefit analysis whenever and wherever the question of environmental exploitation arises.

TANZANIAN CASE

In Tanzania, environmental degradation of coastal areas is a serious problem, which has escalated in the last 10 years, such that it has now given rise to serious concern. Tanzania's coastline stretches 800 km along the Indian Ocean, which like other developing countries is experiencing rapid change.

The following examples show the dimension of the problem.

Dar es Salaam used to have very clean and attractive beaches as well as commendable tourist beach hotels. But some, if not most of them, are now in danger of falling down because of coastline erosion.

Waves reach the beaches at a terrific speed and as a result erosion is inevitable. This has become possible because of, among other reasons, dynamite fishing, which has destroyed the coral reefs which used to buffer the hotels. Thus, dynamite fishing has not only destroyed life in the sea, but has given the sea a free ticket to destroy the beaches.

The Hotel Africana was swallowed by the waters a few years ago, others which might also face extinction in the coming few years include Bahari Beach Hotel, Kunduchi Beach Hotel, Silver Sands Hotel and White Sands Hotel, which was built just a few years back.

In efforts to fight erosion, hotel owners have constructed stone and concrete barriers on beaches, but such measures have not stopped the erosion. Apart from that, the construction of these structures has made these beaches ugly and unsuitable for beach-goers including tourists.

So it is just a matter of years before these hotels will be rendered useless like their predecessor, Hotel Africana.

Another beach hotel has just been stopped in its tracks. This one was being constructed along the Oysterbay. The point about this project is that the hotel, being built by a big businessman in Dar es Salaam is within 60 metres of the shore. This is contrary to the law on such projects. The law says that a hotel should be built a distance of more that 60 metres from the shore. This project was approved during the former President Ali Hassan Mwinyi's tenure in office. This raised a lot of eyebrows in the country. The speed at which it was being built also raised a lot of questions.

However, during the campaigns for the general election in 1995, one of the presidential candidates promised to deal with the issue as one of his priorities, if he won. Well, he won and a few months later he said the project owner followed the right procedures to acquire the plot so he did not see the logic in stopping the project. However, a presidential commission on corruption maintained that the plot might have been allocated through corrupt means. This was partly because the law was in force when the allocation was made after it was turned down several times before.

The project owners, Indian Ocean Hotels Ltd., stopped constructing the hotel more than a year ago. There are reports that the government has ordered the demolition of the hotel and offered to compensate the developers for the costs incurred so far. It is said that the owners were issued with a permanent restraining order by the City Commission two years ago and consequently suspended work.

THE RUFIJI DELTA PRAWNS PROJECT

A foreign investor proposes to start prawn farming in the delta of the Rufiji River, which is the largest river in Tanzania. The project will involve the construction of ponds covering an area of 15,000 ha. This project, has generated a lot of controversy, both in terms of the number of the villagers who would be displaced and the long-term effects of environmental degradation to the area.Some people, opposed to the project, went to the extent of likening it to the tragedy which has befallen the Ogoni people in Nigeria, whose land has been extensively degraded by activities of the multi-national oil companies.

The Rufiji Delta people themselves are also divided on the issue. There are those who support the project, citing its economic benefits (including employment), and those who oppose it.

Those in opposition are supported by a myriad of environmentalists including vocal non-governmental organizations such as the Environmental Journalists Organization of Tanzania (JET), the Land Rights Research and Resources Institute (LARRRI), the Tanzania Gender Networking Programme (TGNP) as welle as the National Environmental Management Council (NEMC), which conducted an environment impact assessment and advised the government against the project.

Despite all the opposition, the government approved the project. Although the project has yet to start, the people of Rufiji have gone to court to protest it.

Let me at this juncture point out the very commendable job done by the media in Tanzania in creating awareness and generating debate on the Indian Ocean Hotel saga and the Rufiji prawns project, which is yet to take off. It was through the media that people became aware of the violation of their right to access the beach and the law which prohibits putting up permanent structures on public beaches. The people of Rufiji came to know of the prawns project after the media had intercepted some documents regarding the project and immediately made it public knowledge. Though the government has approved the project, most Rufijians are not for it.

EDUCATION AND COMMUNICATION

Education and communication on environmental degradation should be aimed at enabling one to come to terms with the fact that, while it is true that nature should be exploited for man's survival, that exploitation should not be total, or destructive. That man should not get rich at the expense of nature or by destroying the environment, as this in the long run might lead to mankind's extinction!

Now, the big question is: Who will be responsible for steering this education and communication? In answering this question there are different schools of thought.

There are those who believe that this should be spearheaded by the government and NGOs should play a supportive role. The government should take leadership of the campaign where its input is required. At the moment the environmental portfolio in Tanzania is held by the Vice President's office.

But there are those who think that our governments are not environment sensitive and due to corrupt tendencies which have been registered and are still being registered there is no way politicians (who are in power) are going to arm the people with weapons they know will in the end be used against them. Whence then the education? It is recommended that the lead should be taken by non-governmental bodies such as NGOs, media organizations, friends of the environment groups all over the country etc.

But all told, it is very important that we do not sideline the role of the government. This is because some decisions need the hand of the government for implementation. Take the example of dynamite fishing in Tanzania. This is such a serious problem that without the interference of the government the possibility of solving it through common sense and public education alone is negligible. It is a problem which has bedeviled our coastline for some years and contributed greatly to the current fast beach erosion. Vast resources are needed in order to fight this bad practice by unscrupulous fishermen. Apart from education on the effects of dynamite fishing, the use of force is also important to make those who undertake dynamite fishing realize the mistakes they make. This involves taking legal action against those caught red-handed.

In Tanzania the National Environmental Management Council (NEMC), a quasi governmental organization is charged with overseeing NGOs that play a big role in the fight against coastal environmental degradation. The NEMC is just a few years old but it is doing a good job in creating awareness on environmental matters through the media, for example, through radio programmes. The Council has a programme, which is aired through Radio Tanzania Dar es Salaam (RTD) once a week.

Through the NEMC, Tanzania is also a participant in an Integrated Coastal Management (ICM) programme, having established its national ICM programme in 1995 as a tool for achieving sustainable use of coastal and marine resources. ICM programmes are currently being put into practice in Tanga, Kunduchi, Mafia and Mtwara/Lindi. The ICM programme entails involving the populace so that it understands the problems of environmental degradation and participates in fighting the problem.

The NGOs on the other hand are also doing a good job in this respect. It is the NGOs, for instance, which enabled the people of Rufiji River Delta to go to court to protest against the prawn's project. This was done through a concerted campaign, whereby some officials from those NGOs traveled to Rufiji to educate the people on the effects of the project. Seminars and workshops were also conducted for this purpose.

Conclusion

In as much as rapid changes in coastal areas for financial gains is a process which cannot be reversed, what is needed are concerted efforts to make sure there is no total destruction of those areas. The populace should be made to understand that over-exploitation of natural resources would boomerang on humanity in the long run. The NGOs should spearhead the campaign against coastal environment degradation.

C

FAO – Policy and planning for integrated coastal area management

INTRODUCTION AND BACKGROUND INFORMATION

Presently, one quarter of the world's population of some 5.9 billion lives in coastal areas and most of the largest urban concentrations are in the seacoasts. The current coastal urban population of 220 million is projected to almost double in the next 20-30 years. Unless governments and users of coastal resources take appropriate action, population pressure and associated levels of economic activity will further increase the already evident over-exploitation of coastal resources and environmental degradation of many coastal habitats. In many developing countries, this trend is further exacerbated by the widespread existence of extreme poverty and unemployment. Furthermore, conflict often arises from competing and antagonistic use of resources, or by the displacement of traditional users of coastal resources by new economic activities.

Integrated coastal area management offers a means to balance the competing demands of different users of the same resources and to manage the resources to optimise the benefits to be derived on a sustainable basis consistent with a country's goals. In many countries, sector-oriented line ministries have the mandate, technical competence and professional experience to conserve, manage and develop coastal resources. Commitment on the part of some ministries is a condition of the successful adoption and application of truly integrated plans for the conservation, management and development of coastal resources. In addition to the institutional capacities to undertake their tasks, line ministries must also have staff with a sufficiently flexible approach for constructive collaboration across ministries.

There is need to put in place institutional options, policy processes, planning mechanisms and issues specific to economic sectors with regard to integrated coastal area management. There are many approaches to resolving the often difficult institutional problems, which arise when countries seek to adopt integrated coastal area management.

Perhaps the most critical lesson from the fairly limited experience so far in integrated coastal area management is the need for adequate human and financial resources to be made available. In most cases, this calls for a re-allocation of funds, rather than additional funding.

It is suggested that the responsibility for the preparation of an integrated coastal area management strategy – which provides the basis for sectoral plans – lie with a lead co-ordinating organization or body. The preparation of plans and the implementation of this strategy should be the responsibility of the line ministries. Alternatively, government might establish a new organization responsible for the design and implementation of integrated coastal area management plans. Such plans should not stand-alone but should be an integral part of sectoral development, resource management and research activities. These plans should be flexible and adjusted periodically as more information becomes available or new issues are addressed.

OBJECTIVES

The aim is to enhance the contribution of economic sectors to the integrated management of coastal areas by developing awareness in sector line agencies, and resource users of: i) the external or internal environmental effects which each sector may generate; and ii) environmental impacts originating outside the sector and felt in one or more of the sub-sectors. More importantly, ways should be found for planners and resource users in each of the economic sectors to take these impacts into account in plan formulation.

Since any ICAM strategy will be influenced by the respective strengths of the bargaining positions of the many parties involved, there is need to improve the bargaining positions of the economic sectors. Because most African countries' economies rely heavily on the primary sector, a particular focus is given to the agricultural, forestry and fisheries sectors. Other interested parties include industry, urban areas and dwellers, the tourist sector, industrial ports, sea transport (including oil transport), and mining. Line agencies can take a proactive stance, and seek to clarify and quantify trans-sectoral impacts, as well as formulating and co-ordinating appropriate management interventions.

The objectives are therefore to assist African countries to achieve sustainable development of their coastal resources by contributing to:

- enhancing national institutional capacities for integrated coastal area management;
- integrating planning and management of the agricultural sector into coastal area management; and
- preventing and controlling environmental degradation in coastal areas.

Methodology and approach

The workshop consisted of:

1. An opening session.
2. Four-regional/national case studies highlighting lessons on:
    - Integrated coastal fisheries management in the Gambia: lessons learned in awareness creation, market-based management incentives, regulatory measures, local participation in management, research and training, and improved sectoral and inter-sectora1 coordination and planning.
    - The Egyptian Red Sea Experiment.
    - Constraints and opportunities in building capacities for environmental management in coastal and marine areas of Madagascar.
    - Incremental learning-based approach in integrated coastal management in Eastern Africa.
3. Integrated Coastal Area Monitoring System (ICAMS) for decision-making: presentation on monitoring and managing coastal water quality.
4. Concluding session defining and summarising the working group recommendations for plenary presentation.

Outputs

Definition of elements necessary for integrating sectoral policy and planning into coastal area management, including requirements for appropriate legal mechanisms, conflict management, institutional coordination, and capacities for improved research and training.

Policy planning for integrated coastal area management

Nadia Scialabba,
FAO, Rome, Italy

1. Current trends affecting sustainable coastal development

Natural resources
Coastal areas are diverse in function and form, dynamic and important economically and ecologically. Population growth and wasteful management practices jeopardise the ecological balance on which present life and that of future generations depends. More attention should be given to the decision-making processes and interactions of individuals and social groups with the natural ecosystem.

Interactions between economic activities
Conflictual spatial occupations, antagonistic and competitive usage, and unmanaged growth create negative environmental impacts and long-term societal costs that need to be addressed. Assessment of relative costs and agreement of various groups on appropriate management actions can minimise trade-off and create synergies.

Globalisation and inter-dependence
The emergence of global environmental concerns (such as climate change) and increased exchange of capital, goods, labour, and information has dramatically increased global interactions and, unavoidably, inter-dependence between different human and natural ecosystems. Globalisation and diversity can be reconciled by looking for specific responses, depending on ecological and economic comparative advantage and local culture.

The demographic milieu
Production, supply and consumption are closely related to the quality, health, dispersal and rate of growth of populations. Migration to coastal areas, in particular to coastal cities, is growing at a faster rate than the world population, posing a major threat to coastal ecosystems. Search for better livelihoods and the open access of coastal resources offer sources of income of last resort. Integrating population issues into development plans and addressing needs (e.g. land distribution, labour requirements, training, employment, technology adoption, and other production factors) should be addressed within the framework of policies and options for coastal development.

Institutions and production systems
Privatisation of common lands or encroachment of urbanisation and industry on agricultural lands, have disrupted small-farmer institutions, have deprived small farmers of their land rights and have deteriorated the status of women who already suffer from inequitable access to land. The productive capacity of communities has been "eroded" by the interaction of various factors, including unsuitable policies which have inhibited the participation of resource users, disenfranchised key actors, and led to erroneous policy choices. This highlights the role of Governments in creating a political and legislative environment amenable to effective cooperation between interested groups and the implementation of appropriate policies.

Food insecurity
Agriculture remains the world's single largest employer but is not, in economic terms, a competitive sector in the economies of many nations. Preserving coastal agricultural lands and coasta1 fishery and forestry resources are vital to food security and livelihood systems through: provision of employment, stabilisation of rural communities,

overall distribution of wealth, reduction of environmental damage, promotion of traditiona1 and informal activities, promotion of links between agriculture and industry, and provision of food to coastal dwellers.

2. Challenges

Correcting policy failures
Lack of awareness of long-term implications of non-intervention and shortsighted economic gains do not allow taking into account coastal ecosystems degradation. As a result of weakened legal frameworks, coastal resources become open to over-exploitation.

Correcting information failure
Lack of information and awareness on the value of all goods and environmental services of the coastal natural capital, and on negative environmental impacts contribute to policies failures. The cost of information collection and analysis can be contained by identifying information requirements related to areas under threat and by adopting a precautionary approach in natural resources management.

Multiple objectives
Management in time and space of the interactions between economic and ecological, and social and natural variability requires a dynamic, progressive and development-oriented perception, with a view to closer integration between conservation and development. Sustainable development actions imply an infinite number of decisions, which are taken by users of “local spaces”. The challenge is to couple the legitimate needs and interests of individual users with the collective interest, including the health of trans-boundary natural ecosystems.

Multiple management
Coastal resource management includes a wide range of management practices: land-use planning; land tenure issues; legal, administrative and institutional execution; demarcation on the ground; inspection and control of adherence to decisions; settling water rights; issuing of concessions for plant, animal and mineral extraction; and safeguarding of the rights of different interest groups. A balanced management perspective is needed in which inter-sectoral relationships are fully understood; trade-off recognised and anticipated benefits and alternatives critically assessed, appropriate management interventions identified and implemented, and necessary institutional and organizational arrangements worked-out.

Multiple integration
Coastal area planning and implementation requires various types of integration. Systems integration relates to the need to ensure that all relevant interactions and issues, regardless of their origins, are considered. Functional integration focuses on ensuring that management interventions are consistent with coastal area management goals and objectives. Policy integration concerns the need to incorporate management policies, strategies and plans with development policies, strategies and plans.

Multiple coordination
Multi-sectoral cooperation, and conflict resolution and negotiation need coordination of various types. Vertical coordination refers to cooperation among various hierarchical levels of government (central, regional, local). Horizontal coordination focuses on gaining cooperation within a specific level of hierarchy (e.g. among local government and various stockholders and sectors). Temporal coordination refers to achieving optimal phasing of management actions.

3. Approaches

The socio-ecological approach
It is the “human space” where people live and derive resources for a fully reproductive life, which delimits socio-ecological zones, and therein lies the entry point for sound management of coastal ecosystems. Socio-ecological land units are the bases for sustainable activities since they determine land rights and natural resource use. At the local politico-economic

level many primary institutions exist and economic functions and basic services are performed. It is at this level where recent decentralisation processes tend to place the structures of local government. It is also at this level that local government and community organizations could forge partnerships with the private sector in order to boost investments. This level is the "interface" between the local communities and national development programmes, direct natural resource users and the larger ecosystem.

Institutional approaches
There is no single way to organise institutions for integrated coastal area management but efforts should be made to fit into existing institutional and organizational structures, and cultural attitudes and social traditions. Existing formal and non-formal institutions involved in coastal resources management or having jurisdiction over coastal resources should be fully considered. Responsibilities should be clearly defined and overlaps and conflicts in organizational jurisdictions should be minimised. Sector-oriented line ministries have the mandate, technical competence, and professional experience to manage coastal resources. Ministries are in a good position to observe the external or internal environmental impacts generated by each sector. Bringing together various concerned government agencies and other stakeholders to work towards common goals and mutually agreed strategies offers considerable benefits.

Integrated Coastal Area Management (ICAM)
Integrated coastal area management is a dynamic process by which actions are taken for the use, development and protection of coastal resources and areas to achieve national goals established in cooperation with user groups and regional and local authorities. In this definition, integrated management refers to the management of sectoral components as parts of a functional whole with explicit recognition that it is the users of resources, not the stocks of natural resources, which are the focus of management. For the purpose of integrated management, the boundaries of a coastal area should be defined according to the problems to be resolved. The definition thus implies a pragmatic approach to the defining of coastal areas in which the area under consideration might change over time as additional problems are addressed which require resolution over a wider geographical area.

ICAM approach
It is suggested that the responsibility for the preparation of an integrated coastal area management strategy – which provides the basis for sectoral plans – lies with a lead, co-ordinating organization or body. The preparation of plans and the implementation of this strategy should be the responsibility of the line ministries. Alternatively, government might establish a new organization responsible for the design and implementation of integrated coastal area management plans. Such plans should not stand-alone but should be an integral part of sectoral development, resource management and research activities. These plans should be flexible and adjusted periodically as more information becomes available or new issues are addressed. Thus, ICAM plans will follow an iterative approach that evolves through successive completion of dynamic management cycles.

4. Policy development and regulatory framework

Legal framework
ICAM may involve changing the way existing institutions operate, creating new institutions, changing user rights, and introducing mechanisms to regulate human activities. This implies repealing or amending existing legislation and enacting new legislation. Legislation can also be used to establish mechanisms for resolving disputes. An initial assessment of existing regulatory frameworks usually evaluates the extent to which existing laws, property and use rights, and institutional arrangements will promote or hinder the ICAM programme and identify required modifications. It is important to avoid adding further layers of bureaucracy and legal complexity.

Legal principles

While it is inappropriate to transplant a law from one system to another, principles used in one system can often be usefully adapted and applied in other systems. A number of principles could be incorporated in national laws in order to promote ICAM: the precautionary principle, the principle of preventive action, the polluter pays principle, responsibility not to cause transboundary environmental damage, rational and equitable use of natural resources, and public involvement.

Legal mechanisms

Identifying appropriate, practical legal mechanisms to give effect to the concepts and principles of sustainable development that underlie ICAM remains one of the major challenges facing legislative drafters. Legal instruments include: guiding the exercise of administrative discretion (to allow legally imprecise principles to be formally considered); changing rights to own and use coastal resources (e.g. to reassert public ownership, to initiate expropriation or acquisition, to recognise customary rights, devolve certain powers to traditional authorities, impose restrictions on private ownership rights); establishing protected areas; establishing zones and coastal setback lines; and requiring environmental impact assessment.

Alternative dispute resolution

Conflict resolution is one of the central concerns of any legal system and courts may have an important part to play in resolving disputes in coastal areas. Regulating competing interests over natural resources has often proved to be ineffective because of the need to balance interests within a wide range of flexible criteria. Alternative dispute resolution technique aim at building consensus by engaging the disputants actively in seeking a result acceptable to all the parties involved. The main techniques are direct negotiation, conciliation, facilitation, mediation, arbitration, and various combinations of techniques such as negotiated rule making. The choice of the technique depend on the parties concerned, the interests at stake, the resources involved, and cultural values and principles. Thus, there are highly contextual and their success depends on a number of requirements: voluntaries, opportunity of mutual gain, participation of interested parties, identification of interests, development of options, and capability of parties to enter into and carry out agreement.

Institutional framework

Effective management intervention is dependent on the existence of appropriate institutions and organizations. Where existing arrangements for management planning and implementation are found inadequate, changes may be gradually introduced. For practical purposes, management activities will initially have to be adapted to existing institutions, and adjustments phased over the longer term. Whether an entirely new integrated institutional structure is created or whether multi-sectoral integration is integration is achieved through collaboration of various agencies, the success of ICAM will revolve around an effective co-ordinating mechanism.

Institutional coordination

Several potential weaknesses in institutional arrangements for ICAM will have to be overcome by the co-ordinating mechanism. Thus, the selection of the most appropriate institution should consider selection criteria such as: mandate compatibility with the proposed functions; capacity to lever funding from concerned ministries and other sources; experience in multi-sectoral planning; ability to survive changes in government; performance in negotiating with line ministries; adaptability to new procedures; willingness to involve local communities etc. Requirements for effective coordination include: agreement on goals at central, area, and sectors level; agreement on respective roles, jurisdictional boundaries, provision of resources and responsibilities at different levels of governance; provision for effective negotiation between different levels.

Institutional capacity

Institutions contributing to ICAM should have the collective capacity to allocate resources according to the goals and strategic approach adopted. The engine to drive the process includes well-trained and experienced staff. The capacity to manage the system can be developed as part of the strategy. It is important that the system as a whole is able to deliver services such as: equitable and efficient decision-making process; use of best knowledge about how the relevant ecosystems function; participation of all those affected by management decisions in the decision-making process; capacity to resolve differences of interest; ability to employ economic policy and effective regulatory instruments; public investment for the protection of coastal ecosystems.

Proactive planning

The ICAM process evolves through successive completion of cycles. Each cycle addresses management issues, formulates and implements strategies and plans, and monitors and evaluates performance. The first cycle usually begins with the most urgent issues and has a limited geographical and institutional coverage. Through successive cycles, the scope and scale of the strategy and plan are increased to incorporate new and more complex problems and stakeholders. Performance review (including monitoring and evaluation) is an integral element throughout the process. Performance review not only suggests regular revisions and adjustments during the implementation phase, but also represents the motor that moves ICAM plans into successive cycles. Thus, the ICAM process is long-term, continuous and iterative. As achievements are consolidated and confidence is gained, there will be an evolution from small ICAM (demonstration) project to eventually, an expanded application to a fully-fledged, effective, national coastal programme. The end products of the ICAM policy and planning process are formulating and implementing a negotiated and agreed strategy. There is no single way to organise ICAM strategies and plans. Whether a given country chooses to start with a local demonstration project, co-ordinate “expanded” sectoral plans (that contain an ICAM part), or create an entirely new integrated plan, it is important that the process leading to the formulation of the coastal strategy involves all stakeholders so that any implementation route follows agreed goals and objectives.

Policy measures

An ICAM strategy describes the means by which the goals and objectives will be met. It will consider the rationale for the selection of instruments that will implement policies. Policy instruments may work either directly or indirectly, and vary in terms of flexibility, orientation (control or litigation based), and degree of government involvement. Policy instruments: direct government investment (e.g. infrastructures, research, training); institutional and organizational arrangements (e.g. legislation related to the responsibilities and powers of the various institutions involved); command and control instruments (regulatory instruments relying on legal enforcement to obtain satisfactory results); economic and market-based instruments (resource users respond to financial incentives and disincentives); and societal instruments (e.g. promotion of civil society organizations, new channels for public involvement).

5. Managerial structures and community participation

Involvement of resource users and communities. Successful involvement of resource users requires: allocation of property rights to a group of users who, in turn, have an obligation to manage them sustainable; that resource users be part of an institution that is able to exercise management authority; provision of training and technical advice by relevant line ministry to users and support to enforcing management decisions; involvement of all resource users in the management of a clearly defined area. Local NGOs can be valuable partners for keeping management focused on local issues and providing useful lines of transmission from the local community to the authorities and vice versa.

Institutional roles

While devolved management is effective, the burden on government continues to be high.

Local managers require enforcement to stop encroachment, as well as considerable training and technical support. Thus, the recognition of the role of line ministries by resource users is important, especially as certain vital functions can be fulfilled only by the public sector. There is need to redefine the effective role of the State at both central and local levels and its productive interaction with civil society and private-sector institutions. Consistent efforts are needed to create stable and complimentary roles for the State, private sector and civil society. More specifically, legislative measures should be developed which relate to the long-term sustainability of the natural environment, decentralised structures should be established on the basis of effective participation at the local level, economic incentives for producers should be installed, and investments deployed for interventions which cannot be afforded by local institutions.

Institutional analysis

Analysis for ICAM extends cross-sectorally to focus on: problems or causes of concern, with particular emphasis on interactions across sectors, including estimates of societal costs; extent to which policies and institutional structures adequately address problems; statement of possible actions that determine how these problems can be resolved or mitigated. Evaluation of problems is related to the allocation of coastal resources; natural resources valuation can assist decision-makers to evaluate trade-off between development options that have environmental and social effects. Identification of each problem with the appropriate parts of the institutional infrastructures and cross-referencing of problems with the relevant institutional elements provides the basis for an analysis of the effectiveness of the institutional response.

Multi-level collaboration

Efforts to develop sustainably at the local level can be overwhelmed by broader socio-economic processes, which are usually market, and policy-driven. Global environmental concerns and international exchange of goods and services are governed by conventions and agreements, which influence national and local decision-making, regulations and partnerships. Local level concerns and needs ought to be voiced in macro-policy arena in order to truly mirror environmental, cultural and economic diversity and potentials. Building bridges that link hierarchical levels (i.e. communities, watersheds, national policies, international agreements) necessarily bring along competing interests and increasingly, skills are required for conflict resolution and co-management that allow institutions, at all levels, to take collaborative actions.

Conflict resolution

Because coastal problems involve a range of actors, multidimensional conflicts and complex interactions between many parties, an institutional capacity to resolve conflicts and institutional supervision will be required to manage the relationships of interested parties and to identify suitable options and agree on objectives and means to attain them. It is useful to identify the various dimensions of a conflict: actors that have an interest in the resolution of conflicts, resources at stake, the stake that each sector has in the resource, and the stage that the conflict has reached. Administrative procedures and dispute resolution offices might also be established to anticipate and resolve conflicts arising within and between institutions. Consideration should also be given to establishing funding mechanisms to cover costs of mediators, run negotiations, and providing training and education for third parties to mediate, facilitate or arbitrate disputes.

6. Information, research and training

Institutional development

Line agencies rarely have expertise in participatory methods and integrated natural resource management. The co-ordinating body will not necessarily be equipped with staff capable of managing disputes. Forming a team that is proficient in strategy and methods requires in-service training. During implementation, local staff should be exposed to a variety of learning experiences, including brief courses, internal workshops and seminars, experience exchange events and study tours. In addition, the process of participatory monitoring and evaluation has a continuing educational and formative orientation by identifying lessons learned and further learning needs. A mix of hiring *ad hoc* project staff and mobilising professionals from relevant line agencies and institutions would allow higher efficiency and wider dissemination of the approach among local institutions.

Data collection and research

Collection of the baseline information seeks to facilitate understanding of the relationships between key factors in order to identify and prioritise management issues. Information required includes biophysical characteristics of the area, social issues and related economic linkages, and the governance framework, embracing laws and institutional characteristics. Sector studies prepared by line ministries are often available and contain the most detailed and accurate information at the time of their preparation. While data collection and research can be implemented by existing research, a redirection of research according to identified needs may be needed. Additional research capacity may require a shift in budgetary allocation to research.

Sustainability indicators

Indicators are used to monitor and evaluate what is changing, the process by which change is occurring and the sustainability of beneficial changes. Not everything that happens can or should be monitored. Data collection and monitoring should be pragmatic and based on selection criteria such as timeliness, relevance and cost-effectiveness. Clear and precise identification of criteria used to describe a specific problem should lead to the identification of the specific indicators of change. Scientific evidence and a precautionary approach, and considerations of local cultural preferences should play a central role in the process of achieving agreement on indicators.

EGYPTIAN RED SEA EXPERIMENT

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1. INTRODUCTION

Egypt has all the ingredients of a prosperous and sustainable society: ample water, abundant and rich coastal resources including magnificent coral reefs, archaeological sites and an equable climate. But its greatest asset is its people. The reaction between Egypt's people (resident and indigenous), international visitors (tourists) and coastal systems can be integrated to form a long-lasting symbiosis.

The Egyptian coasts of both seas, however, are under severe and increasing pressure from the rapid, unsustainable development. Such pressure spawned the Egyptian desire to manage coastal areas in an integrated manner, so that coming generations can also utilise and develop, in a sustainable way, the ecological and the economically valuable coastal resources.

The World Coast Conference (WCC, 1994), issued a statement defining the framework of Integrated Coastal Zone Management (ICZM) as: "it involves the comprehensive assessment, setting objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses; it is a continuous and evolutionary process for achieving sustainable development."

The Egyptian Environmental Affairs Agency (EEAA) was given the responsibility of initiating and co-ordinating national ICZM activities. A National Committee for Integrated Coastal Zone Management (NCICZM) was initiated, and the Secretariat of this Committee was established under the Environment Management Sector of the EEAA. One of the major tasks of the National Committee for ICZM is to develop a programme for the development of a national ICZM Plan.

One of the major events supervised by this committee was the Technical Workshop, which was held at Hurghada, 3-7 May 1995. During this workshop international and national experiences were drawn on to provide a National document known as the "Framework Programme for the Development of National ICZM Plan for Egypt". This document summarised the main problems encountered on the Egyptian coasts and drafted the outlines for the national ICZM plan for dealing with these problems. In addition it provides some major tasks or actions needed related to the different issues in the coastal areas.

2. THE EGYPTIAN COASTAL ZONE – CHARACTERISTICS AND THREATS

2.1. Characteristics of the Egyptian coastal zone

The coastline along the Mediterranean and the Red Sea in Egypt comprises more than 3,000 km. Qualitative satellite information supported by ground observations indicate that nowadays the physical and biological coastal beauty and its related ecological and economic values are disappearing. The main factors affecting the Egyptian coast are accelerated development of economic activities and urbanisation.

The Egyptian population was subject to an annual growth rate of 2.4% during the period 1975-1990. It was projected that the population in Egyptian coastal urban agglomerates would almost double in the period 1980-2000, corresponding to an annual growth percentage of 3.5% (WR 1992/1993).

The population in the Egyptian coastal urban aggregations amounts to about 8 million, living no more than 60 km inland (WR 1992/1993). It is estimated that there will be more than 15 million

Egyptians by the year 2000 (WR 1994/1995).

The coastal zone houses more than 40% of the Egyptian industry and is subject to extensive urban and tourism development. Other important developments relate to irrigation and land reclamation, infrastructure and harbours. Hence, from an economic point of view, the coastal zone of Egypt is a very important area, containing substantial capital investments.

In addition, the future impacts of global climate change will strongly exacerbate the threats to the Egyptian coastal resources. As shown in recent studies, the climate change increased flooding frequencies along the Egyptian coast. Other important effects of climate change are increased coastal erosion and salt water intrusion, affecting freshwater aquifers and agriculture productivity in the Nile Delta region (Delft Hydraulics/ Resource Analysis, 1992).

2.2. Threats to the coastal zone in Egypt

The Hurghada workshop (1995) identified many coastal problems and threats. These problems could be grouped under four major issues.

2.2.1. Shoreline erosion and flooding

This issue includes all problems related to coastal protection by natural and man-made protection systems. A tremendous example of the shoreline erosion problem is the Egyptian Mediterranean coast. The cessation of the Nile flood due to the completion of the Aswan High Dam has reduced sediments into the coastal water of the Mediterranean by 160,000,000 tons each year. As a result the Mediterranean coast of Egypt becoming one of the most seriously eroded shorelines in the world. Extensive studies of coastal erosion and deposition in the delta area have been carried out using ground surveys and remote sensing by Frihy and co-workers at the Institute of Coastal Research, Alexandria (e.g. Frihy et al., 1991; Frihy & Dewidar, 1993; Frihy & Komar, 1993; Lotfy & Frihy, 1993; Frihy & Lotfy, 1994; Frihy et al., 1994). The following brief account is based only on the summaries of these reports: Severe erosion is found at the promontories of Rosetta (53-102m/yr), Burullus area (5.5m/yr) and Damietta area (10.4m/yr).

In the Red Sea area, the increase in flood frequencies may threaten and deteriorate the marine habitats, especially the coral reef, due to the resulting high sedimentation, as well as human activities and utilities in the flood-prone areas. The estimated flooding rate in one of the Red Sea valleys (Wadi El-Gemal) ranges between 29 and 45 million m^3/year.

2.2.2. Irrational land use

In view of the scarcity of suitable land resources and high development pressures related to rapid population growth, there is a high risk of uncontrolled and unwise land-use development. Some problems arising from this are: development in unsuitable areas (saline, polluted) or unsafe areas (land losses, flood risk); deterioration and overexploitation of water and land resources and natural habitats; land-use conflicts between uses/users, unbalanced and non-optimal development of scarce land resources. In view of their multiple use options, coastal areas are specifically vulnerable to these developments.

Many coastal areas in Egypt are exposed to great damage due to irrational use. A prime example is the coastal area of Hurghada (Red Sea). During the the last decade and due to the lack of an ICZM plan, 12,000,000 m^3 of dust were used in land filling of the shallow areas of the Hurghada coast (40 km) to construct resorts and hotels mainly on coral reef as well as on sea grass beds and mangrove forests. Another example is the Nile Delta lakes connected to the Mediterranean Sea (i.e. Manzallah, Edko, Burullus and Marriot lakes). According to the data from the General Authority for Fisheries Research Development, the estimated area of these lakes was 960,000 acres in 1889, reduced to 259,000 acres by the year 1992. Most of this land is used for agriculture.

2.2.3. Water pollution

The incidence of water pollution is a common threat to aquatic systems and especially to coastal water systems which often serve as a sink to land-based sources of pollution. The Egyptian coast is exposed to different types of pollution. Large scale sources of pollution related to e.g. agriculture (fertilizer, pesticides) and specific wastewater flows from point sources. In addition, the coastal water problems are aggravated by coastal and marine related pollution sources such as wastewater flows from domestic sources, industry and tourism, and spills from offshore activities and marine transport.

Wastewater flow from domestic, industrial and agricultural sources is causing a serious problem along the Egyptian Mediterranean coast where the discharge then leads directly to the sea or via the northern lakes (with an average rate of 16 billion m^3/year, Anonymous, 1997). The Egyptian Red Sea is exposed mainly to oil pollution. Oil production of the Gulf of Suez is 30 million tons/year (about 80% of the Egyptian total production). The oil discharge from different sources into the Egyptian Red Sea averaged 3,918 tons/year, from a total of 6,851 tons/year in the whole Red Sea (representing 1.5% of world oil pollution, see Awad, 1989). In other words, 14 kg of oil discharge yearly per km^2 in the Red Sea compared with an international average of 9kg/km^2, i.e. one and half times the international average (Awad, 1989, 1995).

2.2.4. Deterioration of natural resources and habitats

In addition to the above types of issues and problems, a number of other activities pose a direct threat to natural resources, such as fish stocks, wildlife (turtles, birds), coral reefs, mangroves etc. Examples of such threats are overfishing, diving, anchoring boats, mining/excavation, land reclamation and cutting of mangroves. The impacts on the Egyptian Red sea and Mediterranean coast are clear examples of this issue.

3. The Egyptian ICZM strategy

3.1. Objectives

The main objectives of the Egyptian coastal zone management plan had been classified into three major levels:

3.1.1. Long-term objectives (5-10 years)

The long-term objective is to have in place a functioning national coastal zone management strategy (or plan) that provides clear guidance for actions and activities in the coastal zones of Egypt. This plan should, by about 5 to 10 years from 1996, be a binding document, ensuring the sustainable use of coastal resources based on integrated decision-making involving the various line ministries, agencies and the various other stakeholders.

3.1.2. Medium-term objectives

These objectives are to develop national strategies or plans, focusing on the key issues. The issues should be of national importance with actions to be carried out within the long-term objective period under the supervision of the ICZM committee. The following plans should be developed: (see chart on following page).

3.1.3. Short-term objectives

The short-term objectives should be developed within a shorter period after the ICZM plan starting date. It should include a number of case studies and pilot projects focusing on specific problems identified with the most vulnerable coastal areas. The main target of these objectives is to develop a set of urgent measures that could be taken in order to bring to a halt irreversible environmental degradation.

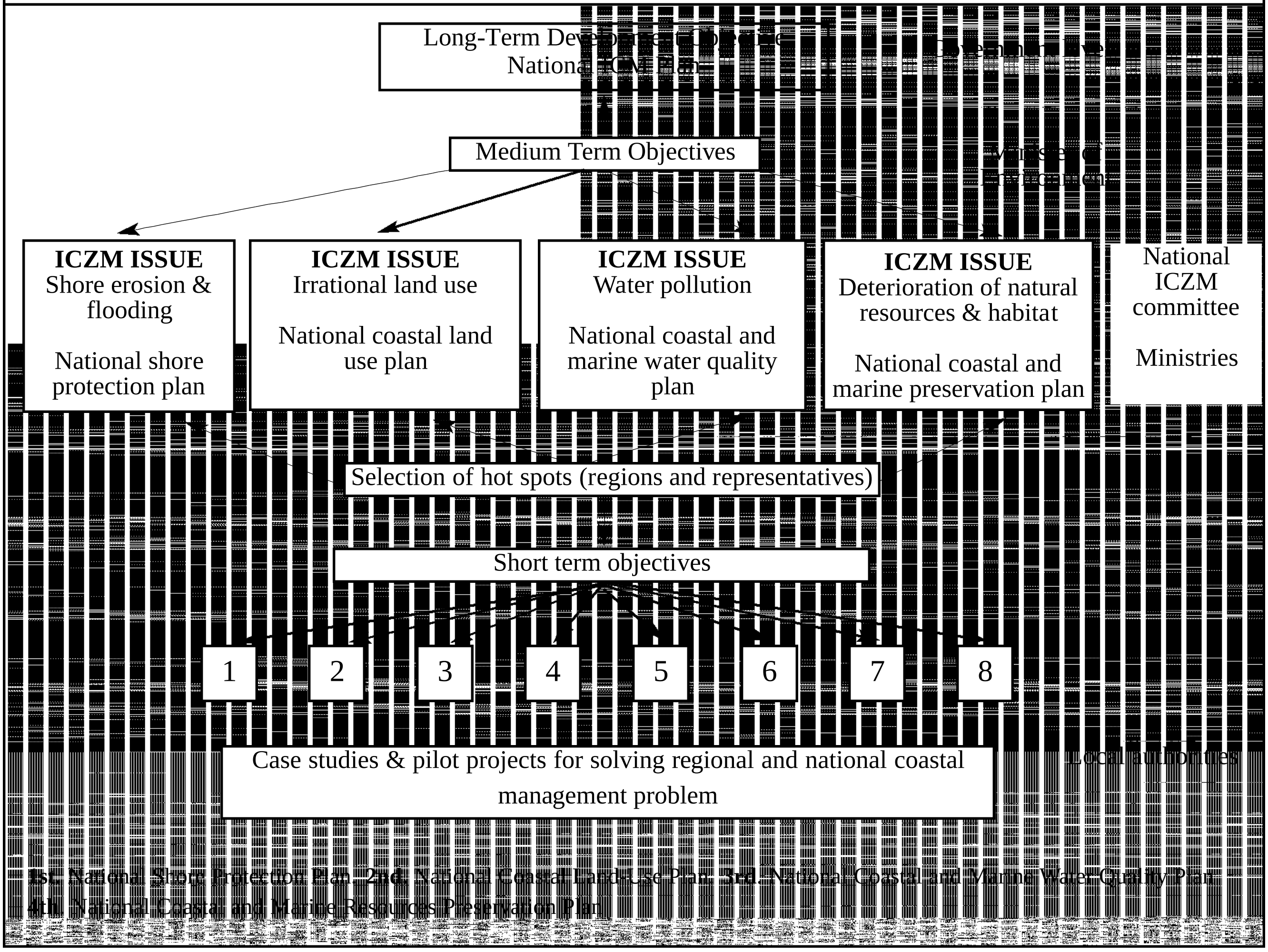
3.2. The Egyptian institutional setting

3.2.1. The Egyptian Environmental Affairs Agency

Although responsibilities for environmental protection in Egypt remain dispersed among many ministers and government agencies, Environment Law No. 4, 1994 established the mandate of the Egyptian Environmental Affairs Agency (EEAA) as the central institution concerned with environmental protection and coordination in Egypt. Since 1997 the EEAA has operated under the newly formed Ministry of Environment.

EEAA's responsibilities, including administering to the provisions of Law No. 4, cover the setting of general environmental preservation policies and programmes; adjusting and drafting environmental legislation; and preparation of environmental studies, standards, specifications and conditions for the control of environmental pollution. The agency is also responsible for the preparation of

Fig. 1. Objectives of the Egyptian ICZM plan



the National Plan for Environmental Protection, an emergency Environmental Plan, and environmental awareness and in-house training programmes. EEAA also administers the natural parks system, approves project funding and participates in the preparation of the Coastal Zone Management Plan.

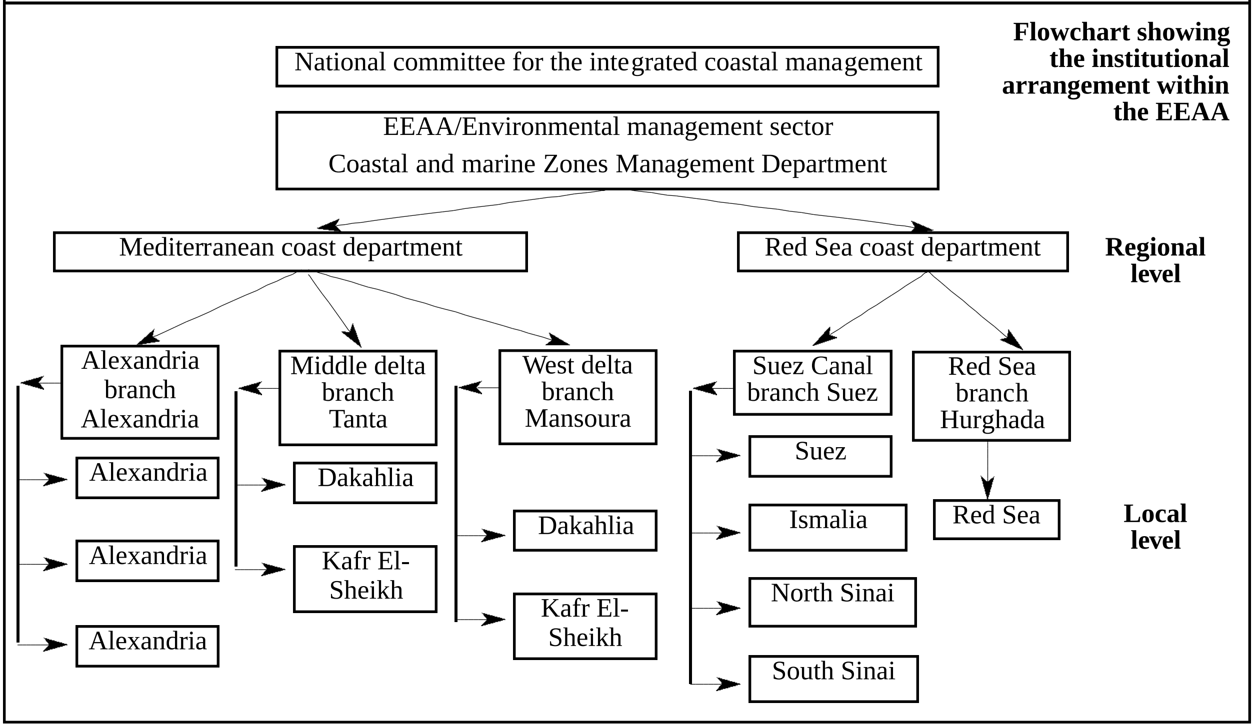
3.2.2. The National Committee for ICZM

After issuing Law No. 4 (1994), the EEAA initiated the action to establish an NCICZM. This committee includes 16 members representing: EEAA (2 members); Ministry of Public Works and Water Resources (1 member); Ministry of Housing (2 members); Ministry of Agriculture (1 member); Ministry of Maritime Transportation (1 member); Ministry of Tourism (1 member); Ministry of Planning (1 member); Ministry of Scientific Research and Technology (1 member); Ministry of Defence (1 member); Ministry of Local Government (1 member); Ministry of Electricity and Energy (1 member); National Water Research Centre representative (1 member); NGO representatives (2 members).

The main objectives of the National Committee for ICZM are as follows:

1) Co-ordinate all coastal activities among the competent authorities towards integrated coastal zone management through the drafting, setting and approval of general guidelines for all activities, including environmental impact assessment studies.
2) Make sure that all land-use plans and development activities in the coastal areas take into account contingency arrangements.
3) Harmonise between the proposed development activity and the carrying capacity of

Fig. 2. ICZM institutional arrangement



the ecosystem towards a sustainable use of available resources.

4) Ensure the active participation in drafting and preparing the ICZM Plan.
5) Ensure efficient implementation of the commitments of the Egyptian Government to the regional and international conventions concerning the protection of marine environment and the coastal areas.
6) Approve programmes and plans aiming at restoring and rehabilitation of coastal ecosystems under stresses.
7) Co-ordinate and specify mandates for different authorities in the coastal area.
8) Approve national arrangements related to the protection of the environment in the coastal area and to contingency plans.
9) Study and evaluate all major projects to be executed in the coastal zone, especially projects which may lead to conflict of interest among ministries or other governmental bodies while reaching a final decision.
10) Look at any activities or projects relevant to ICZM.

Clearly, institutional arrangements are required at different administrative levels (national, regional, local) for taking responsibility for ICZM. However, the national and regional levels were established.

4. The Red Sea coastal zone

4.1. Red Sea resource base and values

4.1.1. Key resources

Coral reefs, fisheries, petroleum resources and other coastal resources sustain tourism, recreation and other forms of development along the Red Sea coast. Human resources, in terms of the local population and tourists, is also one of Egypt's major assets, although unmanaged human activities can lead to unsustainable forms of development. The resources are grouped into human resources, land and water resources, living resources, non-living resources and cultural and natural heritage.

4.1.2. Summary of the main coastal uses

Direct and indirect human use of the Red Sea's coastal zone has been a feature of Egyptian society since earliest history. Coastal activities and uses have risen dramatically in recent decades. This partly reflects the increase in Egypt's population from about 26 million in 1960 to just over 60 million by 1996 (EEAA, 1997. Egypt: National Strategy and Action Plan for Biodiversity Conservation). It also reflects the increasing role of the Red Sea's coastal systems in fulfilling national socio-economic objectives. It is likely that human demands on the coastal zone will become even greater in years to come. Therefore, information of coastal uses (and resource) information is a critical input for assessing resource-use opportunities and conflicts, in terms of their identification and assessment.

4.1.2.1. Urban and residential development

The Red Sea coastal zone is becoming an increasingly attractive location for urban development. Urban buildings clearly occupy more space than smaller settlements, and potentially have a greater impact on the environment. These arise from both construction of buildings and subsequent residential activities of occupants. Article 59 of Law 4 prohibits the construction of any establishment within 200 m of the shorelines of Egypt except with the approval of the Egyptian Shore Protection Authority in coordination with EEAA, following submission by the developer of a detailed EIA of potential impacts to the coastal area and shoreline. The main Red Sea towns are Hurghada,Safaga and Quisyer. Hurghada, the capital of the Red Sea Governorate, has been growing rapidly over the last 15 years. The population Hurghada may grow from 170,000 (1997) to an estimated 290,000 by 2022.

4.1.2.2. Industrial development

Industrial usage of the Red Sea coast includes a range of human activities. These include exploitation of various non-living resources. Oil production is currently about 900,000 barrels per day. Most production occurs in and around the Gulf of Suez, and exploited oil fields extend only as far as the vicinity of Hurghada. There are three license blocks for oil exploration in the Egyptian Red Sea, and these probably contain oil and gas. Extensive mineral reserves are located inland of the Egyptian Red Sea coast. These include: (i) deposits of phosphates; (ii) a considerable variety of metal ores (e.g. zinc, lead, iron, tin); (iii) ornamental stone and semi-precious jewels; and (iv) sand and gravel for use in the construction industry. Other industrial coastal uses include boatyards,mainly in Hurghada and also Safaga, to satisfy the need for boats used by tourists. There is also some small manufacturing and related services (i.e. light industry), particularly in Hurghada.

4.1.2.3. Coastal facilities and utilities

A wide range of facilities and utilities support coastal development in the Red Sea. Major infrastructures include ports (at the major cities) such as Hurghada (fishing and pleasure port), Safaga (passenger and commercial), and a number of minor ones such as Ras Gharib, Hurghada and El-Quisyer. Several small marsas are located along the coast suitable for small and medium size boats (e.g. Marsa Breaka, Marsa Abo El-Darag and Marsa Alam), in addition to the military base at Barnes-Ras Benas. Other sizeable infrastructures relate to transportation (e.g. roads, rail and airports). Small or medium-sized buildings are used for facilities and utilities such as education, health/social services, police and fire departments, as well as recreation, culture and worship. Other services include water and power supply, as well as waste disposal. Solid waste collection and disposal facilities exist in Hurghada, Safaga and Quisyer but are generally inadequate. Much waste is sent to unregulated dumpsites in the desert, but in Hurghada and Safaga the dumpsites are close to the shore.

Environmental consequences of coastal facilities and utilities are variable, but arise from the effects of construction, their presence once in place and their operation.

4.1.2.4. Tourism

Tourism use encompasses construction, particularly of hotels, second homes and dive shops. It also involves operation of these infrastructures as well as other human activities (e.g. day-boats, safari boats, sport fishing, windsurfing, water/jet skiing and golf).

International tourism in the Red Sea coast began in the late 1970s among SCUBA divers, due to the quality of coral reefs and underwater life. These features make the coast one of the premier scuba diving destinations in the world. Coastal areas, the more traditional antiquity destinations in the Nile Valley and other attractions are likely to become linked more strongly through trip circuits in the future. This will enhance Egypt's appeal to both international tourists and the Middle Eastern Market.

Despite fluctuations in tourist arrivals, it seems likely that demand is unlikely to be a major constraint, given that ecotourism is currently a 12 million US dollar industry globally. However, this assumes that the carrying capacity of the Red Sea's reefs and other coastal systems is not undermined.

The Ministry of Tourism (MOT) had a special interest in developing the Red Sea coast and Sinai and declared both as high priority areas for coastal tourism development. At the same time the Red Sea Governorate (RSG) adopted a master plan for Hurghada which vastly extended the uses proposed for tourism, especially tourist villages along the coast. The whole areas along the Red Sea Coast targeted for tourism development by TDA and the Red Sea Governorate.

Hurghada is at present the diving hub of the Egyptian Red Sea coast. Unpublished reports indicate the following: i) an estimated 1,000 boats are operating, of which about 400-600 per day are used as day boats for diving; ii) there are over 200 safari boats and many new boats are under construction; iii) there are 80-100 diving operations, many of which are small operations; and iv) there 2 major ports and about 150 small marinas associated with hotels and tourist villages.

4.1.2.5. Agriculture

Agricultural use of the Red Sea coastal area is relatively minor, with only 7% of the workforce employed in the sector, compared with 34% in industry and 58% in the service industry.

4.1.2.6. Fishing and Aquaculture

The fisheries of the Red Sea provide a source of food, employment and revenue. The fisheries are based on a long-standing traditional (artisanal) fishery and more recent industrialised fisheries. Fishing grounds and fishery resource areas are probably similar, although the latter have not been fully assessed.

Fisheries production from the Egyptian Red Sea area currently represents less than 10% of the national marine catch. The narrow, reef-rich continental shelf of much of the coastline is suitable only for artisanal fishing with hook and line or inshore set nets. Only the shallow Foul Bay to the south, with a 70% sand and mud bottom, permits the use of trawls and purse seines. Landings mainly consist of the high value demersals such as groupers, emperors and snappers. This high proportion of demersal production results from numerous reef, mangal and seagrass nursery areas. The industry employs over 17,000 persons in the project area, of which over half are artisanal fishermen.

While aquaculture is virtually non-existent on the Red Sea coast, 41 potentially suitable coastal sites were identified in 1980 (see GEF Baseline Report). The location of these and other potential aquaculture sites will need to be mapped as potentially sensitive areas. As part of the coastal planning system the preserving at least some of these locations are seen as important.

4.1.2.7. Hunting

This includes subsistence hunting for example the use by Bedouin of falcons and saluki dogs to catch animals such as rabbits and houbara busards. A greater concern has been hunting parties from other countries coming to Egypt, which targeted larger game, in particular gazelle. These activities have recently become banned and illegal.

4.1.2.8. Curio trade

The collection and sale of marine curios (souvenir species) to tourists is significant in Hurghada and Safaga. Important species include fishes such as porcupine fish (*Diodon hystrix*), pufferfish (*Arothron hispidus*) and invertebrates, particularly molluscs and corals. This trade was first noted in 1981. Although the range of species involved and the amounts sold appear small, the methods used to extract some of the target species can be damaging to the reef structure. Corals and shells of hawksbill turtles, both collected and sold locally, are among the species listed in CITES (Convention on International Trade in Endangered Species). This lists species which cannot be exported and imported without a license and is among the global conventions to which Egypt is byparty. However, the potential impact of curio trade on the coral reef ecosystem is urgently needed to determine whether this trade is justified.

4.1.2.9. Conservation

Ecosystem conservation in the Egyptian Red Sea is undertaken through protected areas and other management measures. Archaeological and cultural attractions that appeal to tourists include famous mosques (e.g. Abu El-Hassan Al-Shazly) and monasteries on the southern Red Sea coast. Conservation of the coastal landscape and other geological features can also be an important use and criterion used for selecting protected areas.

While conservation is not always compatible with other coastal uses (e.g. coastal infilling), there are many instances when they are complementary (e.g. preservation of reef quality & use of reefs by divers). Hence, conservation can be a useful environment-development measure, for optimising the income-generation capacity of the natural environment.

4.1.2.10. Military

The military has a presence along several stretches of the Egyptian Red Sea coast. In some instances, military presence can provide *de facto* protection, augmenting any conservation gained from its remoteness and existing protected area status. In other locations, a military presence may offer similar environmental protection,providing that military activities are less harmful than human activities and uses, which might otherwise occur in the area.

4.2. Users conflict analysis

How ICZM programmes are developed and implemented depends very much on specific national perspectives and local conditions, making each programme unique. However the experience gained from past failures and successes of coastal countries can be of great use to the current practitioners. Managing complex systems, such as coastal systems, requires an integrated approach capable of bringing together the multiple, interwoven, overlapping interests related to the coastal system in a co-ordinated and rational manner, directed towards sustainable use and development. This implies managing coastal resources in such a manner that an optimal social and economic benefit for present and future generations is obtained without reducing the natural resource base itself. Fig. 1 (p.100) illustrates that users conflict is very complicated in the coastal area of the Egyptian coast of the Red Sea. This may need more information on the extent of impact and effect of management action plan on sustainability.

4.3. The Egyptian Red Sea coastal and marine resources management project (GEF project)

This project is an innovative tourism and environmental project funded by the Global Environmental Facility (GEF) through the World Bank.

The overall goal is to ensure environmentally sound sustainable tourism and other coastal marine development for the Egyptian Red Sea. The project area was extended from 40 km north of Hurghada to the southernmost point of the Egyptian boundary (approximately 700 km). The area was divided into seven sectors more or less according to habitat changes. Within each sector many sites were selected for environmental and planning data gathering. In total 73 and 97 sites were selected for the two types of data, respectively. Data of the project was based primarily on field surveys, supported by desktop studies and other information collected from various sources.

The flowchart in Fig. 2 (p.101) illustrates the institution, objectives, components, approach and outcomes of the GEF project.

However, the pros and cons of the GEF project can be summarised as follows:

4.4. Aspects on the key steps on coastal management, planning and decision-making (Red Sea Experiment).

Although the Egyptian agencies in charge have taken many steps to improve the action with regard to this issue, some problems still require more effort to be solved.

It is very important to conclude that although the implementation step preceeded the other steps, I think it was a very necessary and urgent

PROS	CONS
1- Integrates three of the most important implementing agencies (i.e. EEAA, TDA & RSG). 2- Stimulates cooperation between technical staff (scientists) and stakeholders. 3- Staff in total was Egyptian, thus helping to raise the level of technical capabilities. 4- Establishes an intensive database and GIS on the Egyptian coastal area of the Red Sea for the first time. 5- Produces management plans for: reef recreation, protected areas and pollution monitoring which should support the national ICZM plan. 6- Provides good facilities for field surveys and data analysis for the implementing agencies.	1- Timeframe was too short to fit in all objectives. 2- The project area was too large for the timeframe and the project objectives. 3- Some important agencies were not included, especially the General Authority for Fisheries Research Development (GAFRD). 4- The Egyptian islands of the Red Sea were excluded from the action plan of the project because the timeframe was too short. 5- Implementation of plans was not taken into consideration, also because the timeframe was too short.

step in the Egyptian experiment to meet the huge and unsustainable development in the coastal area of the Red Sea during the last decade.

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INTEGRATED COASTAL FISHERIES MANAGEMENT IN THE GAMBIA

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1. BACKGROUND

1.1. Introduction

Integrated sustainable development is the primary goal of the coastal and marine area management programme in The Gambia. The integrated approach to coastal fisheries development could be said to have started in The Gambia with the establishment of the Gunjur Community Fisheries Centre in 1983 under the artisanal fisheries development project funded by the European Development Fund. The Community Fisheries Centre (CFC) concept was used as the vehicle for propagation of integrated coastal fisheries development and management in The Gambia. This paper draws on The Gambia's experience in integrated coastal fisheries management over the past 15 years.

1.2. Geographical introduction

The Gambia, located at a latitude of approximately 13º N on the west coast of Africa, is about 480 kilometres in length and 50 kilometres wide at its widest westerly end facing the Atlantic ocean, and tapers towards the east to a width of about 30 kilometres. It has an 80 km long coastline and a continental shelf area of about 4,000 km^2, which is rich in marine fish resources. The estuarine areas have a dense mangrove forest (67,000 hectares, FAO/UNEP, 1996), found up to 200 km inland from the mouth of the River Gambia, which provides breeding and nursery grounds for commercial fish species, shrimps and other invaluable aquatic organisms. It has a total land area of about 11,295 km^2. About one fifth of the surface area is water, occupied by the River Gambia which runs 680 km from the Futa Jallon highlands in Guinea to the Atlantic Ocean dividing the country into the north and south banks. The Gambia has a Sudano-Sahelian climate characterised by a long dry season from November to May and a short rainy season from June to October.

1.3. Demographical and socio-economic information on the coastal area

According to the 1993 census results, The Gambia has a population of about 1,038,000 with an annua1 growth rate of 4.2%. With a density of 97 persons per km^2 The Gambia is ranked among the four most densely populated countries in Africa. The urban growth rate is estimated to be 8% annually and the main urban growth centre in the coastal area is the Kanifing Municipality with an estimated population of 228,214. At present, more than 48.7% of the Gambian population live on the strip of coastal land less than 9% of the total surface area of The Gambia and population growth rate in this area is much higher than in the rest of the country. According to the current rate of urbanisation, a larger proportion of the country's population will be living in the coastal area in the coming decades.

The majority of the people undertake farming, fishing and horticulture as the main occupations. As the agricultural sector is the major employer in this country, increasing population density has intensified the demand for land for agricultural use. However, the agricultural crisis of the 1970's and the concentration of educational facilities and industrial establishments in urban areas have accentuated the rural-urban migration.

1.4. Coastal marine fisheries

The marine fisheries are divided into industrial and artisanal sub-sectors, with the industrial sub-sector being characterised by large-scale investment in export oriented production. The artisanal sub-sector is characterised by low levels of investment and with operators from many dispersed, and often isolated, landing sites. The majority of industrial vessels are large, offshore and foreign-owned whereas the artisanal crafts are locally built wooden canoes.

The artisanal sub-sector provides about 90% of the locally consumed fish and provides direct employment for more than 20,000 people in harvesting, processing, marketing and other fisheries-related occupations. However, the majority of coastal marine fisher operators are not Gambian nationals and there is some degree of seasonal fluctuation in employment. Many of those involved in fish processing and marketing are women. Fish is an important source of cheap animal protein to the population and is be1ieved to have a potential for greater contribution to achieving the country's food security policy objectives. The average annual national consumption of fish is approximately 20kg/person, which represents about 14% of the total protein supply.

Total potential fish production from the marine fisheries is estimated at 88,000 tons annually, with pelagic and demersal fish resources constituting 78% and 21% respectively. Total annual fish production was around 38,000 tons in 1997, clearly indicating a surplus potential. However, there is a recognised need for tighter and more effective control of the threatened demersal resources.

2. Integrated coastal fisheries management in the Gambia

The activities and interventions of external projects and programmes in coastal fisheries development have contributed immensely to our efforts towards integrated coastal fisheries management and development.

2.1. Integrated development of artisanal fisheries programme (IDAF)

The IDAF Programme emphasises the concept of community fisher centres as means of encouraging community participation and mobilisation of community resources for sustainable development.

IDAF interventions in the fisheries sector of The Gambia were in technology transfer, training of fisheries staff and fisherfolks, baseline studies of socio-economic and related factors and in management and other development activities. Both the manpower capacity in the fisheries administration and the organizational and empowerment needs of fishing communities have been affected positively.

In a bid to reduce the amount of fuelwood used in fish smoking, an IDAF consultant introduced the choker fish-smoking technology to The Gambia for the first time in 1985. Popular use of the modified improved chorkor oven has resulted in about 40% fuelwood savings which is significant considering the huge amounts of coastal forest resources used in fish smoking and other domestic activities.

Then in 1992, IDAF assisted the Fisheries Department in carrying out a comparative study on the fuelwood efficiencies of the two main types of the modified chorkor oven: one constructed of burnt mud bricks and the other made of cement bricks. The study found no significant differences in the performances of the two ovens. It however concluded that the mud oven was cheaper to construct considering the lower material and maintenance costs.

In 1991, the IDAF Programme funded a socio-economic survey of the fishing communities in the EEC-funded coastal Artisanal Fisheries Development Projects along the Atlantic coast of The Gambia to assess the impact of Projects implemented between 1983-1991. Fisheries Department field staff received preliminary training in survey preparation and methodology.

In 1992, IDAF collaborated with the Fisheries Department to conduct a study on the interrelationships between population growth and development in coastal fishing communities (CFCs) in The Gambia. Fisheries workers received theoretical and practical training in the contents and methods of study and on Rapid Appraisal Techniques. The study proposed recommendations for development interventions to address key issues relating to exploitation of fisheries resources and population growth for sustainable development.

In 1994, the IDAF Programme assisted the Fisheries Department in organising a five-day workshop on the autonomous (or self-reliant management) of coastal community fisher centres. The beneficiaries were members of the seven CFC management committees. The workshop allowed participants to review their own management strategies and activities, carry out an inventory of their main problems; cluster and prioritise the problems and suggest and identify possible solutions to these problems.

Both the management and sustainability of some of the CFCs have improved significantly since then. An association of seven coastal CFCs has been established on the initiative of the workshop participants. This association holds regular consultation meetings to discuss and propose solutions to their common problems.

Following this workshop on CFC management, the IDAF Programme also sent a consultant to The Gambia in October l994, in connection with the self-reliant management of coastal CFCs. The consultant assessed the differences in management between major CFCs and conducted a follow-up training workshop on autonomous management. These activities also impacted well on management of the CFCs by creating awareness and the grounds for consolidated action by both the management committees and fisheries Department facilitators. The recent (June 1998) establishment of fisheries NGO, called Gambia Fisheries Development Agency could be said to have been a result of these efforts.

In 1993/94, the IDAF Programme prepared – in collaboration with the Department of Fisheries – and tested the methodology for development projects for the study of the processes, elements and mechanisms of people's participation and sustainability in fisheries. The study was very useful in creating awareness and empowerment of both resource users and policy makers.

In 1995, IDAF provided assistance to initiate a cost and earnings study on artisanal fishing operations, a useful exercise for the continuous monitoring of fishing inputs and returns on investment.

In 1995, IDAF assisted officials of the Fisheries Department in the Gambia to undertake a study on community participation in management of fish resources.

In May 1996, IDAF conducted a SWOT analysis of the management and sustainable development of two coastal community fishing centres. The analysis was very useful due to its participatory approach and the use of rapid appraisal techniques that create awareness on the state of the resources and other vital elements in the sustainability of development actions and initiatives.

In l995 and 1998, IDAF facilitated the training of fisheries staff in the use of participatory rapid appraisal techniques to enable fast diagnosis of problems and needs and to facilitate monitoring and evaluation activities in the fisheries sector.

In February 1996, an IDAF review team assessed the achievements and bottlenecks of the fisheries development processes, with particular emphasis on the artisanal fisheries sector. The review concluded that the participatory approach and the principles of integrated development, adopted by the Fisheries Department, have generated enormous confidence between fisherfolks communities and the fisheries administration.

In May l996, IDAF facilitated the organization of a workshop on awareness and gender issues in the Artisanal fisheries for Fisheries and Extension officers by the Management Development lnstitute (MDI) in The Gambia. This workshop deliberated on gender issues in the artisanal fisheries sector and contributed to creating more awareness on gender as it affected the fisheries and other sectors of coastal communities.

Between 1993 and 1996, IDAF employed the services of Gambians within the TCDC framework to undertake studies and training activities in projects in member countries of the IDAF programme.

Following the request of the Fisheries Department and the National Environment Agency, IDAF recruited and sent an environmental consultant to The Gambia to conduct a PRA exercise on Environmental Waste and Hazard Impact Assessment for Communities in Coastal Areas. The objective was to identify the most pressing environmental issues affecting coastal communities and to train coastal communities and coastal resources stakeholders in the use of rapid appraisal techniques for collecting environmental information. During the exercise the main environmental issues of concern to Coastal Fisheries Management Committees emerged and activities to address these issues were partially developed. The whole PRA exercise raised the awareness of the coastal communities and fisherfolks about environmental issues affecting them.

2.2. Integrated coastal fisheries management pilot project (INT/91/007)

This project's intervention in The Gambia was based on the recognition of the fact that fisheries development activities were being influenced by other users of coastal zones and that improved integrated (inter-sectoral) planning and management approaches were needed to deal with resource use conflicts, resources over-exploitation and environental degradation in coastal areas.

The project development objectives were in line with The Gambia's fisheries development objectives, namely: improving the well being of coastal communities through better management of marine and land-based coastal resources and by protecting the coastal ecosystem for sustainable development.

The immediate objectives of INT/91/007 to develop and improve methodologies and co-ordinating mechanisms for integrated coastal fisheries management were partly met. This was mainly due to the fact that the elements of integrated artisanal coastal fisheries management and development were already in place in the Community Fisheries Management Centres along the Atlantic coast of The Gambia. Respecting its strategy of focusing on the management of resources for sustained economic use, INT/91/007 provided support to the Fisheries Department in the evolving process of integrated coastal zone management in The Gambia. The project, therefore, took up certain elements of coastal zone management issues of special importance to fisheries. A summary of the impacts of these activities on the attitude of policy makers, resource users, stakeholders and coastal communities follows:

2. 2.1. Fuelwood use in fish smoking

The project made a detailed study of the use of fuelwood and the costs and earnings of fish smoking. The data on quantities of fish (bonga) smoked and fuelwood used confirmed the assertion in the Gambia Environmental Action Plan that fish smoking was a contributory factor to deforestation in the coastal areas. The study concluded that the rate of fuelwood use in fish smoking was not sustainable. Fish smokers are not paying the true economic value of the fuelwood although fish smoking is a highly profitable undertaking. It made proposals for addressing this problem of deforestation such as improving fuel-efficiency of smoking ovens, expanding the area from which fuelwood is procured, promotion of community forestry and agroforestry schemes in coastal areas and the harvesting of a Gmelina plantation established under an earlier EEC projects.

The removal of open access to the forests in The Gambia through the establishment of community-based management schemes of natural forests was recommended in the medium and long term and would increase wood prices to reflect the economic and social value of forest resources in the country. The removal of open access to forests is now a near reality because the new Forestry Act and Forestry Policy have provisions for the establishment of community forests as well as community management of natural forests in The Gambia.

2.2.2. Participatory rapid appraisal of coastal resources management issues

This was the first time ever that the PRA method was used for information acquisition and awareness creation in the coastal fisheries in The Gambia. Its use to study coastal communities and resources was therefore a test of its adaptability to ICFM issues. It also provided training for fisheries staff and coastal communities and other stakeholders.

The PRA revealed great awareness and concern among the communities about depletion of forests surrounding the fisheries centres due to the fuelwood requirements of fish smoking. The communities also recognised the fact that land use had changed in response to climatological changes. In the sites where the PRA was conducted the fisherfolks have acknowledged that there has been a significant decline in abundance of fisheries resources over the post two to three decades. This is causing conflicts between industrial and artisanal fisheries and among artisanal fishermen themselves using different gears. Fisherfolks were convinced that Government should take more stringent action against violators of regulations and that there should be greater delegation of management authority to the local level.

2.2.3. Management issues of estuarine shrimp fisheries

The project studied the conditions and mechanisms of existing management practices at the community level and the socio-economic characteristics of shrimpers. It emerged that shrimpers did not make a link between resource potential and fishing effort because they were of the view that neither Government nor the shrimpers' organizations should prevent people from entering the fishery. There are rules in shrimpers' communities regarding exclusive rights to fish a certain area by an individual fisherman. These rights are transferable.

2.2.4. Mangrove ecology and oyster harvesting

The Gambia has over 66,000 hectares of mangrove resources but clearing for agriculture and aquaculture as well as diebacks and uncontrolled and inappropriate harvesting techniques are threatening this vital resource. Development of educational materials on mangroves targeting users of the resources could be important for sustainable development and management. The study also recommended the establishment of a National (multi-sectoral) Mangrove Committee to develop a co-ordinated policy for the management of mangrove resources in The Gambia.

3. Intersectoral planning and coordination

Interventions by external projects and programmes as well as the Fisheries Department's own initiative have created awareness about the need for intersectoral planning and coordination for natural resources management, especially in coastal areas. Implementation of the Gambia Environmental Action Plan (GEAP) 1992-200l and post-Rio activities in The Gambia have encouraged and facilitated this process. The GEAP distinguishes the coastal zone as an "important natural and economic resource which, if utilised in an appropriate manner, will yield important economic benefits."

Establishment of the National Environmental Management Council (l992) and the National Environment Agency (NEA) in 1994 have created the instrument for intersectoral coordination for environmental management. Institutional development and the establishment and strengthening of functional and effective intersectoral coordination are the main aims of the NEA and GEAP implementation. The major environmental problems such as resources depletion and coastal erosion justified setting up the Coastal and Marine Environment Working Group under the NEA. All major stakeholders in the coastal area including the Fisheries Department are represented in this Working Group. With the active participation of the fisheries sector, the working group has, through intersectoral planning and coordination, made progress in coastal area management and development.

4. Lessons learnt

The entire process of integrated coastal fisheries management has been a learning exercise. From the various interventions, reviews and studies have emerged some useful lessons.

1. Time is needed to institutionalise the integrated strategy in local communities.
2. Active beneficiary involvement is needed in planning and implementation of centre affairs and processes to enable greater participation of fisherfolk in project formulation.
3. People's involvement in the planning and implementation of centre affairs has been an important factor that contributed tremendously to the awareness.

4. The fisheries Department's role as "development facilitator" should be maintained.
5. It is not enough to create special programmes for women. They need to be given the opportunity to play a major role in local organizational structures.
6. There is an urgent need to design appropriate policies and procedures for credit and savings facilities.
7. Fisherfolk have demonstrated a better understanding of their environment and in particular the resource base. Devolution of major resource management and allocation decisions to the local level is more effective.
8. There is also the need to explore the mechanisms and elements that favour sustainability of initiatives and to promote them in fishing communities.
9. Environmental issues persist because the local community does usually not see them as problems.
10. Business management of micro-enterprises is inadequate and requires reinforcement.

INCREMENTAL LEARNING-BASED APPROACH IN INTEGRATED COASTAL MANAGEMENT IN EASTERN AFRICA

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1. TOWARDS INTEGRATED COASTAL MANAGEMENT IN EASTERN AFRICA

The palm-fringed beaches, coral reefs, mangrove forests and bright blue waters of the eastern African coastal region suggest a natural serenity free of any degradation or pollution problems. By global standards, the West Indian Ocean and the eastern African coastal areas are relatively clean and free of pollution; however this may no longer remain true by 2010.

1.1. Coastal management practice in the Eastern African institutions

Coastal management programmes in the eastern African Nations are implemented within weak sector-based frameworks that poorly coordinate cross-sectoral activities with little or no reference to the river basin management.

Sector-based management of land-based activities in coastal zones has, in turn, become one of the most complex management challenges. In some instances resources fail under two or more sector-based management regimes with differing management priorities, e.g. Mangroves within Marine Protected Areas are managed by Parks Services with a role to conserve as well as the Forestry Management Departments with a mandate to exploit forestry products to generate revenue. Predictably the health of coastal resources has declined. Given the severity of coastal zone degradation and the need for sustainability and effective national regulatory interventions, there is great demand on governments with limited financial resources to act. In many instances, when governments act the interventions are reactive, weak and at times aggravate the problems through sectoral policies that conflict.

1.1.2. Institutional capacity

Most national institutions have limited financial resources, a limited pool of experts and managers. Despite these limitations, institutions have a responsibility to train managers. Inadequately equipped managers in turn seek a balance between the ever-increasing need for economic development and the conflicting demand being made on the coastal environment. As the intensity of coastal resource use increases, most institutions are unable to cope. The capacity for sustainability is exceeded and mitigative measures are largely without much success. Predictably, the health of coastal resources will decline further before significant reversal in depletion and environmental degradation can be controlled through improved management interventions.

In recognition of the serious problems of marine and coastal degradation faced by the region, the Governments of the Eastern African States – Comoros, Kenya, France (Reunion), Madagascar, Mauritius, Mozambique, Seychelles, Somalia and the United Republic of Tanzania – through the Nairobi Convention and Eastern African Action Plan for the Development and Management of the Coastal and Marine Areas, initiated coastal area management programmes. The programmes are supported to mitigate destructive activities as well as to evolve into proactive resource and management strategies; hopefully this will lead to the sustainable use of the marine and coastal areas. The on-going EAF/5 project on the "Protection and Management of the Marine and Coastal Areas in the Eastern African Region" attempts to provide a framework through which some of these issues can be solved.

1.2. EAF/5 approach

The project's main objective is to develop national self-reliance in all matters related to integrated development and management of the environment of the coastal areas.

The project is operating in four pilot sites:

- Tanzania: in Zanzibar (Chwaka Bay Area);
- Mozambique: Xai Xai District;
- Kenya: Nyali-Bamburi-Shanzu Area of Mombasa; and
- Comoros: Moroni.

The major activities of the EAF/5 project are geared towards the development of Integrated Coastal Area Management (ICAM) and are divided into five major components:

i) Development of coastal area management strategies;
ii) Environmental assessment (land-based activities and their contribution to pollution in coastal marine areas);
iii) Environmental legislation;
iv) Application of Geographical Information Systems (GIS) as a management tool; and
v) Public awareness.

These activities are undertaken through national institutions mandated to manage the coastal environment, with the help of collaborating governmental and non-governmental organizations.

1.2.1. Implementation

The project design recognised the need for an incremental learning-based approach. The pilot phase has two main properties:

a) An interactive participatory learning process: The process is adaptive enough to reconcile already conflicting and diverging interests over resources, e.g. fisheries, forestry, tourism etc.; in heavily developed sites, e.g. in Kenya (Nyali -Bamburi -Shanzu); in Moroni in Comoros and pro-actively evolving into a management tool that is dynamic to facilitate resource allocation in developing sites, e.g. Chwaka bay in Zanzibar and Xai Xai in Mozambique.
b) Demonstration projects in well-defined pilot areas with clear boundaries and representative issues.

   Demonstration projects are practical on-the-job exercises to provide experience and a comprehensive information base from which a process towards a holistic approach to coastal resource management is developed. (Few defined issues, attainable objectives, short-term management actions).

1.2.2. The hierarchical two-tier approach

Coastal and marine areas produce and support multiple products and services; these areas therefore cannot be used by any interest group exclusively. The various sectoral activities (tourism, industry, fisheries, trade etc.) must be brought together to achieve a commonly acceptable coastal management framework.

The project recognised the existence of layers of governance, and the need to address each issue at local and regional levels with key stakeholders before developing management strategies for adoption by local stakeholders and government institutions

A tier system was adopted to allow a simultaneous double-track approach that recognised the facilitating and regulatory role of governments and that of stakeholders as resource users and managers. Special emphasis was placed on the need for equal participation and a partnership in the management process.

a) First tier

A team of mid-level experts from different line ministries was set up in each country. The multi-disciplinary team was drawn from institutions with a mandate to manage coastal resources. The team carried out the following: Preparation of environmental profiles (Mozambique and Comoros) and/or issue-based profiles (Kenya-Zanzibar); Formulation of criteria for identification and prioritisation of issues; Identification of stakeholders.

The environmental profiles described the physical characteristics, resource base, socio-economic situation and institutional frameworks. The information was based on existing reports and data from maps and air photos, interviews and observations during field visits. In most cases each team prepared sectoral reports based on professional expertise and influences from the parent line ministry. lssue-based profiles were developed from technical reports for line ministries and stakeholders interviews.

Formal stakeholder workshops were conducted with an aim to build capacity as well as to inform and get responses on findings of facts, proposed strategy and follow-up actions. The stakeholder seminars were divided in phases; (1) familiarisation with the area and existing problems; (2) justification of the identified problems and selected issues to be managed; (3) presentation of a preliminary strategy and feedback.

The process was also required to:

- Develop processes for consensus-building;
- Focus on issue-specific strategies based on stakeholders' priorities;
- Identify resources and resource-use conflicts;
- Establish frameworks for co-ordinating and implementing strategies.

b) Second tier

While experts were conducting interviews with local communities and stakeholders, senior officers of the lead institution organised formal meetings for key stakeholders and local authorities to sensitise key community leaders, government officials and heads of departments on the process of ICM. After a thorough interaction between all key stakeholders in the two tiers, national workshops were held.

i) National workshops

Workshops were conducted to discuss and adopt integrated management strategies, for issues selected and prioritised by 1st and 2nd tier work groups. These priority issues became first generation management and demonstration activities. The national workshops endorsed the activities and priorities for intervention, and were required to suggest ways to strengthen cross-sectoral and inter-institutional coordination.

Selection activities were based on two factors: *local factors* (What is achievable at the local pilot site?) and *national factors* (What type of support is required at the national level and is it readily available?)

National workshops were also required to suggest how capacity-building and institutionalising ICM routine and the establishment of political commitment to the ICM process could be achieved.

2. In-country experience

The following issues emerged as priority concerns that required immediate national attention in ICAM programmes across the entire Eastern African region. National strategies are required to address these issues that are limiting at the local level:

- Weak resource management exacerbated by weak institutional structures and a wave of population shifts/urbanisation to coastal centres;
- Rapid pace of desirable development that was faster than the evolution of strategies needed for management and mechanisms required for effective governance;
- Decline in marine and coastal water quality;
- Loss of marine and coastal biodiversity;
- Weak policies on marine and coastal management.

2.1. Lessons learnt

a) Relationship between national issues and local site issues

Local pilot site solutions must only be seen as first steps towards solving national problems.

The pilot site issues were clearly identified. However, these issues are linked with other broader national problems that require massive planning inputs at national level. The following issues, despite being site-specific, can only be solved if considered within a broader national framework.

- Inadequate food supply in peri-urban areas close to the study site;
- Poor health facilities in peri-urban areas close to the study site;
- Poverty in the peri-urban areas close to the study site;
- Inadequate water supply;
- Lack of sewage system (impact from tourism development, e.g. pollution);
- Land tenure problems (poor land-use management contributing to coastal urban spread);
- Low education and literacy levels etc.

It has been recognised that national leaders also require to be addressed through a parallel process similar to resource users and stakeholders. This requirement is even more crucial to Kenya because of the many layers of government between a site committee at location level and policy-making organs at the national level. Local issues can therefore only be solved if a proper national framework exists. In many instances this framework did not exist.

b) Exhaustive participation of all key stakeholders

In Zanzibar, issues addressed at the local level were also taken as national issues and institutionalised within the Department of Environment. The approved committees became institutionalised at ministerial level within the environment portfolio. This was achieved through stakeholder seminars that addressed villagers, technical officers, directors of various key departments and a national workshop attended by heads of commissions and ministries as well as the minister for the Environment.

Working committees, established at the national workshop, and the adopted strategies in the national workshop were formal and therefore have a legal backing. The legal backing provides a long-term mechanism for solving ICAM issues.

c) Institutionalising ICAM in government

In Mozambique a Coordinating Ministry is already in place with a mandate to coordinate ICM programmes, for example to:

i) Guarantee, through the different sectors and organizations, the promotion and utilisation of natural resources;
ii) Ensure inter-institutional coordination at different levels, between the various agents and interveners in planning and utilisation of natural resources;
iii) Promote and urge management, preservation and rational utilisation of natural resources, especially those of common interest for different sectors.

The consultative participatory process of the EAF/5 project that involves stakeholders, has therefore a legal base within the Ministry. Institutions' support to the coastal management section would strengthen the ICAM process in Mozambique, firmly institutionalising the ICAM process in government.

3. Sustainability indicators in eastern Africa

How much has been achieved? and what is achievable? The current consumption patterns of coastal resources are sustainable. However this is only true if proper management practices are in place. Proper management practices can only be implemented through a process that will shift unsustainable elements within the current system of values. Effective development indicators should be established to gauge shifts from the unsustainable value system that does not place a cost on the environment services. This may involve a measure of:

i) willingness by governments to use the management tools that may in the short term affect the economies that are dependent on policies that are not responsive to resource depletion and degradation (Fishing gear limitations? Selective siting in tourism hotels etc);
ii) willingness by the public to adopt new management strategies based on a new value system that places a cost on environmental degradation;
iii) willingness on the part of governments to educate and create awareness on the "sacrifices" necessary to achieve sustainable development;

Monitoring programmes should also develop environmental quality indicators, for example:

- The health of coral reefs – set benchmarks
- Ground water quality – set a monitoring process
- Improve current public access/fish landing sites by providing clean and well maintained support facilities – e.g. Shanzu-Nyali area in Kenya
- Improve access to the shoreline by restoring former public access points which are now blocked – Shanzu-Nyali area

These indicators can play a meaningful role as management tools for sustainable development only if governments guarantee intervention when necessary.

4. Policy failure indicators

In most countries the following were notable symptoms of policy failures:

1. Institutional weakness (lack of expertise and poor infrastructure, e.g. vehicles, offices and funding).
2. Lack of ownership – no institution has sole responsibility for co-ordinating the management of coastal resources except in Mozambique.
3. Absence of a legal framework and enforcement capabilities.
4. Inadequate/lack of legislation governing access to communal coastal resources, i.e. fishing grounds, mangrove areas, dunes vegetation or beaches.
5. Poor coordination mechanisms between various institutions with mandates to manage coastal resources.

5. Conclusion

The countries of the eastern African regions will need to develop a process at a national level with the following objectives:

1. Resource management: prepare and implement site-specific and management strategies; ensure stakeholders are involved in the planning process;
2. Integrated planning: encourage consistency, complementarity and coordination in the sectoral planning process and actions to achieve conflict resolution and ecologically integrated approaches, respecting on- and off-site issues as well as transboundary issues;
3. Research and monitoring: determine ecologically sustainable levels of input and change; encourage exchange of information; establish timely review mechanisms and encourage environmentally enhancing activities;
4. Regulatory: to enhance a regulatory framework that promotes the precautionary principle in development; and to protect and restore important biological areas and prevent habitat degradation;
5. Legislative: to achieve formalised procedures and regulations that are enforceable;
6. Education and public awareness: provide better understanding by stakeholders and therefore generate support for responsible actions: develop appropriate programs and feedback opportunities for diverse target groups.

This process can be achieved only if one or several department(s) are legally empowered to coordinate ICAM policies. The selected department may also require support to formally put the required infrastructure in place.

INTEGRATED COASTAL ZONE MANAGEMENT IN MADAGASCAR

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1. GENERAL CONTEXT

1.1. Geographical situation

Madagascar is situated between 11°57' - 25°35' South and 43°14' - 50°27' East in the Indian Ocean. The Malagasy coast is just over 5,100 km of which 1,400 km accomodate coral reefs (almost 2,000 km^2), 4,000 km^2 consists of marine marshland (of which 3,000 km^2 are mangroves) and some 270 islets cover an approximate surface of 300 km^2 associated with 137 km^2 of coral reefs. The majority of coral and mangrove formation takes place in the west where the continental plateau is large.

1.2. Description of human occupation

During the last census in 1993, the total population was 12,239,000 of which 22.9% was urban and 77.1% rural. Concerning the coastal zones, the population is estimated at 36.6% and the main characteristics are a growth rate of 3%, high fertility (6 children/woman), a high infant mortality rate (12%) and a young population (55% under 20). This population is very unevenly distributed on the coast, with densities per sub-district (Fivondronana) from 4 inhabitants/km^2 to 127 inhabitants/km^2, and with a marked imbalance between the west, slightly populated, and the east, overpopulated. There is also an intense migration from the South-East towards the West, significant rural depopulation and a high illiteracy rate.

1.3. Land occupation

Land occupation has never been the object of national inventories. The coast accomodates harvest and export cultures; the west and especially the south-west are known for the culture of cotton, sugar cane, butter beans and husbandry. Food crops are present everywhere. Culture on burnt land and pasture fires aggravate effects of erosion. Concerning coastal infrastructures, there are mainly 19 ports, 10 regional and local airports, 4 countryside chief-towns (out of 6) and 20 secondary towns. Secondary activities are represented by 14 agro-alimentary industries, 3 textile-leather industries, 8 wood industries and 13 diverse industries. Tourism is closely linked to the coastal zone with identified concentration sites and reputed uncertain land management. Ecotourism is also being developed in the coastal marine region in 5 to 6 zones.

The coastal zone is an area where several coastal activities develop. These are alternatives to the more destructive continental activities and private investments since a few years. As a result, the risks of irreversible degradation of the ecosystem and marine resources as well as contamination (due to erosion, pollution, and other irrational exploitation) are ever growing.

1.4. Economic Importance of the coastal zone

The coastal zone contributes enormously to the economic development of the country. It supplies a large part of the export products, namely coffee, vanilla and cloves.

Presently it is on the coast that most of the activities of the country take place in terms of fishing, aquaculture and tourism. The economic benefits of these activities has brought them to first place in the national economy. One example that can be used to illustrate this is that fishing and aquaculture exports amount to more than 24,000 tons, representing about 100 million US$. Tourism generates more than 50 million US$.

Thus, these ecosystems present a definite ecological and economic interest, but on which rest serious threats of degradation and pollution.

2. Management of Malagasy coastal zones

2.1. The main problems of coastal zone management

The lack of consideration of the specificity of the coastal environment in sectorial policies and plans linked to the sea

Almost all sectors of the Malagasy economic activity can have a more or less direct impact on the quality of the coastal and marine environment through development of the land and town, industrial and mining sectors, transport, tourism, fisheries and aquaculture. A number of these sectors are trying to redefine their policies in order to make them compatible with the environment. But there exists no particular consideration for the coastal environment nor for the integration of these policies in any same coastal area where these activities can be conflicting.

The non-existence of an institution responsible for the coastal zone

There is no existing institution in Madagascar which is entirely responsible for the coastal and marine zone given its multi-sectorial nature. this responsibility is shared between ministries or organizations responsible for the sea and land development, transport and the environment. Furthermore, the national capacity for carrying out an integrated management of coastal zones project is presently insufficient.

The non-implementation and the inadequate nature of regulatory text

The problems are linked to the lack of means of control of the administrations concerned. The number and oldness of the texts favour contradictions and hide legal gaps. The integration of international conventions in national policies remains to be done. Common law and its effect on local decisions remains a relatively unexplored field.

Difficulties of capitalization at the level of primary producers

The fisherman or farmer is remunerated more in terms of time spent working than in terms of the intrinsic value of the resource. This results in insufficient revenue which prevents the producer from reinvesting in his trade, and a distorted perception of the value of the product, whence the need for an adequate management in his interest. In a context where pressure on resources is high, these ‘picking’ processes strongly affect the availability and the future of certain prized resources.

The lack of information and communication

This constitutes a limiting factor for the development and protection of coastal and marine zones. The marine domain is not a current subject in Madagascar and until now communication efforts have been targeting land resources. The non-existence of a reference document on coastal zones, the great communication difficulties (transport and telecommunications) and the focus on survival needs shroud the necessity for sustainable management.

2.1. The integrated management of coastal zones

The Malagasy environmental policy, of which the general enforcement framework is fixed by the Charter of the Environment (1990), is carried out through the Environmental Action Plan (EAP) which includes, over 15 years, 3 application programmes of 5 years each: EP (Environment Programmes I, II, and III). Despite its importance on the economic and ecological level, the coastal and marine environment was not part of the discussions during the IEP. Only the ‘environmental research’ component gave it some importance with the realization of two research programmes (lobsters, holothurians) which are not yet complete and which are attached to the IEP.

The reasons for the need to integrate the marine environment component (coastal appeared during the EP II orientation study) in the Environmental Action Plan (EAP) relate to (i) the importance of the coastal ecosystems of Madagascar on the ecological and economic level; (ii) the findings of a rapid degradation of certain sectors of the coast; (iii) the absence of objective data on these phenomena and a lack of knowledge on these marine and coastal environments in general.

Madagascar adopted the ICZM strategy by registering the coastal and marine environment in the second phase of the environmental programme and by participating in the Indian Ocean Commission's (IOC) Regional Programme for the Environment. The country is expressing its political will towards this approach by adhering to international conventions that are working towards ICZM (Nairobi Convention, Convention on Biodiversity, Convention on Humid Zones) and that are aware of the failures of sectorial approaches and the central tradition to resolve coastal zone problems.

ICZM is a new concept in Madagascar. The latter has neither experience nor competence in the field. Integrated development approaches have been or are being carried out in the west and south-west of the country in the framework of a sectorial fishing programme, but they are oriented essentially towards the management of halieutic resources. Other land development tools have been locally implemented such as: (iii) the preparation of six protected marine areas; (iv) various tourist projects of local interest; (v) development of the Pangalane Canal; (vi) disposition of concentrations of fish to diversify traditional fishing.

Knowledge of elements that modify the coastal zone is still insufficient as well as an understanding of its evolution. Specific regulations for the coastal zone are unclear and obsolete.

The 'Marine and Coastal Environment' component (MCE) constitutes one of the direct components of EP II. As all direct components, it can be supported by the other components of EP II as AGERAS (support to regionalized management and to the spatial approach), GELOSE (secured local management), FORAGE (regional support funds for environmental management) and all other support components (training, GIS/EIS and research in particular).

2.3. Objectives and activities of the MCE programme

This component which is responsible for the best possible coordination, synergy and complementarity between the various projects and programmes dealing with the coastal and marine zone in Madagascar. This component's global objective is to ensure the "sustainable development of coastal zones" through a three level approach:

- *The national approach* which will define the national framework of integrated management of coastal zones with the formulation of a policy for the development and protection of these zones, which will be applied by virtue of a better knowledge of marine and coastal environments, and through the elaboration of management tools. Thus the objectives of this approach concern:
  - the elaboration of policies and strategies for the integrated management of coastal zones;
  - the elaboration and setting up of a legal body for the coastal zone 'coastal law' (translation of the policy on a regulatory plane);
  - the formulation and setting up of a master scheme that indicates the main orientations in terms of space, development of coastal resource exploitation activities and protection of the natural environment;
  - the elaboration of thematic national master plans ('Protected Areas', 'Pollution Prevention/Reduction','Research'). These master plans will be the translation of the policy and scheme into action plans, and will include, amongst others, the instruments (financial, regulatory) to be put in place;
  - the setting up of an intersectoral institution for development and management of the coastal zone;
  - the setting up of a national coastal environment observation network;
  - the setting up of a national protected areas network.
- *The regional approach* has as objective to favour the consideration given to the coastal and marine environment as well as the establishment of the regional development scheme and the regional action plans in view of the application of the coming decentralization law.

- *The local approach* will take care of the implementation of concrete actions destined to relieve the pressures on the environment, with as priority the implementation of local community management of renewable resources, a key element of all sustainable development interventions. Two priority sites have been identified, namely Nosy Be and Toliara. The objectives are:
  - the elaboration and implementation of a local development scheme;
  - the elaboration and implementation of a local pollution prevention/reduction plan with the setting up of a local observatory as an integral part of the national observatory;
  - the implementation of local community management of renewable resources, with the implementation of degraded ecosystems restoration mini-projects or the development of substitution activities;
  - the creation of protected areas.

3. ICZM APPLICATION PROBLEMS

3.4. State of knowledge of marine and coastal ecosystems

Marine and coastal ecosystems are still badly known and some sectors of the Malagasy coast have never been explored. Furthermore, knowledge on coastal and marine biodiversity is very incomplete. Species that have been discovered were mostly classified between 1960-1970. Their evolution and their present state, as well as their habitats remain partially studied as the many studies carried out were not conducted continuously in time and space. The only information available comes from small portions of research, a bibliographical study in the framework of the national monograph, an environmental pre-audit carried out by the REP/IOC-EU project and studies conducted for the classification of sensitive zones by the KEPEM project in which the Malagasy coastal and marine diversity were surveyed in more or less a complete manner thanks to the results of past work, some of which are already old. However, the ecosystems' biology, ecology, the value of their stock and their present evolution on the whole island have not yet been well defined, except for the shrimp on the north-west coast.

3.2. The existing institutional framework

In Madagascar, the existing institutional framework includes:

- The ministries: Fishing and Halieutic Resources, Water and Forests, Land and Town Development, Agriculture, Husbandry, Public Works, Transport, Energy and Mines, Tourism, Industry, Population, Interior, Defence.
- Implementation agencies of the EAP: ONE, ANGAP, ANAE, FTM, CFSIGE, CPF.
- Research institutes: CNRO, CNRE, IHSM, FOFIFA, CNKT, IPM.

It is to be noted that there is no capacity in terms of ICZM and the capacity in terms of land development is limited. As for field studies in the coastal and marine environment, despite the presence of a human potential, there is a lack of coordination.

3.3. Conflict management

Analysis by types of conflict is not yet feasible at this stage and would mainly be based on the administration's perception, research and on scientists. The elaboration of environmental profiles and target studies will enable the recording of the perceptions of decentralized organizations, of operators and consumers. Groups and associations for the defence of consumers and the environment do not seem to be present and organized enough to manage conflicts and negotiate their solutions with the public authorities. Some local situations are still not perceived as conflicts as they are so common.

In daily life, conflicts are dealt with by customs, according to the precise and various regulatory and penal systems (dina) that exist in each region, depending on the types of offence. It is common for legal courts to pronounce in favour of the customary rule for offences that are brought to its knowledge. In all the traditional communities we find the 'tribunal of the wise'. This traditional justice, despite being ancestral, still exists, is recognized, rigorous and is applied. In the case of a fault or the unsuitable adaptation of the State's control systems, recourse is sought at the dina which is an asset of the EP I.

4. Institutional organization for the management of the programme

4.1. The operational structures of the ICZM programme

Structures common to the EAP

- The IMCE (Interministerial Committee for the Environment) is the decision-making level which assists the Head of Government in the main orientations of environmental policy and in operational strategies. It also contributes to the integration of environmental action in different sectorial policies.
- The NEC (National Environment Council) is the consulting level which sees to the application of strategies defined by the Malagasy Environmental Charter and which guarantees a synergy between the environmental programme and the national development policy.

National ICZM structures

- The EXCOM (Executive Committee) is the organ of coordination and follow-up of programmes and projects dealing with the coastal and marine environment. Its composition is restricted to representatives of main organizations (about ten) that ensure national responsibility in terms of the management of coastal and marine resources.
- WRG (Intersectoral Work and Reflection Group) is the national unity operational structure for ICZM and also constitutes a communication and information platform. It is currently made up of representatives of some forty organizations and works under the thematic commission with decision-taking in plenary sessions.
- The national technical cell, composed of three professionals and one technical assistant, is responsible for the technical coordination of the whole 'Coastal and Marine Environment' (CME) programme. It is responsible for animating the WRG and the implementation of the programme. This cell is attached to the ONE.

Local structures

Like national structures, but that currently exist at the level of pilot zones such as Tohara (south-west) and Nosy Be, the operational structures at the local level are composed of:

- An Intersectoral Work and Reflection Group which is a sub-commission of the Regional Programme Committee and which has the same attributions as those found at the national level.
- The technical support cell (TSC) which technically coordinates all CME programme actions at the local level.

It is to be noted that these structures are temporary and adapted to the needs of the launching phase of the programme. The definite structures will be identified and stipulated in a national ICZM policy to be elaborated.

4.2. Collaboration between development partners

The Coastal and Marine Environment Programme of Madagascar has opted for a united and participatory process:

With local communities: these include, according to the various appellations (*fokonolona*, *longo*, *toko*) of lineages, clans or villages in well-defined territories united by the same interests and following the rules of common life. Some of these structures evolve according to an associative mode (groups of water users, groups of economic interest) in order to become an interlocutor of the public authorities in the framework of development actions. Socio-professional groups are developing to facilitate their access to rural financial systems. The professional organizations in the sector; artisanal and modern are both equally being encouraged to develop in the framework of co-management of public authorities and also to defend corporate interests.

Public and para-statal services participate in the project actions as partners. They are present as much as possible at all stages in order to propose solutions and concerted pilot actions. These services are called upon to play a role of master implementation of ICZM actions, while the CME has a technical and financial support role.

Decentralized territorial groups and decentralized technical services are called upon to play a major part in the conception and implementation of ICZM actions, in particular those having a spatial development objective.

The project structures presented in the field and their respective founders are also privileged interlocutors, generally endowed with field knowledge and means and usually possessing essential information. Cooperation with these structures and coordination with their founders, as with their trustees has been judged to be indispensable to favour the integration of field actions.

Lending organizations of the public and associative field are numerous, in particular in research (CNRE, CNRIT, CIDST, ISHM, CNRO). The FTM, the CFSIGE and the Management of the Domain are also called upon to participate in the implementation of the project actions in their fields of competence. NGO's exist which could be requested, either to fund particular services, or to relay CME actions and those of the master public works in the field.

5. The need to reinforce the capacity of parties involved

One of the major constraints of the ICZM programme in Madagascar is the lack of technical means and management capacity at all levels to orient and coordinate the development and implementation of the programme. It is not easy to find coastal managers that have the necessary qualities to coordinate activities between public organizations, mobilize human and financial resources, direct research oriented towards management and ensure the development of information.

These facts have been noted since the recruitment of the programme's technicians, namely the technical assistance during the setting up of the members of the intersectoral work group both at the national and regional level, and also since the creation of the executive committee. For this, the programme had to start with a standardization of the members'information of these organizational structures before proceeding to ICZM training itself. Even after the training in ICZM, it was noted that it would be difficult to proceed to the formulation of an ICZM policy and its implementation until a large array of technical and professional competence was acquired in the following fields:

- environmental assessment and resource analysis;
- environmental economy;
- land development;
- pollution reduction technology;
- geographic information systems (GIS) and information management; and
- communication.

However, given the experience in other countries, the ICZM programme in Madagascar has opted for a strategy that aims to reinforce human resources and institutional capacities; through an active participation in the programme, through information/communication and through training in the form of workshops and seminars.

As ICZM is a relatively recent field in Madagascar, the exchange of experiences with other interested countries constitutes one of the driving elements for the development of the Malagasy ICZM programme.

D

The socio-cultural dimensions of SICOM in Africa

SOCIO-CULTURAL DIMENSIONS

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The United Nations World Decade of Cultural Development (1988-1997) and the intergovernmental conference on cultural politics for development, which was held in Stockholm last April, has brought the international community to consider that development should take into account development of the human being in every aspect and as a whole, and that culture is an essential dimension of development.

It is not easy to define culture. Our definition includes all expressions of our creativity, in social and scientific fields as well as architectural, musical and artistic fields in general. It is also constituted of a whole system of values, beliefs, attitudes, customs and social interactions. It moulds our perception of the world and our relationship with the world.

Culture is thus inextricably linked to the great development challenges of our time: to eliminate poverty, stop demographic growth, fight against diseases, protect the environment and natural resources, promote a culture of democracy and peace.

It is obvious that solutions to the issue of sustainable integrated management of coastal zones will only be found if a global, pluri-dimensional and world scale approach is adopted. That is if the matter is considered in economic, social, scientific, ecological and cultural terms, and in the context of a world becoming increasingly interdependent.

Culture will undeniably have an important role to play in efforts towards achieving sustainable management of coasts: technology alone will not be able to solve the problem of refuse and the waste and depletion of African coastal resources. Their sustainable management will require drastic cultural changes and adaptations in styles of life, in urban-rural dynamics, in consumption habits and the way in which progress and the modernization of development techniques is carried out.

Education, which is one aspect of culture, will play a major role to ease this cultural adaptation and to promote the development of the local potential and technological innovation for sustainable development. The success of this action towards integrated sustainable management will largely depend on the following elements in particular:

1. The reduction in unequal access to education and the fight against poverty, at international level as well as in each state, will create solidarity, hence offering a conducive environment for sustainable management of natural resources and coastal zones.

2. The recognition of the value of traditional knowledge and practices in the field of management and use of resources, which are based on generations of experience and observation deeply rooted in local cultures. Traditional knowledge and values have to be reconciled with modern science for management which is fully integrated in the social and cultural context. The latter should not be perceived as a system imposed from outside and which would then, understandably, trigger rejections. For thousands of years, natural resources have been saved from the destructive influence of humans by customs and cultural habits such as taboos which prevented over-exploitation and wastage. There is a tendency now to move from varied cultures adapted to very diverse ecosystems, towards globalization with which there comes the danger of homogenization of behaviour and

models of consumption, of which the main characteristic is that of being as less economic as possible and increasing quantitative aspects. *Keeping in mind traditional knowledge is therefore necessary to save the future*.

3. The active participation of men and women in the thinking process and the implementation of management and sustainable development is a necessary requirement for its success. For this, sustainable management practices have to be rooted in the daily life of populations, including cultural traditions and the minority. To do as such implies knowledge and respect of the differences and diversity in cultures with a spirit of dialogue and democracy, together with an atmosphere of legal understanding at national and international levels.

   Thus it seems that biological diversity and cultural diversity can be considered as two aspects of the same phenomenon. Just as nature produces a variety of species adapted to their environment, humans develop a variety of cultures that fit in with local conditions. Cultural diversity can be considered as an essential component of sustainability.

   Even if globalization offers immensely enriching opportunities and fruitful interactions between cultures, it nevertheless constitutes a threat for these two categories of diversity. Populations and cultures that have existed in harmony with the environment for thousands of years are threatened to disappear together with the ecosystems that ensured their survival. The cultures of the world have to be preserved in all their diversity. The recognition of the need for integrated and sustainable management will greatly contribute to their protection.

4. The protection and the recognition of the potential of cultural heritage and cultural landscapes, whether tangible or intangible, have to be integrated into the management of coastal zones. Cultural heritage is a fundamental value of cultural identity and in this respect plays an essential role in the mobilization of populations for development. It is a vital component of the resources and wealth that needs to be managed sustainably. The global management approach will take into consideration the interactions between the management of the coast and civilization.

   The island of Mozambique site, which is on the list of world heritage sites for its universal value, is a good example of a project associating the restoration of ancient architectural heritage to a project developing the potential of the site including its natural environment. This project is also part of an economic and social development programme for the benefit of the island's inhabitants.

   The sustainability of the development of the island is closely linked to the participation of the inhabitants in this project and their welfare. The urban rehabilitation of the island is associated to works concerning water supplies, the treatment of wastewater and refuse, to the management of energy needs, the management and preservation of the environment and in particular the beaches. Here we have a good example of what could be development for the tourist industry which is not simply the construction of unaesthetic polluting buildings which destroy the environment and the socio-cultural aspect of the site.

   When natural and cultural heritage is part of the integrated management of development and when the local population is closely involved, it can represent a great means of improving the welfare of populations and the cultural radiance of a region or of a country. This example shows that the quality of life of populations cannot be improved without their active participation, their involvement and their mobilization in favour of projects. It also shows that development need not inevitably lead to poverty, destruction of the environment, and cultural and social disruptions.

   It appears that one of the stakes of the sustainable integrated management of coastal zones, is the preservation of natural and cultural heritage, which are the first victims of bad management.

I hope that the cultural programmes that have been set up with the support of UNESCO that deal with the protection and development of the potential of cultural heritage, or other projects such as the African College for culture and development and the cultural network SACIS, as well as remarkable cultural institutions such as the CRAC (Regional Centre for Cultural Action), are able to play an active role so that culture is associated with programmes of integrated sustainable management of the coastal zones of Africa.

The intergovernmental conference on cultural policies for development recommended the various states to make cultural policies one of the key elements of development strategies and in particular to favour the integration of cultural policies in development policies and more precisely in connection with social and economic policies.

INTEGRATED MANAGEMENT OF COASTAL ZONES AND POTENTIAL TOURIST VALUE OF THEIR CULTURAL HERITAGE

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The present contribution expresses a few ideas that may enrich the thoughts and debates of the round table on the integrated management of coastal zones and the potential tourist value of its cultural heritage.

According to the experts, the coastal zone is situated between the maritime limits of the exclusive economic zone (about 200 marine units) and the continental limit which is found 50 km beyond the zone of influence.

Referring to the countries of the Gulf of Guinea (Benin, Nigeria, Togo, Ghana etc.), the coastal zone is essentially composed of the sedimentary relief constituted of plates, lagoonal systems, beaches, humid zones and offshore bars.

Thus, this is a region in which natural processes of the formation of living and non-living resources overlap with the effects of human action, since human populations migrated from further inland to inhabit the coastal area in large agglomerations. This migration flux is also due to the physical wealth of the coast, that is with water, a great diversity of plant and animal resources and several sites that favour their survival and reproduction.

The coast is an economic and attractive area; it is a site where communication and exchanges take place, as well as having real potential in the tourist industry in the case of coastal countries. But due to the rapid growth of the population and economic and industrial activities, the coastal zone and in particular the living resources (animals and plants) are under high pressure. For various reasons, the coast is undergoing serious physical disturbance as a result of terrestrial and marine pollution.

The consequences are over-exploitation and a decrease in the lagoonal fish productivity, deforestation and degradation of the mangroves, coastal erosion and disfiguration of natural sites, and the destruction or alteration of the cultural heritage.

The aim of the Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM) is to define the basis of a strategy for the sustainable integrated development of the coasts of the African continent, while taking into consideration the cultural, social and human dimensions, thus addressing the question of exploitation and the management of coastal zones. This question arises firstly from a general evaluation of the degradation of the coastal environment in the absence of legislation or implementation of existing laws in the field of coastal and marine environment, and secondly from a number of other factors influencing the coastal zone including tourism. According to statisticians, tourism for most countries concerned, constitutes a considerable source of economic and financial resources.

In most African countries, the tourist industry is often geared towards satisfying the exigencies of foreigners coming from the northern hemisphere. Even the public authorities interfere with local cultural identity and values, disturbing, degrading or sacrificing sites, environmental resources, traditions, monuments etc.

Tourism policies often lack intersectorial approaches to define strategies which would allow a real integration of the different dimensions, namely the socio-cultural dimension. This is necessary in order to answer questions relating to the rational exploitation of coastal zones and those dealing with a better communication between partners in view of ensuring an appropriate and sustainable solution.

This intersectorial approach has now become essential to face the global negative effects that have been caused by human action. Integrated management is presented as a multi-approach mechanism constituted of a set of sectorial processes that should lead to the rational use of resources that are still available as well as the whole ecosystem, while keeping in mind cultural values of the traditional ways of managing the environment. This type of management should revolutionize the tourist sector in the context of the sustainable development of coastal zone communities.

Indeed, the economy of the states have big numbers and statistics to show at the end of the day. But, out of all this, does the local population benefit at all? Do they feel fully concerned by the coming and going of tourists in their village? Their region receives tourists throughout the season, and the development of tourism and the resulting profits have knocked down a number of barriers and done away with hesitations.

Until recently, tourism in most of our countries was an economic option where the social and cultural aspects were only used to attract foreign visitors. This view has slowly been corrected thanks to the evolution of the concept of tourism itself. We have realized that the culture and economy are essential elements of the sector, since the natural and cultural heritage are the determining factors of tourism today. Indeed, whatever be the content or meaning given to tourism, it is essentially a dialogue of cultures, the interculturality of people, the bringing together of two different worlds. In other words, tourism is traveling, escape, discovery, meeting, knowing the other. We cannot therefore talk of tourism without art and traditions, fauna and flora, without cultural manifestations or events.

Tourism has become a world stake. For Africa, and more particularly coastal zones, it is a vector of sustainable development provided that past mistakes are corrected while proceeding towards a true definition of development objectives for coastal zones, which until now, have not had the required attention from the public authorities or other promoters of tourism. These zones are regions of potential development for eco-tourism and cultural tourism which aim at taking into consideration the integration of and management of the cultural and natural heritage, the landscape, in the economic and social development. This approach involves the participation of the community to a large extent.

To reach this goal, there need to be pre-requisites, that is, to define, with the actors concerned with the management of coastal zones, the development objectives which aim to better foresee the coastal sensitivity to different human impacts, and to establish a development and resource use plan by gathering scientific, technical and cultural information.

In this perspective, the information on heritage has to be taken into account as a whole in view of its integration in the elaboration and implementation of a real cultural tourism. The latter should reflect material and immaterial resources in general which represent the collective memoirs of the communities through time and space.

Hence, the objectives are aimed towards:

- the rationalization of the mechanisms responsible for the development of the coast taking into consideration the various socio-cultural and economic aspects,
- the identification of potentialities and the guarantee of the survival of rare and threatened species,
- the guarantee of the sustainable and optimal use of coastal zone resources in order to protect them for future generations,
- the promotion of social stability,
- the sensitization concerning the principles of the protection of the environment, at all levels of the state and communities.

These objectives have to lead to a series of actions to be taken together with the coastal zone communities, who will feel more concerned and involved in their implementation. By doing so they will be directly participating in the improvement of their lifestyle by contributing to the process of sustainable development of the coast, through which they will benefit from the advantages generated by tourist activities.

The new approach of tourism should take the global environment into consideration, that is, where natural and cultural heritage no longer simply act as supports to tourism but rather are the determinant elements of tourism.

Therefore, the potential of the heritage should encourage rational exploitation of the area as a habitat in the framework of integrated management of coastal zones. The rural and urban architecture as well as lagoonal and marine sites should also be subject to rational exploitation in the same context. Humid and marshy soils which are highly fertile sites can be profitably exploited.

Integrated management should create a capacity of exploitation of the zones concerned; create remunerative jobs in the activities generated, thus absorbing unemployment, fighting hunger, poverty, delinquency and urban emigration (husbandry, pisciculture, horticulture, agriculture, handicrafts and services etc.).

Human and natural resources, arts and traditions, know-how, handicrafts, styles of life and traditional technology have to be made to contribute directly to the area.

This approach that takes into account global physical, biological, and human structures of the coast, has to first contemplate:

a) exploitation knowledge of the area (detailed survey of land occupancy, methods of land and water resource utilization, production technique methods),
b) the inventory of cultural resources (state of knowledge on ethnic groups, their history, cultural events in relation to the environment),
c) the development and resource-use plan (plan of land occupancy, degraded zones, zones for the development of eco-tourism activities, landscape management).

Culture, land and sea: Sustainable use of resources

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1. Introduction

Our contribution concerns culture and development and their relationship with tourism in the coastal areas of Mozambique.

Various definitions have been offered for culture. In approaching our task we take the UNESCO definition developed by Mundialcult in 1982. This view of culture is all-encompassing and considers that all peoples have their own culture which they cherish and others should respect. Incidentally this view of culture served as the backbone for the reflection of Perez de Cuellar's report on our creative diversity and for the Intergovernmental Conference on Cultural Policies for Development, held in Stockholm, 30 March – 2 April 1998. This view of culture is also taken by the Southern African Development Community (SADC) Sector for Culture, Information and Sport in its recently adopted policy document.

Still in the area of provisions, we perceive development as a multifaceted undertaking which takes cognisance of economic, social and cultural aspects and which recognises that they influence each and each of them has a role to play in the uplifting of the human condition. Having characterised the concepts we now reiterate our bias: we see culture and development complementing each other. We see the interaction, involvement and empowerment of the communities as important contributors to meaningful and sustainable growth. Therefore, this paper argues that for development to be meaningful it needs to be cognisant of the experiences and practices of sustainable use of resources of the people. We discuss the relationship between culture and development using data we have generated during the fieldwork we have recently undertaken. The study was conducted in three coastal areas of Mozambique, namely Inhassoro (South), Buzi (Centre) and Metuge (North).

2. Culture, land and sea

Do not behave like the caterpillar which eats the leaves that protect it from its predators.
(An African proverb)

In discussing the experiences that show sustainable use of resources we will begin by pointing out to the fact that resource management is a collective affair and that it is governed by norms and practices to which the individuals adhere. We will also explain that individual behaviour and attempts to depart from the socially agreed norms may often invite social shame and exclusion of the individual. Finally the paper discusses the role of tourism and how it can contribute to sustainable growth.

2.1. Resource management as a collective responsibility

Do not behave like a toad inflating yourself to reach the cow's height: You will burst and die.
(An African proverb)

Among the coastal people we have visited, there is a great deal of encouragement for the individual to improve on what others already know. Experiments and innovations which we will be discussing later on are often an addition to what the community knows, not a abrupt change. They may increase production safety and the like but they are not expected to introduce drastic changes in the patterns of production behaviour. This approach to life has consequences. For instance, the individual is expected to use the resource base while taking into account that tomorrow he or she will want to drink from the same well. Therefore, fast, unscrupulous consumption, often to the detriment of morale and the environment, is discouraged.

Another important aspect that shows the collective responsibility to manage the resources is the way communities divided themselves into categories and the way trespassing into the category of others is not illegal but shameful, strange. For instance, in Buzi women use their nets to fish midget prawns on the shores. Men, on the other hand venture into the deep and sometimes rough sea in search of lobsters. Men or women who joined the group of the other without any socially plausible experience would be considered abnormal. Since individuals anticipate these judgments they censure their own behaviour and, this way, overgrazing by the differents categories will be relatively reduced since each of the groups, including the young, will have their own pastures.

The rules of how one should behave are learned in the process of social integration (which does not stop until death) and through observation and trial. Therefore, the seemingly leisurely activities we saw children engaged in were in fact schooling activities on their own right. They were not an end in themselves, but a means to perfect the skills one will need in future. Take the children in Buzi, as an example, We found them swimming morning and afternoon whenever high tide was available in the sea bay. To a casual observer the children were wasting time, not helping with domestic chores or others. However, a closer look reveals that the boys are preparing themselves for the future activity of breadwinners as fishermen. By the same token, in Metuge we found community members gathered under the shade of a house chatting hours on end. Again, fleeting visitors may dismiss these gatherings as time wasted. Again, a closer look reveals that those sessions are just as useful as those in the lecture room, in the library or in front of a Discovery Channel programme. There is learning and sharing of knowledge and experiences. Perhaps more importantly, these sessions are also a behaviour controlling device. That is, the individual who may violate social norms including misuse of resources or the like, may be excluded from these groups. Such exclusion may cut off the individual from the collectivity and from the learning that takes place there.

So far we have been pointing to the fact that our study has revealed that resource management is a collective responsibility. The next section looks at myths and taboos.

2.2. Myths: Tools for resources management

God gave us two eyes and two ears but one mouth. Look and listen more and speak. (question) less.

(An African proverb)

Myths and taboos act as deterrents against social malpractice and are powerful enough to instil the expected behaviour of the individual. The myths do not predict in the cause-effect fashion. What they predict is not to happen soon after some malpractice has been committed. Rather, their prediction is of long term. Therefore, the individual is left anxious to know when the prescribed punishment for his/her wrongdoing is to land.

During our fieldwork we found that the coastal people of the three research sites, to assist in the management of both land and marine resources, use a number of myths. Minister Ferraz once addressed this issue at the Mozambique National Conference on Culture, an event I have made reference to earlier. He made the point that among some communities myths and taboos play an important role in ordering resources exploitation. Our study confirms that this is the case among the coastal communities. In the three areas visited myths, taboos and rites are found. These practices, together with social shame that the individual may be subjected to as well as moderm inspections, help, somewhat the fish stocks to recover.

What needs to be retained in this description is not only the role of these social practices in the management of the resource base. It is also the constant call of the individual to relate to nature and the ancestors in a harmonious and dynamic ways. The fact that ceremonies are held and that some leaders are recognised as interlocutors with the ancestors is also significant in other ways: it serves as a constant reminder that humans are simply an element in a complex jigsaw that also involves nature and the ancestors.

As an example, the opening of the fishing season in Inhassoro is an eventful affair. The local chief, Chibamo, leads the ceremonies which in 1996 counted with the presence of the provincial governor. In Buzi we found that when fishing does not go well, the fishermen come together and request the services of Inhangoro, the local chief to lead the libations to placate the ancestors. Clearly the point is that when things go wrong the first question they ask themselves is: how are our relations with our ancestors? Have we wronged them? When did we last have ceremonies here? And so on. This way, a constant relationship with these ancestors is maintained and collective control over resources is exercised.

2.3. The practice of recycling

This object will be useful at home. If not, children can play with it.
(An African proverb)

Often, when we think of recycling we confine ourselves to western views of the process. However, in the three research sites we found that the local communities take it to heart. That is, the people visited are able to apply an object or parts of it to new uses once it becomes unfit for the original purpose or return it to the same uses with local adaptations. This contrasts with the assumption that recycling is exogenous to such groups as the peasantry. In Buzi, for example, old fridges are used as cool boxes. Fishermen use them to hold iceblocks they buy in the city of Beira to refrigerate their catch. Similarly, they do not throw away old boats. These are used, instead, for salinating fish which is then dried and exported to Zimbabwe and Malawi. In Metuge, the leftovers tubes that were used to run electric wires in buildings are used in fishing. Pieces of these tubes are fixed together so as to be long enough to allow the diver to breathe fresh air through his mouth while under water in search of fish. The visors, which allow them to see under water, are also made of cast-off pieces of glass and rubber.

In Inhassoro we found a fisherman who built his own landrover. Using wood and metal he built the frame. The engine came from an old Landrover. He proudly told the research team that this car has been seen by a number of important visitors. The same fisherman uses sheets of zinc to protect his homestead from erosion. Poles support the sheets and the seawater no longer hits the sand directly but the sheets and poles.

In this section we have demonstrated that there is great awareness that objects which have lost relevance to be used as they are or in the same way, not to be discarded to fill up rubbish dump. Recycling, as it is undertaken, shows how environmentally friendly these communities are. In the next section we look at innovations.

2.4. Innovation

Necessity is the mother of invention.
(Universal saying)

We have indicated earlier that innovations are undertaken by the communities visited by the research team. Nevertheless, these innovations are not meant to overhaul the patterns of production or social behaviour. Innovations often add on to what is already known. This is certainly true among the peasants visited during this study. One such invention found in Inhassoro is the use of aerial breadbaskets to store seeds. The technique prevents rodents from reaching the produce and at the same time guarantees ventilation and preservation of seeds.

In Buzi, we found a local farmer who keeps a record of rainfall throughout the year. He claims that over the years the technique, together with the observation of the stars and the moon, has allowed him to predict when the rains are likely to fall and when the best period to sow is. In Metuge, one informant, Malique, invented a system of watering his vegetable plot which the extensionists have come to name “crane” but which the inventor himself calls *kaputhi*, a local name derived from its shape. In Buzi, the dug-out canoes are fitted with engines so that they can sail deeper into the sea. It is interesting that once these engines have been fitted the canoe is no longer called such. It acquires the name of *chata*. In Metuge, fishing boats are fitted with wooden poles across giving them the shape of an aeroplane. These poles reinforce the equilibrium and safety of the canoes at sea. The research team came to establish that the technique was learned in the neighbouring province of Nampula. Today most of the small canoes in Pemba and in Metuge use this technique. In Inhassoro, a local fisherman found a solution to the problem of lack of – or unreliable – cooling systems. He made cages, which he keeps under water. In these cages prawns and lobsters are kept and fed until he has enough stock to sell in the town of Maputo or Beira.

Both adaptation and innovations are the result of observation and experimentation. The knowledge and insights that in other latitudes are learned in libraries among the members of these rural communities are acquired through sharp observation and sharing of knowledge in gatherings as I have made reference to earlier. We have found that these rural communities are able to identify the best soil for each crop and as one of the informants, Careno, remarked “this was not learned at school. At school, they only teach you the soil in general”. By detecting the presence of one or another type of grass they are quite certain which crops will go well with that particular type of soil. For instance, in Buzi the research team learned that grasses such as *Cynodom dactylon* is advisable for maize, sunflower and beans. Furthermore, it was also learned that these communities know which trees will stimulate growth of crops and which ones will throttle them. In Inhassoro, for instance, the growth of cotton and maize is stimulated by *Sterculia africana*. Conversely *Tamaridu indica* throttle these crops.

Similarly, these communities know which grade timber is for canoes and boats. In Buzi for example, the research team found that *Cordyla africana* and *Guibourtia conjugata* are first choice while *Sclerocapa berrea* is the cheap alternative. Still with the fishing side of the activities the team established that fishermen do not venture into the sea. They study the winds and the stars because these are said to influence the movements of shoals.

2.5. Multi-insurance policy

The person who chews on only one side of his mouth risks pain.

(An African proverb)

It emerged from our study that the rural economy is a multi-pronged system and the results from one system are used to feed the other. This suggests that these communities are aware of the fact that over-exploitation of resources is not a good thing and by the practices they adopt they can avoid it or at least minimise it. In Inhassoro, the people will leave their land to recover nutrients for a number of years while they cultivate other plots.

The fact that they are not dependent on one activity allows them, for example, to have breaks from the fishing activity. In Metuge, the local fishermen can break away from fishing and dedicate their energies to vegetable production. These vegetables are sought after in the capital city of Pemba. In Buzi, one informant, Xidoko, told us that his proceeds from the fishing go to increase his farm production. Now he uses cattle and not a hoe to plough. This again means that he can slack off on fishing and spend more time in agriculture. We have earlier made mention of the fact that the categories in which the communities divide themselves (age or gender) also make their contribution to the sustainable use of the resources.

3. Tourism and sustainable development

"The development of tourism can contribute to quality of life and sustainable development if it is based on the commitment and participation of the local population."

H. Barré (World Decade for Cultural Development)

The beaches dotted along the 2,700 km of Mozambique coastline are a tourist attraction par excellence. Tourism can be a friend or a foe and when it is the latter it can have a devastating effect on the environment and culture. In Mozambique, the Ministry of Environmental Affairs has taken to heart the sensitisation of society about the importance of conserving the environment. Newspaper articles remarking "wonder what the MICOA will say about this" or "perhaps MICOA will have the last word" suggest that environmental issues are sinking deep into the conscience of Mozambicans.

Similarly, as the national conference on culture has shown, there is consensus that we need to preserve our culture and transmit it to future generations. Already a cultural policy is in place and a number of activities to implement the decisions taken at the conference are underway. The approved cultural policy advocates the relationship between culture and development. This way it takes cognisance of the fact that preservation is not to be limited to culture alone. It needs to include the preservation of the environment.

Therefore, at the governmental level one could say that the instruments and mechanisms are in place. What could be still a concern is that often the gulf between statements of intent and practice can be wide enough to allow all sorts of ill thought-out projects to go on.

Sustainable tourism would be an activity that would take cognisance of and assist in the development of local industries, input skills and resources. The idea would be to improve on the current practices so that what is done is done better but still sustainable. We ourselves need to caution those tourists that their practices and behaviours may contribute to breaking local norms. A case in point would be fishing during the closed season. Another case would be the encouragement of overfishing and greed by the offer of attractive prices. Already such practice is taking place in Inhassoro where two fishermen are using nets that are pulled by tractors and which scoop up even the small fry. The point is that the government may need to reinforce its inspection and monitoring capabilities.

As we have indicated at the beginning we advocate the people's involvement and participation in initiatives that are to benefit them. It is important that they develop a sense of ownership, which can only come if they know what the project is all about and how it is to affect their lives.

Proper feasibility studies need to be undertaken not only to address environmental concerns but also cultural ones. Such studies need to be multidisciplinary in nature so as to appreciate the problem from all angles and provide solutions that take into consideration all the general concerns. With peace and stability the beaches of Mozambique will attract investment. Already we have established that such enterprises are beginning to take hold in Inhassoro and Buzi, but not Metuge. Nevertheless, the government's institutional capacity is not strong enough to bring about compliance with the policies we have made reference to earlier.

Conclusion

This paper documented some of the practices and experiences of the sustainable use of coastal resources. In these concluding remarks we need to state that a number of factors have come to influence the way these communities use resources. The first point we wish to make is that, for a number of reasons, the urban centres have become attractions to the young. In the course of our study we visited local markets in Metuge and Inhassoro, the only place where local people of different ages gather. We have established that the age group between 18 and 35 is underrepresented. This means that they have migrated elsewhere, including the urban centres. The implication is that to the chain of transmission of knowledge is broken. This in itself can have a profound impact on how the resources are managed in the future. The returnees may introduce ethics and practices unheard of in the community. Examples could include, lack of respect for human life and personal property and greed. When we visited Inhassoro, we met one of the informants who had just returned from town. Taking advantage of the knowledge acquired in town he was busy registering plots in his own name. Although he could claim that the land belonged to his grandparents, there was no guarantee that he will not trespass on the land of others. The whole exercise was done in secrecy.

The other point that we wish to stress has to do with the horizontal exchange of experiences. Facilitation of visits of members of one community to the other can bring in important and useful experiences. We have made reference to the fact that the use of poles across canoes in Metuge had been learned from the neighbouring province of Nampula. We are, therefore, of the belief that further studies could be undertaken and the results used in horizontal seminars facilitated by the researchers but in which the community members are the interactors. These horizontal seminars are not only a possibility but an affordable necessity. The exchange of sustainable techniques of exploiting resources can be beneficial to the country and to the people themselves.

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CULTURES, SOCIETIES AND TOURISM

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1. INTRODUCTION

Coastal ecosystems are uniquely adapted to their surrounding conditions, and can be both remarkably resilient and unexpectedly fragile. In this regard, all components of coastal systems are interrelated and can therefore influence or be influenced by processes taking place both out at sea or well in land.

The apparent complexity and diversity of the various elements that constitute the coastal zone mean that the zone has the capacity to support a wide range of activities. This sheer variety of activities in the coastal zone is a clear reflection of the value of the coastal resources to human society. Unfortunately, there are now many conflicting uses: urban, industrial, residential and recreational lands use arising from the broad and growing spectrum of human activities.

Therefore, to bring about a sustainable development of the coastal environment, the ecological potential and functioning must be safeguarded. To do this, appropriate actions cannot be achieved by integrated planning alone, but also the need for a general awareness and sensitivity of how nature works, and what actions are appropriate or inappropriate in maintaining the ecological balance and improving environmental quality in coastal areas.

In that regard, this paper will place emphasis on capacity building in a culturally-sensitive approach to development with a view to enhancing appreciation of community participation and the use of indigenous and local knowledge systems in the planning and management of coastal resources.

2. CONTEXT

Coastal zones contain many of Earth's most complex, diverse and productive ecological systems. A large variety of human activities take place within the zones such as recreation and tourism, cultural and historic monuments conservation, fishing, living, ecotourism etc.

Inspite of the enormous potential of coastal zones, the uncontrolled pursuit of multiple activities will inevitably lead to conflict of interests, costly duplication of activities, unnecessary competition for finite resources, environmental degradation and socio-cultural conflict. Such a situation reduces the possibility of dialogue, collaboration and cooperation among the various stakeholders and hence encouraging isolated actions in various domains.

Coastal management, therefore, becomes a key task facing maritime nations. If we have to sustain the productivity and natural functions of coastal areas, there is the need to revisit the way we plan and manage coastal development. Effective coastal management is more than accessibility to scientific knowledge and technological and financial means.

Given the diversity, complexity, fragility and immense profits, which stand to be made through exploitation of coastal resources, the dominant discourses on the subject are worthy of closer scrutiny. Western science tends to regard high technology, specialization and homogeneity as key aspects in any conservation scheme. Low technology and heterogeneity, by contrast, characterize traditional cultures, while sustainable interactions within the ecosystem are based on necessity. Behind these differences are mutually exclusive ways of thinking about nature. Western science, based on empirical research rooted in positivistic and causal views of the world, runs counter to traditional ecological interactions guided by ways of knowing based on intimate co-existence with nature (CIRAN/NUFFIC, 1995).

Two significant issues could be drawn from the above:

- How do we mobilize indigenous and local knowledge and reconcile it with scientific and technological know-how in the development and implementation of policies and programmes for coastal management, while at the same time ensuring that holders of that knowledge maintain control over the process and that their knowledge is not epitomised by a larger decision-making process over which they have no control or input?
- Traditional knowledge, languages and the specialized vocabularies that reflect unique traditional strategies for dealing with sustainable resource management are getting lost, with the passing away of elders, who are the living depositories of traditional customs and knowledge systems. How do we stem the loss of the as yet undocumented indigenous knowledge base of communities, which have maintained traditional resource management livelihoods that are sustainable and environmentally sound?

3. Promoting a culturally sensitive approach to sustainable and integrated coastal management in Africa

In the light of the above-mentioned issues, an effective coastal resources management based on the participation of communities and making full use of their capacities, knowledge and resources, must therefore seek to attain the following objectives:

- enhance awareness, understanding and sensitivity of the crucial role of culture in influencing the means and goals of sustainable development;
- foster an appreciation of a culturally-sensitive approach to effective coastal resource management through the collaboration and participation of various stakeholders;
- promote greater understanding and appreciation of the linkages between biological diversity and cultural diversity;
- enhance our understanding of traditional ecological knowledge systems and how to explore their integration with scientific knowledge; and
- deepen our understanding, appreciation and sensitivity of the complexity and diversity of the various elements of coastal zones and how to integrate these elements into a strategic plan to enhance sustainable development.

To attain these objectives, it is recommended that the capacity of all stakeholders involved in the design, management and evaluation of coastal development programmes and projects be developed in a culturally sensitive approach to development. The use of this approach requires the following methodologies and actions:

1. Comparative and multidisciplinary research is needed in the predesign phase of projects, to better understand the practical and economic utility of using indigenous sustainable development initiatives on their own, or for integrating them with modern techniques built on solid scientific foundations. Multidisciplinary research approach that integrates the two different, yet compatible knowledge paradigms - western and indigenous, has promising potential for providing innovative and effective mechanisms to document, preserve and utilize indigenous knowledge systems for activities that promote sustainable development of coastal zones. The research methodology should employ participatory enquiry tools to enhance the active participation of various stakeholders in the data collection and analysis process.
2. The results of the research should be widely disseminated through various forms: conventional media (television, radio and press), workshops and seminars for various

levels of stakeholders, formal education process (mainstream education), non-formal education and use of traditional modes of communication through the use of theatre-for-development, music, dance, story-telling etc. with a view to assessing the effectiveness of communicators in the development of messages that could be accepted in their communities. The various stakeholders should be given the chance to react to the findings of the research, and in some cases (workshops/seminars) should take part in the recommendations to be put forward. Their recommendations should not just be based on study results but also their experiences, aspirations and constraints.

3. Whatever programmes are developed from the research, they should ensure that the short-term interests of stakeholders are embedded into the long-term perspective development concerns of coastal communities to enhance sustainable development. In this regard, use could be made of coastal zone databases, coastal land use, master plan and strategic plans for the long-term development of coastal zones.
4. It is widely believed that, sometimes, coastal communities are not fully aware of the problems associated with coastal management. Therefore, whatever plans or programmes are designed, an intensive awareness-creation campaign is required to make them more sensitive to and cognizant of the various issues, problems and challenges of coastal resources management. Sometimes, special interest groups should be targeted such as fishermen, hoteliers, managers of cultural and historic sites, tour and ground operators, nature conservation experts, construction industry workers etc. In this case all media-conventional and traditional forms could be utilized, using specific types of information for specific groups.
5. In the management of development activities, the communities should be empowered by making full use of local institutions, involving them in the management process and utilizing indigenous and local knowledge systems for the development of innovative sustainable resource management strategies. Providing international support for indigenous institutions and communities to help them decide on the type of scientific tools and partnerships they can use to meet their immediate and long-term resource and cultural development objectives could enhance this. Here, the example of UNESCO's experience in the Yoff coastal area in Dakar, Senegal, is a good case in point. Socio-cultural aspects of the fishing community were used to improve their deteriorating living conditions (UNESCO, 1996).
6. The monitoring and evaluation of activities should also encourage a participatory approach to ensure that the views, expectations and frustrations of all stakeholders are taken account of and reflected in new programmes in the implementation of ongoing projects.
7. Considering the sometimes-conflicting goals and interests of various stakeholders in the management of coastal zones, in order to facilitate information flow among them and enhance awareness creation, collaboration and partnership, the establishment of a networking framework is required. This could take the form of inter-agency committees or networks of government agencies, organizations, researchers, communities etc. (UNESCO,1997).

The aforesaid actions reveal several issues that could go into the design of an effective capacity-building programme for promoting a culturally sensitive approach to sustainable integrated coastal management.

i) *Conflict resolution.* In view of the conflicting goals and interests of various stakeholders in coastal resources management, there is the need to develop skills in the identification of sources of conflict and their root causes, and the design of mechanisms for resolving conflicts.

ii) *Network split and dynamics.* In order to enhance information flow among various stakeholders with a view to promote collaboration, cooperation and partnership, there is the need to develop capacity in networking.

iii) *Integrated development planning*. The use of multidisciplinary and holistic approach to the management of coastal resources, calls for specialized skills in integrated development planning and management.

iv) *Methodology of participatory development*. Development practitioners and agents need to have their skills developed in participatory research; planning, training and evaluation to enable them ensure the participation of communities in the planning, implementation and evaluation of coastal development programmes and projects.

v) *Cultural impact assessment*. Skills are required in the methodologies of measuring and evaluating the cultural and societal impact of development activities.

vi) *Methodologies* for integrating cultural factors into development framework processes.

vii) *Methodology* of evaluating the cultural indicators of situations and effects in development activities or assessing the cultural integrity of development activities (cultural self-evaluation).

(viii) *Bottom-up planning/flow of cultural information*.

(ix) *Institutional analysis*. Through this methodology, the various locales in a given community are documented and an analysis made as to how they could be of use in project implementation (socio-cultural and historical profile survey techniques, cultural mapping techniques).

(x) *Training of trainers*. The concepts, methodologies and skills of grassroots NGOs need to be developed in the following areas:
- communication: how to effectively communicate project ideas and results to communities to enhance acceptability;
- research: training in qualitative research techniques to ensure that the concerns and aspirations of communities are fully reflected in plans and programmes;
- negotiation skills to enable communities to better articulate their needs and aspirations in policy-making gatherings;
- consultancy and advisory services skills to enable NGOs to offer better services to grassroots communities.

4. Contribution of the African Itinerant College for Culture and Development (AICCD) to Capacity Building in a Culturally Sensitive Approach to Sustainable Integrated Coastal Management

Building endogenous human resource capacity and strengthening research and training institutions in a culturally sensitive approach to development in Africa, constitute the primary mission of the AICCD.

The College is the result of programme activities undertaken within the framework of the World Decade for Cultural Development (1988-1997). Now, it is being implemented in the medium term as a pilot project jointly by UNESCO and the United Nations African Institute for Economic Development and Planning (IDEP) based in Dakar, Senegal.

The College is a regional network system and as such implements its programme activities in full cooperation with a wide variety of well-established research and training institutions, professional associations and individual social scientists and scholars in different sub-regions of Africa.

In addition to having access to a large pool of experts and institutions to work with, the College has also carried out certain actions, which will be very relevant to follow-up activities from this conference:
- in collaboration with IDEP, it has conducted a comprehensive human and institutional training needs assessment on a culturally sensitive approach to development in all sub-Saharan African countries;
- in collaboration with the Pan African Association of Anthropologists, it has pro-

duced a curriculum and course outlines for the teaching of Culture and Development in Africa. The next stage in this exercise is the development of a resource book and teaching manuals on Culture and Development in Africa;

- in its medium term plan and strategy, AICCD has a programme component on a culturally sensitive approach to integrated coastal management in Africa. There are now plans to develop concrete proposals and seek more partners in a networking framework, to design and implement the programme.

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Workshop 2

GOOS-AFRICA: GLOBAL OCEAN OBSERVING SYSTEM FOR SICOM

Global Ocean Observing System (GOOS)

What is the vision of GOOS?

The vision guiding GOOS is one of a world where the information needed by governments, industry, science and the public to deal with marine related issues, including the effects of the ocean upon climate, is supported by a united global network to systematically acquire, integrate and distribute oceanic observations, and to generate analyses, forecasts and other useful products.

What precisely is it and what will it do?

GOOS is conceived as:

- A sustained, co-ordinated, international system for gathering data about the oceans and seas of the Earth,
- A system for processing such data, with other relevant data from other domains, to enable the generation of beneficial analytical and prognostic environmental information services, and
- The research and development on which such services depend for their improvement.

The primary objectives of GOOS are:

1. To specify the marine observational data needed on a continuing basis to meet the needs of the world community of users of the oceanic environment;
2. To develop and implement an internationally co-ordinated strategy for the gathering, acquisition and exchange of these data;
3. To facilitate the development of uses and products of these data, encourage and widen their application in use to protect the marine environment;
4. To facilitate means by which less-developed nations can increase their capacity to acquire and use marine data according to the GOOS framework;
5. To co-ordinate the ongoing operations of GOOS and ensure its integration within wider global observational and environmental management strategies.

GOOS will provide information about the present and future states of seas and oceans and their living resources and on the role of the oceans in climate change. Its foundations are in place and the existing states of scientific knowledge, technical capability, and current operational systems point to the need for incremental, progressive implementation now. In fact, implementation has begun, based on the integration of previously separate existing observing systems.

Why do we need a global system?

Ocean processes know no national boundaries and the ubiquitous nature of many of the problems to be solved means that it is often prudent to implement even local and regional operational or research programmes co-operatively and in a co-ordinated way. Such coordination needs to be carried out so as to achieve economies of scale and mutual support, and to enable future global extension. The Tropical Ocean and Global Atmosphere (TOGA) Programme is one such co-operative programme. It has established the basis of operational prediction of the onset of El Niño and the associated El Niño–Southern Oscillation (ENSO). This has its origins in the tropical Pacific but creates ramifications well into the mid-latitudes on a virtually global scale.

There are some programmes that must be designed and implemented on an agreed international, global basis where the problem being addressed is truly global, as in the case of large-scale oceanic circulation; for example, or where the investment required is large and the benefits are essentially public goods, i.e. they cannot be appropriated. Much of the monitoring and generation of advice relating to environmental change has these properties.

What is global about coastal seas?

The achievement of a predictive understanding of coastal ecosystems depends on the development of regional to global networks that link observation and analysis in more effective and timely ways. GOOS is thus promoting integration of the fragmented coastal environmental research community and its linkage to the community at large, especially user groups like policy makers, environmental and resource managers, NGOs, the business community, and the public in general, to enable them to get the scientific information they need to make informed decisions in a timely fashion. GOOS is also promoting a broad-scale view of coastal ecosystems that takes into account the large scale forcing of the coastal system and which leads to reliable mechanisms for predicting environmental changes and their ecological consequences. The ultimate goal of Coastal GOOS is to encourage and support the development and application of now-casting, forecasting and predictive capabilities as a means of preserving healthy coastal environments, promoting sustainable uses of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations.

What is the economic significance of GOOS?

A significant proportion of the world economic activity and a wide range of services, amenities and social benefits depend on the wise use of the sea. For many countries, marine resources and services provide 3-5% of their Gross National Products (GNP). For a few countries, the proportion is much higher. In the technically developed "Group of Seven" countries, marine resources and services contribute, on average, 5% of GNP or about US$ 600 billion per annum (1991). The vast majority of all international trade is carried by sea, with 3,5 billion tons of cargo transported in ships. By the year 2020, it is probable that 75% of the world's population will live within 60 km of seacoasts and estuaries. World production of offshore oil and gas was worth US$ 135 billion in 1990, amounting to 20% of world hydrocarbon production. The world fish catch is 80-90 million tons/year, amounting to some 20% of the total human consumption of animal protein and worth approximately $70 billion. Wetland and other shoreline areas are extremely important breeding and spawning areas for many species of fish and other organisms and yet, globally, over 50% of such areas have already undergone severe environmental degradation. Expected growth in population with the attendant pressure on natural resources, suggests that the economic significance of the oceans is more likely to increase than to decline, as will the need for its sustainable use. Economic analyses suggest that the costs and benefits of operating GOOS are likely to be similar to those of the World Weather Watch, an analogous system that underpins all weather forecasting.

Who are the beneficiaries?

Direct potential beneficiaries of GOOS will include the managers of coastal defences, ports and harbours, fishing and fish farming, shipping, offshore industry, and recreation. Indirect beneficiaries, through climate forecasting based on ocean observations, will include the suppliers on land of food, energy, water and medical supplies (e.g. for epidemics of malaria like those associated with El Niño events).

What is the legal basis for proceeding?

The legal basis for proceeding is defined by various international conventions and action plans, including: the Convention on the Law of the Sea; the Framework Convention on Climate Change; the Biodiversity Convention; Agenda 21 (agreed at the United Nations Conference on Environment and Development in Rio in 1992); the Global Plan of Action for the Protection of the Marine Environment from Land-Based Activities; the London Dumping Convention; the Agreement on Highly Migratory and Straddling Stocks, and others. Ocean information is needed by governments to meet their obligations under these Conventions.

When did GOOS start?

GOOS was created by the IOC Assembly in 1991 in response to the desire of many nations to improve management of seas and oceans, and to improve climate forecasts, for both of which it is necessary to establish observations dealing with physical, chemical and biological aspects of the ocean in an integrated way. Agenda 21 specifically calls for GOOS to be developed to meet the needs of coastal states for sustainable development of seas and oceans.

How does it relate to other global initiatives?

GOOS is part of an Integrated Global Observing Strategy (IGOS) in which the UN agencies (UNESCO and its IOC; WMO, UNEP, and FAO) are working together and with ICSU and the satellite agencies (via the Committee on Earth Observation Satellites – CEOS). In that context, the GOOS forms the ocean component of GCOS (the Global Climate Observing System) and the marine coastal component of the GTOS (the Global Terrestrial Observing System). GOOS itself is sponsored by the IOC of UNESCO, WMO, UNEP and ICSU.

How is GOOS progressing?

GOOS planning is coherent and widely accepted at intergovernmental, regional, and local levels. Uncertainties as to method and objectives are being researched in a progressive manner. The operational systems are being based on sound science and technology. Thought-out strategies, achievable priorities, targets and milestones have been set; methods of accomplishing them have been defined; and all these have been reviewed and endorsed at an appropriate level.

GOOS is being implemented through 5 overlapping phases:

1. Planning, including design and technical definition;
2. Operational demonstrations and pilot experiments;
3. Incorporation of suitable existing observing and related activities and new activities that can be implemented now to constitute the GOOS Initial Observing System;
4. Gradual operational implementation of the "permanent" or ongoing Global Ocean Observing System;
5. Continued assessment and improvement in individual aspects and in the entire system.

The planning phase

The first phase is well advanced, and a "Strategic Plan and Principles of GOOS, has been published. The initial shape of the GOOS is being developed by advisory panels dealing with: (i) climate; (ii) coastal seas; (iii) living marine resources; (iv) the health of the ocean (i.e. pollution); and (v) marine meteorological and oceanographic services. These panels report to the GOOS Steering Committee (GSC) that is responsible for the design and implementation of the GOOS. An Intergovernmental Committee (I-GOOS) assists in gaining intergovernmental support and approval for the design and implementation. Building the capacity of developing nations to contribute to and benefit from the GOOS is the responsibility of a Capacity Building Panel.

Discussions are beginning to assist the development process by providing governments with an opportunity to sign up to the Principles of the GOOS, and their operational agencies with an opportunity to commit certain of their current operational resources to the GOOS to enhance its implementation. Many individual governments have already established, or are creating, their own national GOOS committees to oversee their contribution to the GOOS.

Pilot projects

Phase 2 has begun with the formation of pilot projects to test the operation of the GOOS in specific regions, and to refine the GOOS sub-systems. The NEAR-GOOS pilot project covers North East Asian seas. It focuses initially on developing data exchange between its four partners, and on building the user community. In the future it will develop a numerical modelling and forecasting capability. The initial focus is primarily on physical data. In Europe, the EuroGOOS Association of

30 operational agencies from 16 countries is bringing researchers and operators together to create more efficient and effective observing systems for the Arctic, Baltic, Mediterranean, and North West Shelf of the continent, in the process identifying the needs for research and technology to make GOOS more effective in the future. Ocean modelling and forecasting figures high on their agenda, along with improved data exchange. An Atlantic-scale project is proposed to provide improved boundary conditions for the forcing of models for European coastal seas. While the initial focus of EuroGOOS is on physical parameters, chemical (nutrient) and biological (plankton) parameters also feature prominently in the EuroGOOS programme. Active interest in building other regional projects has been expressed by the nations of: (i) the western Indian Ocean (WIOMAP); (ii) S. E. Asia (SEA-GOOS); (iii) Mediterranean (Med-GOOS); and Southwest Pacific (Pacific-GOOS).

Technology demonstrator projects include PIRATA (Pilot Research Array (of buoys) in the Tropical Atlantic), and GODAE (Global Ocean Data Assimilation Experiment). PIRATA will demonstrate the value to climate forecasting of measurements from the equatorial Atlantic. GODAE will integrate and assimilate in-situ and satellite data in real time into global ocean models in order to depict ocean circulation on time scales of a few days and space scales of a few tens of kilometres, to demonstrate the viability of the GOOS in this domain.

Capitalising on existing systems

Phase 3 has begun with the creation of a GOOS Initial Observing System (GOOS-IOS), from a number of pre-existing observing systems, each of which will continue to serve the group of clients for which it was originally set up. The systems include: the upper ocean measurements of the Ship of Opportunity Programme (SOOP); the meteorological observations of the Voluntary Observing Ship (VOS) network; data from the fixed and drifting buoys co-ordinated by the Data Buoy Cooperating Panel (DBCP); data from the buoys of the Tropical Atmosphere Ocean (TAO) array set up to monitor El Niño events in the equatorial Pacific; the tide gauge data from the Global Sea Level Observing System (GLOSS); data from the Global Temperature and Salinity Profile Programme (GTSPP); information from the Global Coral Reef Monitoring Network (GCRMN); and communication through the Internet and the Global Telecommunications System (GTS) of the WMO; plus marine meteorological and ocean data from NOAA is operational satellites. Calibration and validation of satellite data relies on ocean surface ocean observations from the GOOS Initial Observing System, and the success of ocean forecasts made by numerical models relies on the integration of remotely-sensed data from satellites with observations of the ocean's surface and subsurface that cannot be made from space.

At this time, apart from the GCRMN, these measuring systems are concerned primarily with physical observations. However, consideration is now being given to which chemical and biological information is required and how to integrate it with physical data. Living marine resources exist mostly in the coastal zone, but the monitoring requirements for living resources and coastal seas remain under development. The challenge is to develop a high quality, integrated approach to coastal monitoring and forecasting, taking into consideration the needs of resource managers. Current observing systems include the Harmful Algal Bloom (HAB) programme of the IOC; the International Mussel Watch programme; the Marine Pollution and Monitoring Programme (MARPOLMON); and the Continuous Plankton Recorder (CPR) programme.

Full-scale development

Phase 4 will be developed over the next 10-15 years. It will involve continued integration of other components like those mentioned above, including new systems, with every attempt to enlarge the range of variables to include chemical and biological ones pertaining to the management of sustainable healthy coasts, including living marine resources and ecosystems.

Implementation will proceed following two parallel themes:

1. Coastal and shelf monitoring and prediction;
2. Open ocean monitoring and prediction.
   Within coastal seas, actions will focus on preserving healthy coastal environments, promoting sustainable use of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations. Open ocean operations will be more concerned with the short-term needs of offshore industries, fisheries and ocean-going trade, with improvements to weather forecasting, and with the medium to longer-term detection and forecasting of climate change. Open ocean operations are essential too for managers of coastal seas, in that coastal seas are affected by large scale, open ocean phenomena. Examples include the El Niño and its massive impact on the coastal fisheries of many countries, and the huge regime shifts in sardines and anchovies in many coastal fisheries in recent decades, which reflect some very large scale forcing. Measurements and numerical models of open ocean conditions will be used to provide the boundary conditions at the edges of regional numerical models of coastal seas, to ensure the accuracy of forecasts of coastal conditions.

Within both themes investment will focus on actions that:

1. Have a high impact in terms of the delivery of the data and information that are needed;
2. Are known to be feasible and thus likely to be successful;
3. Continue and enhance activities that are already proving their worth, and encourage replication or expansion at a low level of risk;
4. Comprise more substantial demonstration projects having community support;
5. Give effect to intergovernmental conventions and agreements.

In due course, when the module panels have developed their initial plans, the present modular panel structure of the GOOS will need to be changed to reflect the thematic structure of this implementation framework.

Infrastructure

Achievement of this implementation framework, and the necessary review of performance of the system required for phase 5, demand the provision by Member States of appropriate structural support and expertise to: (i) conduct appropriate planning and coordination; (ii) ensure creation, maintenance and promotion of internationally accepted operational procedures and practices; (iii) facilitate training and awareness and capacity building.

Among the key items in the resulting infrastructure are:

1. Establishment of an Information Centre;
2. Establishment of a Data and Information Management Service;
3. Negotiation of a data policy (the default is application of the data policies of the sponsoring organizations)
4. Development of methods to assist capacity building target on GOOS;
5. Improvement of investment in that capacity building.

Resources

GOOS will be implemented by nations working together. GOOS supporters are now in the process of convincing operational, research and aid agencies that implementation of GOOS can deliver worthwhile benefits for them and those they serve, at a reasonable level of risk which makes investment worthwhile. It is hoped that governmental authorities and international agencies will be persuaded that if the guidance is followed, a coherent effective global system will result, to provide the services they require and wish to encourage and sponsor. A first step will be the contribution of appropriate existing local and regional systems to GOOS by individual nations or groups of states. Equally important at this point in time is the enhancement of support for the GOOS infrastructure, which is enabling GOOS to happen.

Historical and current views

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Chapters 9 to 16 of Agenda 21 address the need to manage the Earth's ecosystems and resources for sustainable development. In enjoining the parties to the global effort on managing the environment for sustainable development, the document emphasises the need for purposeful research efforts to resolve a number of uncertainties in our understating of the global and regional environmental process in the Earth's atmosphere, on land and in the oceans. Objective 9.4 of Chapter 9 reads:

"To improve our understanding of the processes that influence and are influenced by Earth's atmosphere on a global, regional and local scale, including, inter alia, physical, chemical, geological, biological, oceanic, hydrological, economic and social processes; and to reduce uncertainties with regard to the economic and social consequences of response measures taken in this regard."

The Declaration further instructs:

"To develop, maintain and, where appropriate, enhance systematic observations of the atmosphere and affected ecosystems, as well as impacts on human health and economic systems. The emphasis should be on assembling coincident and supportive databases, where possible, and on exchanging these data and related information to the fullest extent possible;"

To achieve these objectives the Declaration took note of the disparity in developmental stages on the globe and recommended that a further objective of Agenda 21 should be:

"To enhance international cooperation in building the capacities and abilities of countries to identify atmospheric problems, to conduct research, to assemble, collect and assess data by using existing data and by establishing and expanding systematic data observations capabilities, and to participate in the exchange of the resulting data and information."

In response to Agenda 21 recommendations IGBP, UNEP and other international organizations met to formulate strategies for operationalising the research and scientific needs of Agenda 21. The final outcome of these strategy and planning meetings are a series of global observation systems, sometimes referred to as the G3OS (GCOS, GOOS, GTOS). The Global Terrestrial Observation System is perhaps the youngest of the Global Observation Systems. These observation systems are networks of research and observation institutions and programmers who contribute to global databases that are needed to produce the information on the development processes.

GTOS

The Scientific and Technical Planning Group for the establishment of GTOS met 1993 through to 1995. FAO offered to host GTOS and a Secretariat was established in 1996. The first Steering Committee met in Rome in December 1996. The Committee produced its implementation plan in 1997 and adopted it at its recent meeting in June 1998 in Santander, Spain.

GTOS mission

"The central mission of GTOS is to provide policy makers, resource managers and researchers with access to the data needed to detect, quantify, locate, understand and warn of changes (especially reductions) in the terrestrial ecosystems to support sustainable development."

GTOS focuses on five issues of global concern:

1. changes in land quality,
2. availability of freshwater resources,
3. loss of biodiversity,
4. climate change and
5. pollution and toxicity.

GTOS further promotes the following activities:
- integrated analysis of biophysical and socio-economic data,
- interaction between monitoring networks, research programmes, and policy makers,
- data exchange and application and
- quality assurance and protocols to harmonise measurements and provide guidance in data analysis.

STATUS OF GTOS/GOOS IN AFRICA

The question of GTOS activities in Africa is somewhat premature, as GTOS/GOOS has only recently (June 1999) adopted its programme implementation plan. What is of interest is the recognition of coastal work in Africa that is a potential GTOS/GOOS network. Let me cite a few examples:

Regional Seas Programme reference No. 1
1. Type of programme: United Nations; coordination

2. Geographic area of implementation: Global

3. Programme profile
The UNEP Oceans and Coastal Areas/Programme Activity Centre (OCA/PAC) is responsible for implementing and maintaining the Regional Seas Programme. Currently there are thirteen individual programmes; each is governed by corresponding Conventions and Agreements, referred to as Action Plans. The following is a list of the Action Plans for the African region, as well as the contributing institutions:

The Mediterranean Action Plan (MAP) (adopted in 1975) has several contributing institutions including the Co-ordinating Unit for MAP, Regional Activity Centre (RAC) for the Blue Plan (BP/RAC), the RAC for the Priority Actions Programme (PAP/RAG), the RAC for Specially Protected Areas (SPA/RAC), and the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC).

The West and Central African Action Plan (WACAF) was adopted in 1981 and is co-ordinated by the Regional Co-ordinating Unit for WACAF, based in Abidjan, Côte d'Ivoire.

The Eastern African Action Plan was adopted in 1985 and is run by a secretariat based in the Seychelles.

To work on a scientific justification for an integrated global ocean-monitoring programme, OCA/PAC joined the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). This is of importance to monitoring programmes, as it interconnects marine biology, geology, chemistry and physical oceanography.

4. Data and Information Management
Each programme collects and manages its own data, according to its own criteria. Results are published by OCA/PAC.

5. Co-operation
The Regional Seas Programme is implemented with the help of the concerned nations. In addition, UNEP also collaborates with such international organizations as the UN Economic Commissions for each region, FAO, IAEA, IOC, IMO, UNESCO's Man and the Biosphere Programme (MAB), UNDP, UNIDO, WHO, WMO as well as many others.

COASTAL MANAGEMENT INITIATIVES IN KENYA AND ZANZIBAR

The signing of the East African Regional Seas Action Plan in 1985 and, more recently, the Arusha Resolution on Integrated Coastal Zone Management in East Africa, signed by six East African states in 1993, are evidence of the increasing importance placed on coastal management in the East African region. The demonstration projects in Kenya and Zanzibar should contribute not only to the sustainable use of coastal resources in these countries, but also to the emerging knowledge and experience available to the region.

These projects demonstrate that considerable work, however isolated in places, is going on in Africa to address the land-ocean interface. There is however little coordination between terrestrial work and coastal work, even though it is acknowledged that coastal symptoms are indicators of land use. It is to bring about this synergy between terrestrial and ocean observation systems that GTOS and GOOS should cooperate and co-ordinate their research to fulfil those essential objectives of Agenda 21 to inform on the development process.

In GTOS, CEOS (Committee on Earth Observation Satellites) is represented by Dr. Cilhar. I note that though satellite monitoring of coastal zones is a daily routine in developed countries, satellite data on African coastlines is somewhat scanty.

Data acquisition and information management

GTOS works closely with the Committee on Earth Observation Satellites (CEOS). In addition, GTOS has created an allied panel for data acquisition and information management, the Joint Data and Information Management Panel (JDIMP). Through this panel GTOS offers to harmonise data collection through expert advice in methodology database establishment and networking through GNET.

What needs to be done?

In 1993 IGBP initiated the LOICZ (Land Ocean Interaction at the Coastal Zone) programme and enunciated a number of Core Projects. Among the suite of recommended programmes are the following research focuses:

Focus 1
The effects of changes in external forcing of boundary conditions on coastal fluxes
- catchment basin dynamics and delivery,
- atmospheric inputs to the coast zone,
- exchange of energy and matter at the coastal zone, and
- development of coupled models for coastal systems.

Focus 2
Coastal biogeomorphology and global change
- the role of ecosystems in determining coastal morphodynamics under varying environmental conditions,
- coastal biogeomorphological responses to anthropogenic activities, and
- reconstruction and prediction of coastal zone evolution as a consequence of global change.

Focus 3
Carbon fluxes and trace gas emissions
- cycling of organic matter within coastal systems,
- estimation of net fluxes of N^2O and CH^4, and
- estimation of global coastal zone emissions of dimethysulphide.

Focus 4
Economic and social impacts of global change in coastal systems
- evolution of coastal systems under different scenarios of global change, and
- effects of changes to coastal systems on social and economic activities.

Development of improved strategies for the management of coastal resources

You will note that in virtually all these tasks there is an explicit need to couple GOOS and GTOS activities. For example the Miombo Woodlands project could constructively inform on coastal zone processes.

At regional and national levels however there is a pressing need for capacity building. Several of the regional coastal projects are administered from outside the continent, because they are externally funded. I would like to reiterate the opinion of the African Academy of Sciences here that even a small commitment of GNP to scientific research would make a visible impact on national scientific research endeavours. I hope that one of the outcomes of this conference is a recommendation to the regions to add an item on the national budget committed to environmental research.

From outside the continent, I would point out that GTOS has access to the FAO visiting researchers programme, which scientists on sabbatical could avail themselves of and that applicants would be required to work on specified topics.

CONSTRAINTS

I have inferred above that one of the constraints to achieving the goals of PACSICOM objectives is local finance. However one of the Rio outcomes is the General Environmental Facility, GEF. These funds are normally dispersed through national financing protocols.

The programmes I have outlined above indicate that there is a community of coastal scientists in Africa, their numbers varying by coastal region. What the conference may wish to consider is sectoral as well as regional distribution of technical skills on coastal issues. The establishment of a register of coastal scientists in the region would help plan the capacity building process.

GOOS-AFRICA NEEDS

1. greater collaboration among coastal study groups,
2. harmonisation of data collection, archiving, retrieval and accessibility by researchers,
3. a GOOS/GTOS Bureau to manage the regional coordination, and
4. aggressive capacity building to bring African coastal zone scientists to the sea.

Marine data and information exchange in West Africa: An important element of GOOS-Africa

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Introduction

The Global Ocean Observing System (GOOS) is an integrated, international scientifically based system for the co-ordinated monitoring and subsequent prediction of environmental and climatic changes nationally, regionally and globally. It includes long-term systematic measurements of physical, chemical and biological properties of the ocean, the analyses and distribution of data and data products for environmental monitoring.

GOOS consists of five main modules:

- climate-monitoring, assessment and prediction,
- marine living resources monitoring and assessment,
- coastal zone monitoring, management and development,
- health of the ocean assessment and prediction, and
- marine meteorological and oceanographic services.

GOOS coastal module

The coastal GOOS module is of immense importance to Africa considering the fact that coastal zone forms the socio-economic nerve centre of the continent. The African coastal area covers a total area of 1,557,533 km^2, representing 11.7% of Africa. The coastal zone harbours a total population of 86.34 million people, representing 23.81% of the total African population. Coastal resources include oil and gas, non-fuel minerals, fishery resources and others. The socio-economic structure includes industries, tourist facilities, and residential and commercial facilities. Coastal hazards like coastal erosion, flooding, deforestation, pollution, salt-water intrusion are widespread in the coastal zone. This is destabilising socio-economic activities in the coastal zone. The five GOOS modules are expected to provide products like: sea level predictions, harmful alga bloom analyses, coral reef productivity determinations, analyses of contaminants distribution, predictions of sea ice conditions, analyses of plankton distribution and variability and global analyses of various productivity indicators.

GOOS products especially the Coastal GOOS module, will be useful to offshore oil and gas activities, fisheries, mineral extraction, pollution management, climate prediction, port operation, coastal protection, ship re-routing, tourism and public health. Hence, predictions and monitoring of the state of the coastal seas and oceans for days to decades into the future will add several percentages to the revenue of all maritime and non-maritime industries in Africa.

GOOS-Africa elements

While developed nations have formed regional components of GOOS, the GOOS-Africa concept will complement the international nature of GOOS.

Major elements of GOOS-Africa include:

- data measurement and collection systems,
- data and information management,
- data analysis, modelling and products and
- technical assistance, training and technology transfer (capacity building).

Marine data storage and exchange form an important aspect of these elements. Sustainable exploitation and management of the resources in the marine and coastal areas are heavily dependent on adequate scientific knowledge of the physical, chemical and biological processes in the ocean and their interactions with adjacent coastal areas.

Existing data are not easily available to regional scientists and the international oceanographic community due to poor storage and inefficient data exchange facilities like electronic communication systems. The technologically developed nations already have existing facilities to make rapid progress in the implementation of GOOS. However, the African continent has a lot of ground to cover to make the GOOS-Africa concept a reality.

The GOOS-Africa concept definitely will have to deal with the following issues with regard to marine data and information systems:

- data acquisitions systems,
- data analysis, storage and exchange,
- human resources, infrastructure, and
- funding.

Data acquisition systems

The African region has some institutions with modest resources for acquiring oceanographic data. These institutions however lack equipment and resources comparable to those in developed countries. A catalogue of existing equipment and resources for conducting research and collecting oceanographic data for the African region will have to be established. This will ensure the standardisation and compatibility of methodology for acquisition of oceanographic data.

Data analysis

Scientific development in the African continent more or less mimics colonial influence. This introduces some difficulty with respect to language, communication and eventual data analysis compatibility. Data analyses for the different GOOS modules need to be standardised to ensure compatibility with the global GOOS concept.

Data storage and exchange

Large sets of oceanographic data have been collected in the West Africa sub-region through local, regional and international programmes. Many of such data are in either manuscript or analogue forms scattered in local institutions, various governmental, non-governmental and United Nations organizations implementing several marine related projects in the region.

The West African region particularly lags behind the East African region in storage and exchange of oceanographic data. The RECOSCIX-CEA at the Centre for Oceanographic Research (CRO) Abidjan was set up by IOC to assist scientists in the region to exchange data and information and as a dispatch centre similar to the IOCINCWIO in East Africa. So far, this centre is yet to take off due to lack of facilities and funds. Most West African institutions lack electronic communication facilities to interact with this centre when it becomes fully operational. Even where electronic communication exists, the cost of operating the communication facilities is high and beyond the reach of local institutions and scientists.

Human resources

The region lacks adequate human resources for the collection, analysis, storage and exchange of oceanographic data. Pilot projects for development of human resources will be needed for the effective take-off of GOOS-Africa. Many regional and international marine related projects like Gulf of Guinea LME, and other LME’s like the Benguela, Somalia and Canary. IOC and UNEP programmes have human resources development components in their programmes. However there is need to co-ordinate these humans resources programmes that have data management and exchange ingredients.

Infrastructural facilities

Due to the lack of advanced technology, Africa lags behind in oceanographic infrastructure and facilities. In most cases, oceanographic research is hampered by lack of equipment; badly equipped laboratories and lack of spare parts even when modern instrumentation are available. Provision of infrastructural facilities with modest oceanographic equipment backed by an efficient maintenance programme will be required for the GOOS-Africa data management and exchange component.

Funding

The implementation of GOOS is almost entirely dependent upon the co-operative participation of marine observing and research centres, industries and non-governmental agencies. Existing facilities and projects may not be able to accommodate the funding required for the planning and operations of GOOS-Africa. Hence a special provision for funds must be made to hold a GOOS-Africa workshop, prepare the GOOS-Africa strategy, collation, storage and exchange of data. Towards this goal, a means of getting certain industries, financial institutions and other donor agencies to fund a GOOS-Africa data storage and exchange pilot project will be much needed.

Conclusion

The African continent is presently plagued by a variety of environmental problems such as coastal erosion, flooding, pollution, deforestation, salt water intrusion, loss of biodiversity – to mention a few. These problems are better addressed through a holistic approach employing the principle of Integrated Coastal Area Management.

The principle of Integrated Coastal Zone Management is usually in response to (1) the need to protect and preserve threatened coastal resources such as land, water, air, scenic and aesthetic values, beaches, estuaries, barrier islands, lagoons etc, and (2) the need to manage the use of coastal resources in a rational manner, resolve use conflicts and strike a reasonable balance between developing and preserving resources.

The following recommendations are meant to ensure full participation of the West African region in GOOS activities:

- An inventory of existing communication systems including equipment in the region should be undertaken. The proposed GOOS-Africa *ad hoc* Committee, in collaboration with the International Oceanographic Data Exchange and Information (IODE) regional and national co-ordinators, can be mandated to undertake this activity. Such entity will identify the actual problems and seek ways and means of solving them on a local and regional basis.
- A GOOS-Africa workshop was recommended for 1999 to develop a GOOS-Africa strategy implementation plan.
- RECOSCIX-CEA: This project has not been very functional. Efforts should be made to get this regional IODE project going.
- Token financial assistance should be given to identified institutions to assist them towards acquiring communication equipment and paying for connection to the Internet.
- The African component of the Global Ocean Data Archiving and Rescue (GODAR) should be initiated to identify and collate historical data available in the region and other overseas institutions for archiving and rescue.
- Most National Oceanographic Data Centres (NODCs) are not operational due to lack of effective coordination and equipment. Human capacity and constant staff turnover are resulting in lack of continuity of the programme. Efforts should be made to assist countries in the region to ensure functional NODCs.

In the past, the African region lagged behind in the implementation of global oceanographic projects like TOGA, WOCE and the newly established CLIVAR project. The region cannot afford to lag behind the developed world in any future global project, especially the GOOS project if the gap between developed and developing countries is to be bridged. GOOS-Africa should consolidate the foundations of the new regime of the ocean in the 21st century.

The development of a global ocean observing system for Africa

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Introduction

Observational systems as well as data acquisition, analysis and interpretation are an integral part of sustainable development issues. This workshop will define a strategic framework for the effective use of environmental data for socio-economic well-being in Africa.

The Global Ocean Observing System (GOOS) can directly assist Africa in its need for sustainable development. GOOS has been defined in terms of five modules representing categories of perceived user interest. Each module has the potential to contribute to well-being in Africa with local priorities being applied in implementation.

1. *Climate Module:* This can contribute to food security for the countries of Africa through the oceanographic controls of long range rainfall forecasts.
2. *Living Marine Resources Module:* Protein from coastal fisheries is a key component of food security for the people of Africa.
3. *Coastal Module:* Up to thirty per cent of the people of Africa live in the coastal zone and for them, the coast is a resource.
4. *Health of the Ocean Module:* It focuses on the sustainability of the coast as a resource. The cost of pollution from poor development and the enhancement of the quality of life of the people are key issues.
5. *Ocean Services Module:* It will provide immediate environmental information, helping in daily activities by warning of extreme events and by development planning.

With its emphasis on environmental observations for sustainable integrated coastal management (SICOM), GOOS has a relevance to this PACSICOM conference as a whole. The sections below take up the matter of the establishment of GOOS-Africa its potential benefits and its importance to SICOM.

What is needed for GOOS-Africa?

I start by considering the state of data acquisition in Africa. The acquisition of field data in the sense of long term monitoring lies in the hands of national agencies. This is certainly the case for relevant observations in the coastal zone. The national agencies then have the responsibility for exchange and storage, analysis and dissemination. The ability of each national agency to undertake these tasks effectively will depend upon the financial means at their disposal and on local priorities for expenditure. However, advantage can be taken of common regional interests to establish a structure to serve many countries. Where such regional structures involve marine and coastal interests they will be candidates for acceptance into GOOS-Africa.

A longstanding example of regional cooperation, which extends over the whole of Africa, is in the realm of marine meteorological variables, which are routinely collected and disseminated via the Regional Meteorological Telecommunication Network in Africa. The variables include pressure and winds but can be extended to marine variables such as sea state, sea surface temperature (SST) and sea level. Collection points are usually harbours and airports around the coast. The observations are used to provide forecasts of maritime weather and sea state as well as warnings of extreme events such as cyclones for the shipping, fishing and offshore industries and for the navies of the countries of Africa. These activities and their extension to other oceanographic variables will form a natural part of the Ocean Services Module of GOOS-Africa.

Satellite coverage providing remotely sensed marine and coastal environmental data is available from operational and research satellites in real-time and delayed-time modes. The cost of routine operation is high. Sea surface temperature provides the obvious example. It is available in quick-look and digital formats. For example, Meteosat gives good temporal but poor spatial resolution whilst the NOAA series gives good spatial but poor temporal resolution. Waves, colour and altimeter are examples of variables which can be obtained from research satellites. All these marine environmental observations have direct applications in the GOOS user community. Quick-look format observations can be pulled down directly from the relevant satellite by local equipment. However digital data for subsequent analysis and interpretation requires formidable infrastructure and funding. Again advantage can be taken of regional initiatives. The Satellite Applications Centre of the CSIR in South Africa is contracted to various international space agencies and distributes products in digital format at a cost from both operational and research satellites.

Satellite coverage is an example of the increasing use of electronic communication for the transfer of observational data. The necessary infrastructure backbone and Internet service providers are slowly becoming active and reliable throughout Africa. Initiatives such as the World Bank's African Virtual University may also help in the provision of better communications. GOOS-Africa will be reliant on better communications if it is to be effective. In the long term, analysis and dissemination depends on an adequate observational archive. As far as marine data is concerned, a regional facility is available for the sea areas around southern Africa and beyond in the Southern African Data Centre for Oceanography (SADCO). Its area of interest focuses on the southern African region but extends into the wider Atlantic, Indian and Southern Oceans from 10°N to 70°S and from 30°W to 70°E. This includes the sea areas off all the countries of Africa from Sierra Leone in the west to Somalia in the east, the offshore islands and extends down to the Antarctic continent. It complements other regional data centres, which also focus into their own region.

SADCO has holdings from the ocean areas of 70,000 records of oceanographic station data and 300,0000 records of data from Voluntary Observing Ships.

Along the coast of South Africa it holds Marine pollution monitoring records at ocean outfalls, 250 time series of currents and SST from specific projects.

SADCO provides customised products such as inventories of data for selected regions and time periods and histograms, roses and profiles of individual and aggregated data. Raw data can be supplied to on-line customers through e-mail and ftp.

The sponsors of SADCO are the South African government through the Department of Environmental Affairs and Tourism, the South African Navy and the Foundation for Research Development for the universities, the Namibian Ministry of Fisheries and Marine Resources and in the private sector, marine consultants such as the CSIR and RACAL Survey. The sponsors are the principal users of SADCO operating throughout southern Africa and farther afield.

In this discussion of the state of data acquisition storage and dissemination in Africa. I do not wish to give the impression that the situation is satisfactory or in any way comparable to the situation in the developed world. I have emphasised some activities which are reasonably well established and which could form part of the backbone of GOOS-Africa. The situation in the collection and storage of data relevant to sustainable coastal management in Africa for example marine pollution data is far less readily available. It is here that GOOS-Africa will be needed for the future.

A strategic framework for GOOS-Africa

In order to guarantee the success of GOOS-Africa, a solid and realistic foundation needs to be established. This Workshop can provide the means to achieve this. As this conference is concerned with sustainable integrated coastal management some thought should be given to direct ways in which GOOS-Africa can benefit SICOM in Africa.

First of all, I believe that it will be important to recognise that common issues will link countries together and that progress will be made if regional collaboration is encouraged. Sustainable coastal management is an obvious common issue. Others are fishing, offshore oil urban development and the need for capacity building.

The underlying imperative is urban and industrial development in Africa's coastal zone consequent to the burgeoning population levels. Industrial development provides jobs and an enhancement of socio-economic conditions. Urban development provides shelter and a better quality of life. Fisheries and tourism are increasingly important for food and jobs and lead to the concept of the coast as a resource with inherent value. If this value is to be retained and used for the ongoing benefit of the people present developments must not be destructive, as they have been elsewhere in the world. Africa must benefit from the experience of others and embrace sustainable integrated coastal management.

In all these endeavours the availability of high quality relevant environmental data is essential. Only then can proper planning accompany the proposed coastal developments through carefully constructed sensitivity analyses and coastal management guidelines. Adequate environmental impact legislation is essential to guide developers. Mention has already been made of marine environmental observations being used in forecasts to improve the efficiency of industries operating along the coast from tourism and mariculture to mining and harbour operations. The avoidance of coastal degradation and pollution with insidious effects on public health also depend on proper environmental monitoring. The link between SICOM and the five modules of GOOS with particular adaptation to the regional problems of Africa in GOOS-Africa is clear.

In order to build GOOS-Africa into an effective engine towards African advancement, effective support in respect of infrastructure and capacity building is needed. GOOS-Africa as a regional body can be an influential agency for lobbying government's international donors and the private sector in this endeavour.

My own personal view is that the private sector is playing an increasingly important role in ensuring the benefits of coastal development in Africa. I believe that they are willing to be persuaded to finance initiatives such as GOOS-Africa. It is the immediate benefits from marine and coastal services which will catch their attention. But many are already persuaded of the long-term political advantage to be gained from being the protector rather than the polluter of the marine and coastal environment.

Finally it should be mentioned that the formation of GOOS-Africa would establish a new member of the GOOS family. The existing members will welcome the new member in direct ways. Euro-GOOS is influential in the Mediterranean. In turn, Med-GOOS will serve as a strategic alliance between Euro-GOOS and GOOS-Africa. The sponsors of Euro-GOOS are the very international industrial consultants and companies, which are active in the African environment. It is these members of the private sector that I look to for support for GOOS-Africa who will be persuaded that the development of local and regional infrastructure and expertise will benefit not only themselves but also the people of Africa.

Recommendations for GOOS-Africa

1. Link common national interests in the marine and coastal zone into regional initiatives, which can form part of GOOS-Africa.
2. Build on existing activities such as those in marine meteorological services to extend into poorly served areas of interest such as SICOM.
3. Use GOOS-Africa to lobby governments, donor agencies and the private sector to support relevant infrastructure and capacity building.
4. Use Euro-GOOS to actively involve in GOOS-Africa international industrial development companies operating on the coast and offshore of Africa.

CAPITALISING ON EXISTING SYSTEMS

Phase 3 has begun with the creation of a GOOS Initial Observing System (GOOS-IOS), from a number of pre-existing observing systems, each of which will continue to serve the group of clients for which it was originally set up. The systems include: the upper ocean measurements of the Ship of Opportunity Programme (SOOP); the meteorological observations of the Voluntary Observing Ship (VOS) network; data from the fixed and drifting buoys co-ordinated by the Data Buoy Cooperating Panel (DBCP); data from the buoys of the Tropical Atmosphere Ocean (TAO) array set up to monitor El Niño events in the equatorial Pacific; the tide gauge data from the Global Sea Level Observing System (GLOSS); data from the Global Temperature and Salinity Profile Programme (GTSPP); information from the Global Coral Reef Monitoring Network (GCRMN); and communication through the Internet and the Global Telecommunications System (GTS) of the WMO. Data from these systems are supplemented by global coverage of the surface skin of the ocean from satellites, though none of these is operational. Calibration and validation of satellite data relies on ocean surface observations from the GOOS Initial Observing System, and the success of ocean forecasts made by numerical models relies on the integration of remotely-sensed data from satellites with observations of the ocean's surface and subsurface that cannot be made from space.

At this time, apart from the GCRMN, these measuring systems are concerned primarily with physical observations. However, consideration is now being given to what chemical and biological information is required and how to integrate it with physical data. Living marine resources exist mostly in the coastal zone, but the monitoring requirements for living resources and coastal seas remain under development. The challenge is to develop a high quality, integrated approach to coastal monitoring and forecasting, taking into consideration the needs of resource managers. Examples of existing observing systems currently under consideration include the Harmful Algal Bloom (HAB) programme of the IOC; the international Mussel Watch programme; the Marine Pollution and Monitoring Programme (MARPOLMON); and the Continuous Plankton Recorder (CPR) programme.

FULL-SCALE DEVELOPMENT

Phase 4 will be developed over the next 10-15 years. It will involve continued integration of other components like those mentioned above, including new systems, with every attempt to enlarge the range of variables to include chemical and biological ones pertaining to the management of sustainable healthy coasts, including living marine resources and ecosystems.

Data acquisition and information systems in the eastern Mediterranean and Red Seas

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Infrastructure: The institutions in place

There are three main marine data acquisition institutions in Egypt:

- The Department of Oceanography, Alexandria.
- The National Institute of Oceanography and Fisheries, Alexandria and Suez.
- The Institute of Coastal Research, Alexandria.

In the Red Sea, PERSGA, the Programme for the Environment of the Red Sea and Gulf of Aden represents the Regional Organisation for Cooperation and coordination between the countries of the Region in the framework of the Jeddah Convention. Its secretariat is in Jeddah, Saudi Arabia.

Data acquisition

Red Sea

Several monitoring programmes can be found in the Red Sea with the support of GEF and other funding agencies. GEF supports the following programmes:

- Eritrea: A preliminary feasibility study of a programme on "Conserving Coral Reefs in the Red Sea",
- Yemen: Programme on " Protection of the Marine Ecosystem in the Red Sea" and
- Egypt: Programme on "The Red Sea Coastal and Marine Resources Management Plan".

In the Red Sea and Gulf of Aqaba, the so-called "Red Sea Programme" (RSP) is funded and sponsored by a German Agency (BMBF) with participation of Egypt, Israel, Jordan and Palestine. The RSP encompasses seven research projects, including a sea-going programme dealing with the physical and chemical properties of the phytoplankton biomass, and a programme on the physio-ecology of the blooms of the blue-green alga *Trichodesmium.*

There is a fruitful on-the-job capacity building activity in the GEF programme in Egypt, encompassing a large number of junior scientists. Capacity building in the RSP is very limited.

The IOC convened a Workshop in Jeddah in October 1995 on "Oceanographic Input to the Integrated Coastal Zone Management in the Red Sea and Gulf of Aden". The workshop dealt with issues such as oil pollution and the impacts of urban and tourism development. The Workshop agreed on an Action Plan for the Red Sea.

Eastern Mediterranean

There is a continuous data acquisition activity through MSc and PhD research projects. They deal with a variety of aspects such as the level of pollutants in different compartments in the coastal zone, the fluxes from land-based sources, the impacts on benthic and pelagic systems, coastal morphodynamics, the physical and chemical processes. It is to be noted that the data acquisition programmes are usually restricted in time to one year and that no quality assurance is performed. They remain largely in manuscript form and are not communicated to any database.

Data bases and data exchange

There are several databases:

- The National Oceanographic Data Base (in the NODC).
- The GEF Project's Data Bases from the Red Sea.
- The Oil Contingency Programme Data Base.
- The Data Base of the Egyptian Environmental Affairs Agency.

It is to be noted that: the NODC, faced with the reluctance of researchers and institutions to communicate their data, has been unable to carry out a national programme for data collection. It has produced a Climatological Atlas of the Mediterranean Sea based on 24,000 stations in the Mediterranean since 1910. There is no communication between the different databases and not even in between the GEF projects in the Red Sea.

Proposals for a strategy for GOOS-Africa

Institutional

Expected benefits

Behind the rationale for the participation of the countries of Africa is the conviction that the continent will derive a multiplicity of benefits from cooperation with this global system. Such benefits include:

- The building of technical and educational capacity in the countries of the continent to allow them to develop the human resources needed to acquire information and "products" for their own socio-economic purposes.
- The generation of data and products that can be applied for the sustained use and the preservation of their marine and oceanic environment.
- To improve their ability to provide food security for their people through the sustainable management of their renewable resources.
- The ability to predict climate changes, their associated extreme events and their impacts on the coastal zone.

1. It is proposed that an IOC sub-commission be established for GOOS-Africa analogous to the NearGOOS sub-commission.
2. Establishment of national and regional coordination Committees to act as management bodies to monitor the operation of the system, to further the implementation of the plans and to advise the participating countries.
3. Establishment of national and regional data centres where needed and to support those already in place. The exchange mechanisms and the formats will be agreed upon.

Data acquisition

1. Enhancement and upgrading of the structures in place.
2. Agreement on an initial set of basic variables to be monitored and on an incremental programme.
3. Collection, assessment and sifting of available data and information.
4. Agreement on data quality assurance procedures including:
   - Intercalibration exercises.
   - Training workshops and capacity building programmes.

Data for SICOM in western Africa: Regional/sub-regional marine data and information collecting processing systems

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Introduction

In the GOOS (Global Ocean Observing System) Strategic Plan it is envisaged that GOOS “will depend almost entirely upon the co-operative participation of national marine observing and research agencies, industries and non-governmental organizations”.

This paper outlines some of the data collection and management efforts by institutions in the West African Region (from Morocco to Equatorial Guinea, i.e. the area approximately covered by the FAO Fisheries Committee for the Eastern Central Atlantic, CECAF) and their possible utilisation in GOOS.

Information system in relation to living marine resources: State of data and ressources

In many of the States in the Western African region, there are research institutes charged primarily with the study of oceanography and fisheries. Examples are the Institut Scientifique de Pêche Maritime (Morocco), Centre National de Recherches Océanographiques et des Pêches, (Mauritania), and Centre de Recherche Océanographique Dakar-Thiaroye (Senegal), Centre des Recherches Océanologiques (Côte d’Ivoire), the Marine Fisheries Research Division (Ghana) and the Nigerian Institute for Oceanography and Marine Research (Nigeria). Where there are no such institutions, data collection and some aspects of research are carried out in university departments (e.g. Sierra Leone) or Fisheries Departments (e.g. The Gambia and Togo).

Primary data collection and management could either be the sole responsibility of a research institute as in Ghana (Koranteng, 1989), or a number of institutions (research, fisheries administration etc.) as in Mauritania, (Maus, 1997).

Marine research activities in the region which could be of relevance to GOOS include observation of physical processes in the coastal area (e.g. sea surface temperature, salinity etc), study of profiles of water masses, primary and secondary productivity and remote sensing of oceanographic parameters (e.g. surface temperature and ocean colour). Other activities are trawling and acoustic surveys for the assessment of fishery resources and catches assessment. Although most of these activities are national in character, there is a limited level of sub-regional collaboration in these research and data collection efforts (e.g. in countries of the Commission Sous-regionale des Pêches, CSRP i.e. Mauritania to Guinea and in the western Gulf of Guinea, i.e. Côte d’Ivoire to the Republic of Benin).

Management (processing, archival and retrieval), dissemination and utilisation of the data pose serious problems in many of the countries. In the region, there are different levels of competence needed in these activities. Whereas some of the countries (e.g. Morocco, Senegal) have elaborate data management systems including fisheries databases, others (e.g. Togo, Benin) do not have the capacity in this respect. It appears that the level of competence and availability of material resources depend on the importance of the fishery sector in the national economy. In recent years, many countries in the region facing financial difficulties, have had to reduce their capacity for collecting and analysing oceanographic and fisheries data and also for manpower training for such activities (Nauen et al. 1996).

Inadequate communication links between institutions hinder the dissemination and sharing of information between States (Nauen et al. 1996) and even within States (Maus, 1997). Presently, no elaborate databases of regional or sub-regional nature exist in the West African region. Initiative for the establishment of such a system was taken by the Ministerial Conference for Fisheries Cooperation between States Bordering the Atlantic Ocean (Anon, 1993). To date, the intended product, a regional maritime database (BDRM) has not materialised but the development of a Fisheries Information and Analysis (FIAS) which includes a prototype of the BDRM is receiving attention in the CSRP area (McGlade and Nauen, 1994).

What is needed for GOOS-Africa?

Co-ordinated and sustained data collection is a problem in many States in the region. Available data are usually fragmentary and/or are presented in a format unsuitable for serious analysis of such data. Often, the time series of data is either too short or rather incomplete. Even where pertinent information exists, these are often not thoroughly analysed. Initially, the efforts of GOOS could be directed at “mopping up” all such data and making them usable and useful for public or private planning and decision-making. This initial exercise which needs to be carried out with collaborating institutions in the region will lead to the identification of the types of information that States are capable of collecting using their own resources. The data could then be organised in suitable databases for GOOS working groups and be made accessible to all collaborating institutions and the scientific community. Marine scientists in the region have relied on externally produced databases like the Comprehensive Ocean Atmosphere Data Sets, COADS (Woodruff et al.; 1987).

The question of identifying or defining effective linkages between data sources and coastal management issues has featured prominently in the agenda of several scientific gatherings in the West African region (e.g. see Koranteng, 1993; Anon, 1993; McGlade and Nauen, 1994). Basic infrastructure (e.g. for acquiring remotely-sensed data) is lacking in many countries in the region even though a good number of scientists of the region have received training in this field of expertise. Such scientists could be identified and their institutions strengthened to contribute to GOOS programmes.

Given the precarious situation of the economies of many of the countries in the region, including those undergoing structural adjustment, it is obvious that initially, funding for GOOS-Africa has to be sought mainly from outside the continent. One approach would be to incorporate GOOS activities in GEF-assisted large marine ecosystem (LME) projects, especially those in a preparatory phase. For the moment close links could be forged with operational GEF projects like the Gulf of Guinea LME project.

A possible way of seeking effective involvement of decision-makers is to identify co-ordinating and focal point institutions in participating countries. The Gulf of Guinea LME project uses such an approach. In recent years, it appears that donor agencies give more consideration to projects of regional or sub-regional nature than national ones. GOOS-Africa could assist sub-regional groupings to formulate GOOS-related research and monitoring activities that could be presented to donor agencies for consideration. One such project could be identifying some existing research institutions and equipping them to serve as regional centres of excellence dedicated to specific ocean monitoring activities. In this way expertise and equipment could be shared, data collection would be co-ordinated and complementary thus avoiding duplication of efforts.

What can be achieved? What are the benefits?

Prospective benefits of GOOS are numerous both in the short and long terms. In the West African region, especially the countries in the north, fishing is an important component of the national economy. The upwelling that occurs in the region (almost permanent in the north and seasonal in the south) holds the key to the nature and condition of fishery resources in the region, especially of pelagic resources. Therefore, observation systems, which would facilitate the forecasting and monitoring of upwelling conditions (i.e. onset, duration and intensity) will be beneficial to the management of the fisheries. A regional or sub-regional co-ordinated observational system will contribute greatly to the understanding of a phenomenon that occurs on such a large scale as the upwelling.

Nearshore processes, like freshwater input to the sea from rivers, rainfall and pollution also have appreciable influence on ocean climate and dynamics of marine resources (Koranteng, 1998). The tudy of relevant parameters in this area can be achieved through GOOS.

Recommendations

a) An inventory of existing relevant data may be undertaken as a GOOS-Africa activity.
b) To be able to participate effectively in GOOS-Africa, countries could be assisted to formulate regional or sub-regional projects that could be presented to donor countries and organizations.
c) Establishment of sub-regional observatories and centres of excellence in oceanographic and marine research.
d) Networking.

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CAPACITY BUILDING FOR GOOS: DEVELOPMENT NEEDS AND REQUIREMENTS FOR EASTERN AFRICA

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The participation of eastern African countries in global oceanographic programmes like the Tropical Ocean and Global Atmosphere (TOGA), and the World Ocean Circulation Experiment (WOCE), has been hampered by limited capacity for research in physical oceanography and marine meteorology. The network of tide gauges installed with assistance from the University of Hawaii, within the framework of the TOGA programme, is the best-developed ocean-observing network in the region. In recent years several bilateral, regional and multilateral initiatives have been arranged to try and develop capacity through both manpower training and the provision of equipment. The biological and fisheries sciences, in particular have benefited substantially, from these initiatives. However, a lot still remains to be done to ensure availability of a critical mass of scientists and technicians which will enable the region to develop an ocean observing system, and participate meaningfully in global oceanographic programmes.

INTRODUCTION

Sustainable development of our natural resources is hampered by our inability to detect emerging environmental problems at an early stage when remedial measures are still possible. This inadequacy is more pronounced in the marine environment. But our knowledge of the ocean, and humanity's impact on it is only now beginning to recognise the complexity and interdependence of all aspects of the system.

The conventions (Framework Convention on Climate Change, and Convention on Biological Diversity) which were signed at United Nations Conference on the Environment and Development, held in Brazil in 1992, commit us to establish an adequate observing system for understanding and monitoring change. Improved knowledge and predictive capabilities will be the basis for more effective and sustained use of the marine environment, with the associated economic benefits. These will depend on the existence of a reliable ocean observing system.

THE EASTERN AFRICAN COUNTRIES

The eastern African marine regions includes the coastal and the oceanic water between 11°54'' North and 28°30'' South (the latitude of the southern coral communities of Maputaland, South Africa) and extends from the coast of Africa to 65° East. The states of the region are Somalia, Kenya, Tanzania, Mozambique and South Africa along the mainland coast, and the island States of Comoros, Seychelles, Mauritius, Madagascar, Mayotte and La Reunion (France), and the Chagos Archipelago (a British Indian Ocean Territory).

The region is covered by the Intergovernmental Oceanographic Commission's Regional Committee for the co-operative Investigation in the North and Central Western Indian Ocean (IOCINCWIO), and is also referred to as the Western Indian Ocean region. The region is the scene of some interesting oceanic processes. These include the seasonally changing Somali Current, the East African Coastal Current, the Equatorial Counter Currents, and the Mozambique Current. Their behaviour is closely linked to that of the monsoon winds, which reverse directions seasonally, thus making the response of the Indian Ocean circulation markedly different from the oceans.

The coastal areas in the region are getting more attention due to development of tourism and other industries. The importance of the coastal areas, and the need to understand the behaviour of the ocean, and the latter's interaction with the land and atmosphere is now recognised by the coastal states. However, the high cost of facilities required for oceanographic research (e.g. research vessels and equipment) coupled with the shortage of trained personnel has hampered the development of this field. Whereas fisheries research and management capabilities of the countries of the region have been developed over the past few years, the development of the capacity for physical oceanographic and marine meteorological research has been relatively slow. This is because, unlike fisheries, the benefits of oceanographic research are not immediately obvious.

GOOS and related activities in the eastern African region

The Global Ocean Observing System (GOOS) will ensure global, permanent, systematic observations needed for: forecasting climate variability and change; assessing the health or state of the marine environment and its resources, including the coastal zone; and supporting an improved decision-making and management process. GOOS will be established by Member States of the Intergovernmental Oceanographic Commission (IOC), and implemented through nationally owned and operated facilities and services. GOOS will, as far as possible, build on existing activities, bodies and programmes of the IOC and World Meteorological Organisation (WMO).

Global Sea Level System

The IOC approved a plan for development of a Global Sea Level Observing System (GLOSS) in 1985. GLOSS consists of a network of sea level measuring stations. These provide high quality standardised data from which valuable sea level products are produced both for international and regional research programmes and for practical applications at a national level. GLOSS also provides useful information on sea level variations related to climate change. Under the GLOSS programme, seventeen sites were proposed for the IOCINCWIO regional workshop on Causes and Consequences of Sea Level Changes on the Western Indian Ocean Coasts and Islands, held in Mombasa in 1991. The workshop recommended the establishment of 15 extra sites that were of national or regional importance.

The TOGA Sea Level Centre, in collaboration with the University of Hawaii, has assisted in the installation and maintenance of a number of sea level stations in the region since 1986. The Permanent Service for Mean Sea Level in the United Kingdom has provided basic training for some technicians from the region. There is a need to review the status of the sea level observing network in the region, the achievements of the programme, shortfalls as well as measures which should be taken not only to ensure that the stations operate, but also to complete the proposed regional network.

IOC, together with the United Nations Environment Programme (UNEP) and The World Meteorological Organisation (WMO), have launched a Pilot Activity on Sea Level Changes and Associated Coastal Impacts in the Indian Ocean. The activities of this project will include: (i) overseeing/assisting in data collection and data transmission in collaboration with appropriate national agencies; (ii) data storage and analysis aimed at understanding the data, and products useful for coastal management. A training course on analysis of sea level data, including tide prediction was held at the National Institute of Oceanography, Goa, India, at the end of 1995 within the framework of this project.

International Oceanographic Data and Information Exchange (IODE)

The participation of eastern African countries in the IODE programmes is minimal. Kenya and South Africa have established National Oceanographic Data Centres (NODCs), while Tanzania has had a Designated National Agency (DNA) for oceanographic data management. However this DNA has not been active. There are no other oceanographic data centres in the region.

The need to develop capacity in the collection, analysis and distribution of data and information from the oceans and all seas was one of the components of Chapter 17 of Agenda 21. This was to be done through strengthening of national scientific capabilities for data collection and analysis, creation of national databases, linking of these databases to existing data and information services and mechanisms and cooperation with a view to the exchange of information and its storage and archiving through global and regional data centres. This strategy is perfectly in line with the IODE programme:

- Adhere to the IODE data management procedures and ensure the use of standard methods for data collection and storage in the region.
- Ensure access of scientists in the region to data sets not located in the region including satellite data sets.
- Develop and disseminate data products for the benefit of scientists and policy makers in the region.
- Establish exchange of data and information with the World Data Centre (WDC) Oceanography.

TROPICAL OCEAN AND GLOBAL ATMOSPHERE (TOGA) AND WORLD OCEAN CIRCULATION EXPERIMENT (WOCE)

In 1985, the World Climate Research Programme (WCRP) initiated the ten-year TOGA Programme to study inter-annual variability driven by the coupled tropical ocean and global atmosphere system. WOCE was launched as a WCRP Programme to study the circulation of the global ocean that so forcefully influences the behaviour of the global climate system on long time scales. The principal observation phase of WOCE began in 1990 and was concluded in 1997. The TOGA and the WOCE programmes represent a major contribution to our understanding of the World Ocean and the ocean-atmosphere coupling.

Centres and groups have been established in several countries worldwide to analyse and interpret the data. In the IOCINCWIO region, little has been done in this regard, though scientists from the region have participated in some of the research cruises within these programmes. Factors contributing to this include: lack of facilities for data collection, limited access to data collected by other groups within the programme, lack of skills for analysing and interpreting the data.

During the third session of IOCINCWIO (Mauritius, 14-18 December 1992) the Regional Committee noted that with regard to ocean dynamics and climate:
"That the region's capabilities to interpret and use the results from large-scale experiments like TOGA and WOCE are very limited. There is a need to enhance this capability and train human resources to both use the data and interpret the results so as to provide advice on actions to the governments..."

Two measures were proposed to remedy this:

- The data can be delivered to Member States through the RECOSCIX-WIO Dispatch Centre where relevant facilities exist.
- A regional workshop should be organised to consider the results of the TOGA and WOCE experiments, to assess the level of participation of the countries of the region in the TOGA and WOCE programmes, to identify gaps in data collection which need to be addressed by local data collection, to relate the TOGA and WOCE results to regional needs; to advise on the continuation of TOGA programmes in the region (e.g. sea level network) at the end of the programme, and to advise on strategies for participation in other related programmes, especially GOOS.

INSTITUT DE RECHERCHE POUR LE DÉVELOPPEMENT (IRD, FRANCE)

IRD (formerly ORSTOM) has set up four oceanographic databases for the Indian Ocean by gathering, validating and compiling, into standard formats, oceanic measurements collected by different institutions. These are:

- *Oceanographic cruise measurements*, consisting of hydrographic stations of the oceanographic cruises carried out in the Western Indian Ocean from 1906.
- *Vertical profiles of sea temperature*, containing extracts of temperature from oceanographic cruise measurements – BT, XBT and CTD cats.
- *Sea surface parameters*, containing ship data transmitted through the meteorological network, from tuna purse seiners, from log

sheets and specific forms filled by ship masters, water samples taken by observers on board purse seiners and analysed at an IRD laboratory.

- *Remote sensing satellite measurements.* A satellite receiving and processing station was set up in Reunion under a programme named "Survey of Environment Assisted by Satellite" in 1989. It archives and processes high-resolution data from NOAA and ERS-1 satellites. IRD also maintains a network of ocean temperature observation stations on the following islands: Comoros, Madagascar, Mauritius, Seychelles and Reunion.

Biodiversity programme

The Eastern Africa Regional Office of the World Conservation Union (IUCN) initiated the Eastern Africa Marine and Coastal Conservation Programme in order to catalyse a Western Indian Ocean marine biodiversity programme that would comprise initiatives in coral reefs, threatened species, marine protected areas and integrated coastal zone management. IUCN has also collaborated with several national institutions and international/intergovernmental agencies to implement programmes, which include marine data management in the region.

Coastal and marine environment resource database and Atlas project

The Eastern African Coastal and Marine Environment Resource Database and Atlas is a project coordinated and funded by the Regional Seas Programme of UNEP, with support from the leading institutions in the region and the Belgian Government. Designed to enhance the achievement of the main objectives of the Eastern African Action Plan, the task of the project is to collate existing information on natural resources, and to summarise this in country map sheets. Information relevant to the country will be stored in a geographic information system (GIS) database, allowing regular updating and handling of queries from regional and national institutions.

The individual country sheets will be bound together in the Regional Resources Atlas for Eastern Africa at a later stage. Work on the Kenyan part is completed. The other country contributions will be completed by end of 1998.

Eastern African action plan projects: EAF5/6

The Eastern Africa Action Plan, developed in the early 1980's and adopted by representatives of countries of the region in 1985, provided several activities and actions aimed at improving the management of the marine environment and resources in countries of the region. Programmes initiated within the framework of the action plan include EAF5 – Protection and management of the marine and coastal areas of Eastern African Region, and EAF6 – Assessment and control of pollution in the coastal marine environment. Training on GIS and coastal zone management has been provided to institutions in all countries of the region. Equipment (computers and digitizers) has also been provided to some of the institutions for developing coastal resources databases.

Regional centre for services in surveying, mapping and remote sensing

The centre started to operate in 1975. It is an intergovernmental institution operating under the auspices of United Nations Economic Commission for Africa and the Organisation of African Unity. It serves the following twenty-two countries in the sub-region: Botswana, Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, Somalia, Swaziland, Sudan, Tanzania, Uganda, Zambia and Zimbabwe. The objectives of the centre are to:

- Provide natural resource and environmental data through the use of techniques such as: surveying, mapping, remote sensing, geographic information systems.
- Provide training for nationals of Member States in the fields indicated above.

- Carry out studies and research in surveying, mapping, remote sensing, and geographic information systems, and make available to Member States the results of the studies.
- Provide advisory services to Member States, upon request, on problems relating to natural resource and environmental information.
- The centre has arranged several training courses on the use of remote sensing, for oceanographic studies, in collaboration with other agencies including UNESCO and IRD. There are also plans to establish a Hydrographic Information Centre.

The approach to GOOS and national commitments

From the foregoing, it can be concluded that some programmes related to GOOS are already being implemented in the region. The most active and promising one is the sea level monitoring programme. Since several of these programmes are interrelated, there is a need to co-ordinate them better, so as to make optimal use of the resources available.

The member states of the region should strengthen their national oceanographic institutions and facilities. Operational management of GOOS components will require close collaboration between different national agencies, such as meteorological services and research institutions, and close interaction with the marine user community. A national commitment is required. In the Eastern African region there is a need to establish or strengthen the national institutions responsible for the marine environment. For proper coordination there is a need to establish a national GOOS committee, which will be responsible for defining the resources and resource requirements.

Further, countries should establish an officially designated GOOS contact for existing and new data collection activities. Finally, priorities for the local and national implementation of GOOS related training needs and opportunity should be established.

Capacity for GOOS in the region

The capacity available for the implementation of GOOS programmes in the region is limited. There are several training initiatives, including a regional post-graduate programme in physical oceanography. This programme is executed jointly by the universities of Gothenburg in Sweden and Dar es Salaam in Tanzania. The Swedish International Development Authority (SIDA) sponsors it. The Fundamental and Applied Marine Ecology programme, sponsored by the Belgian Agency for Development Cooperation and executed by the Free University of Brussels in Belgium, has also offered training opportunities for scientists from the region.

However, the opportunities these offer have not been sufficient to develop a critical mass of scientists in the region. The training for technicians is one area that has been ignored in most of the countries of the region. Frequently the trained scientists lack facilities for research/monitoring activities when they return to their home institutions.

The recently established Western Indian Ocean Marine Sciences Association has introduced a Marine Research Grant with support from SIDA and the IOC. Funds available through this programme are limited and usually only cover the field allowances and a limited amount of purchases (fuel, stationary etc.). There is a need for a programme to strengthen the capacity of institutions in the region. This should also include a capacity to repair and maintain oceanographic equipment, as many institutions lack this facility. As a consequence, donated equipment can often not be used, as it cannot be repaired.

The lack of a research vessel has been one drawback to develop a research capability in the region. Only Mozambique has an ocean-going vessel that could be converted for research. The National Institute runs the vessel for hydrography and navigation with support of the Danish Agency for International Development.

The purchase and maintenance of a research vessel is still beyond the means of most of the institutions in the region. So one should explore the possibility of chartering a research vessel available for a certain period per year. It is essential that the Eastern African marine scientists and technicians be appropriately trained in the methods and procedures of GOOS. They should also be encouraged to carry out monitoring and assessment programmes related to GOOS with assistance, guidance, and logistic support from more experienced institutions in the developed countries.

Substantial training, education and mutual assistance efforts and technology transfer initiatives need to be launched to enable all countries in the Eastern African Region to participate in GOOS and to interpret and apply the resulting data, end-products and information. Many countries in the Eastern African Region suffer from a lack of facilities and skilled personnel to analyse and interpret the data, and even to make use of end products. Capacity building in GOOS can result only from the following:

- Long-term commitments and partnerships between developing and developed countries.
- Identification and use of new local and external sources of support.

There is therefore, an urgent need for partnership between developing and developed countries.

Conclusion

The manpower available for oceanographic research in the Western Indian Ocean region has improved significantly in recent years due to the various initiatives launched by SIDA, IOC, UNEP and other organizations. However, these are still underutilised because of the lack of appropriate infrastructure, including equipment and research vessels. The training of technicians has not been adequately addressed. In many instances equipment lies idle as trained technicians and/or spare parts are not available.

The only operational observing systems in the region are: 1) the sea level network developed with assistance of the University of Hawaii, and 2) the ocean temperature stations maintained by IRD in Comoros, Madagascar, Mauritius and Seychelles. There is a need to complete the sea level network and extend the temperature stations to other countries in the region.

The participation of these countries in the Voluntary Observing Ship programme, and the Drifting Buoy programme has also been minimal due to the lack of resources. It will be difficult for some of the countries to provide sufficient resources for the participation in these programmes. There is therefore a need for collaboration to enable meaningful participation.

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Northern Africa: An integrated approach involving local observations, satellite data and environmental modelling

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Introduction

Intensive industrial and other activities along the coast, including fishing and transportation, as well as the need for protection and rational utilisation of natural resources, demonstrate the importance of coastal seas in the world ocean. It is often due to these activities that there is an immediate need for a better understanding of the coastal ocean.

In addition, the coastal areas have emerged as a sensitive area within the context of "global change", with respect to its role as a land-ocean-atmosphere interface, as signified by the LOICZ (Land Ocean Interaction in the Coastal Zone) core project of the IGBP (International Geosphere Biosphere Programme, 1995). The role of the coastal ocean in the global system, in terms of supporting high rates of primary production and receiving river inputs and pollution from land, the impact of global change on sea-level and ecosystem changes adjacent to the coast, motivate high priorities to be assigned to the coastal ocean.

On the other hand, the interdisciplinary problems of coastal zones, in the context of interactions among the coastal ocean, the land, the atmosphere and the open ocean regions, have not been fully resolved. The above considerations are particularly relevant in the Mediterranean Sea, which is an enclosed basin characterised by a narrow continental shelf and, moreover, affected by strong air-sea interactions induced by local wind (mistral, sirocco, bora etc). Therefore, the open sea processes act almost directly on coastal and shelf waters and, consequently, the evaluation of coastal phenomena (from wave patterns to biomass content) requires the understanding of the physical-chemical-biological characteristics for the whole basin.

The present proposal addresses the implementation of the proposed integrated approach for some selected coastal areas of Northern Africa (Egypt, Tunisia, Algeria, Morocco, and Italy).

Objective description

This project aims to study the physical and ecological conditions of the coastal area of Northern Africa in the framework of operational oceanography, that is the integration of measurements (obtained by marine platforms, ships-of-opportunity and satellites) with modelling for the coupled system atmosphere-marine environment. The research will be structured as indicated below.

Measurements

The combined use of measurements obtained by research vessels, ships-of-opportunity and fixed buoys or platform is foreseen. In particular, the data set will include physical, chemical and biological parameters as nutrients, primary production, phytoplankton and so on. It is well known that the Mediterranean is mainly an oligotrophic system even if coastal/shelf zones show eutrophic characteristics induced by nutrients from river discharges and/or upwelling events. The understanding of the link between the coastal areas and the open sea environment requires long series of data, and then a particular technological effort should address this task. Finally, data and information will be useful for monitoring areas of interest with regard to the degradation at ecologically and economically important hatching and breeding areas, to the reduction of biological resources in commercially important species, to the conservation biodiversity etc.

ACQUISITION AND PROCESSING OF SATELLITE DATA

The acquisition and processing of satellite data mainly refers to the NOAA data (TOVS and AVHRR) for the analysis of spatial and temporal evolution of sea surface parameters (SST and chlorophyll) with particular attention to the formation of some marine features at mesoscale level (vortices, filaments etc.) that are relevant indicators for physical and biological exchange processes between coastal and deep waters.

ATMOSPHERIC MODELLING

This research concerns meteorological forcing modelling, with particular attention to the parameterisation of turbulent fluxes of mechanical energy as well as latent and detectable heat at the air-sea interface. The present scheme for coupling an energy and mass balance at the land surface (named LSPM) and the atmospheric circulation model RAMS will be extended to the coupling of air-sea interactions. The use of the ECMWF analysed fields of wind, temperature and humidity as initial conditions, and of SYNOP ground data during case studies of particular strong meteorological events as boundary conditions is foreseen. The atmospheric forcing obtained in this way will be used to feed the marine models indicated below.

EDDY-RESOLVING OCEAN MODELS (EROMS)

As indicated above, local winds constitute a strong forcing for the Mediterranean basin. The present Limited Area Models (LAMS) are able to reproduce these winds with sufficient accuracy and therefore the coupled marine modelling must deal with the high spatial resolution (less then 10 km) for a 3-D ocean model. Data on wind, heat and mass flux at the air-sea interface, provided by the satellite data and observations, will be used as forcing and surface boundary conditions.

For a better understanding of some small-scale processes, numerical models based on a “process” approach will be developed. For example, the effect of the river run-off on the open sea and/or on the development of such sub-synoptic features as arcs will be shown using this approach.

THE LINK BETWEEN LARGE-SCALE CIRCULATION AND COASTAL DYNAMICS

Besides the local winds, a remote forcing must be considered, i.e. that associated with the large-scale circulation of the basin which includes the coastal area of interest. To assess the open-ocean boundary conditions for coastal dynamics, the framework of nested modelling will be considered. Coming back to the rapid variability typical of the wind-driven dynamics, in order to model it correctly, it is necessary not only to force the coastal model by means of high frequency winds, but it is also required that the eddy resolving ocean model, to which the coastal model is coupled, contain the same high frequency variability. To this respect EROMs forced by instantaneous winds will provide the information on the large-scale circulation.

SURFACE SEA WAVES

Sea surface oscillations, coupled with atmospheric pressure oscillations and exhibiting almost the same period (on an order of about ten minutes or so), have been observed in different coastal regions of the Mediterranean. Conditions which can support the development at such a concomitance and its persistence are a dynamical coupling, at the air-sea interface, resulting in generations of waves by atmospheric forcing through a resonant interaction. In this way, travelling atmospheric disturbance can bring about large amplitude trapped waves near the coast, when their speed is the same as that of sea waves and when their wave number coincides with one of the modes of the trapped waves.

It is still an open question as to what kind of atmospheric conditions are necessary for the onset of gravity waves matching the above conditions (cyclonic circulation, atmospheric baroclinicity and related wind shear, topographic effects).

Further studies on this subject will be useful for improving both the knowledge of conditions which can be prejudicial to coastline stability or to harbour safety, and the parameterisation of mechanical energy exchanges at the air-sea interface in LAM models over the sea.

COUPLED PHYSICAL-BIOLOGICAL MODELLING OF THE MARINE ECOSYSTEM

On the basis of previous studies developed for different basins of the Mediterranean Sea, we will implement a coupled physical-biological model for the Northern Africa coastal area so as to evaluate the different roles played by the forcing terms on the mesoscale dynamics. In particular, the marine circulation model is based upon the GFDL - MOM (Modular Ocean Model) and the biological model involves four state variables: a limiting nutrient, phytoplankton, zooplankton and detritus. The final task is to simulate the patchy structures mainly controlled by mesoscale processes in conjunction with sinking of plankton and nutrient limitation. In addition, as small pelagic fish species experience a plankton phase in the early phase, an attempt will be made to link the observed spatial and temporal distribution of European anchovy *(Enagraulis enchrasicolus)* eggs and larvae in selected areas over the African shelf with the output of the implemented model. Forcing and boundary conditions will be provided by local measurements, satellite data and meteorological parameters obtained by the LAM.

Protection of biological coastal resources by artificial reefs

Experiments carried out along the coasts of the European countries showed that it is possible to increase exploitable biomasses through the deployment at artificial reefs of the coastal areas. In fact, a reduction of mortality rate during the recruitment phase prior to fishing, protection of juveniles, increased food availability as well as protection for a certain number of adults in order to attain a recovery of depleted stocks and an increase in the exploitable biomass.

Three types of artificial structures can be distinguished:

1. Protective extended artificial reefs to preserve existing habitats (soft bottom nursery *Posidonia* beds, corraligeneous biocenoses located on the continental shelves etc);
2. Productive artificial reefs, which form new habitats (i.e. complex ecological systems);
3. Multi-functional mixed artificial reefs, which combine the characteristics of the aforementioned types and which can be integrated with mariculture initiatives.

The preliminary research should include:

1. Analysis of existing small-scale fisheries, including socio-economic aspects;
2. State of coastal resources;
3. Choice of suitable sites for artificial reef deployment;
4. Planning of artificial reefs and development of a management plan. Subsequent research will be necessary to follow the biological and socio-economical effects produced by reef deployment.

INSTITUTIONS INVOLVED:

- Istituto Talassografico, CNR, Trieste
- Istituto per lo Studio della Dinamica delle Grandi Masse, CNR, Venezia
- Istituto di Biologia del Mare, CNR, Venezia
- Istituto per lo Studio delle Metodologie Geofisiche Ambientali, CNR, Bologna
- Istituto per la Pesca Maritima – CNR, Ancona and other Institutes belonging to the Italian National Research Council (CNR)

Besides the above-mentioned institutions, the following university departments will be involved:

- Dept. of General Physics, University of Torino (Prof. A. Longhetto)
- Dept. of Science and Advanced Technologies, University of Alessandria (Prof. P. Trivero)
- Dept. of Mechanics and Aeronautics, University of Rome (Prof. P. Orlandi)
- Dept. of Aerospace Engineering, University of Rome (Prof. C. Ulivieri)
- Dept. of Physics, University of Rome (Prof. S. Improta)
- Dept. of Engineering and Environmental Physics, University of Potenza (Prof. V. Tramutoli)
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The development of GOOS in the Indian Ocean

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Introduction

Of five GOOS modules (as outlined previously, e.g. G. Brundit's paper), the first (climate) and third (coastal) modules are of primary direct concern to Africa and the Island States of the Indian Ocean, though the other three modules are also of great importance to several socio-economic sectors. However, it should be admitted that the climate module is much more advanced in development on a global scale as it has benefited from various ongoing operational programmes.

In the Western Indian Ocean and Africa, GOOS is still in its infancy. A first attempt to initiate this programme in the region was made by WMO and lOC as follows.

Western Indian Ocean Marine Application Project (WIOMAP)

A first Implementation Planning Meeting to discuss this project was held in Mauritius from 20-22 May 1997. This project is a regional contribution to GOOS in the Western Indian Ocean and its main purpose is to enhance operational marine services in the region based on applied research and on the greater accessibility and exchange of scientific data. The main activities will include:

- coordination and enhancement of national observational efforts in the expansion of data collection arrays,
- the establishment and upgrading of electronic communication for data and product exchange,
- implementation of an overall regional data management facility, and
- development and improvement of regional marine modelling capabilities, preparation and dissemination of products to enhance marine prediction service.

A project brief and project outline was submitted in May 1997 to the GEF Regional Co-ordinator for Biodiversity and International Waters (Africa), New York through UNDP (Mauritius) with a request to provide funding for the preparation of full project proposal. No response has been received so far.

Status review

Data

Routine marine observations in the western and central Indian Ocean are very limited. Prior to the eighties, Coastal Radio Stations (CRS) in the region used to receive ship marine meteorological observations on a routine basis. On some days, 40 ship observations were received in Mauritius. However, with the introduction of Coastal Earth Stations (CES) through INMARSAT, ships equipped with the INMARSAT system are transmitting to CES their observations which do not reach the region through the Global Telecommunication System of WMO with the result that messages reaching CRS have dwindled considerably. At present hardly 5 ship observations are received by CRS. This will gradually be phased out now that the Global Maritime Distress Service system will become fully operational (on 1 February 1999). CRS is the only communication with ships in the region.

However, it is known that non-routine data collection is being conducted by various national meteorological and oceanographic agencies – universities, research institutes (fisheries), research scientists from both outside and inside the region – on an *ad hoc* basis for specific purposes related to particular programmes. There is no exchange of these data among individuals or institutions.

Communication

The main communication systems for the exchange of marine meteorological and oceanographic data and information (for instance, surface and sub-surface temperature) are the WMO Global Telecommunication System (GTS) and the Meteorological Data Distribution (MDD) system operated through the Meteosat. These systems are currently inadequate for the distribution of marine data and products. Other means such as the Internet should be exploited for the purpose.

Regional and global observing networks

GLOSS is one of the global oceanographic programmes. It is well established and was developed within the framework of TOGA programme. However, following the completion of TOGA (1995), funds are no longer available to maintain these regional GLOSS stations and many of them are no longer operational due to lack of spare parts and consumables.

Concerning VOS/SOOP, many countries in the region have merchant ships, which are not participating in these programmes (except South Africa) due to lack of appropriate infrastructure (Port Meteorological Office), equipment such as ship's automatic weather station and training. Regular measurements of sub-surface temperature are being made on only a few XBT lines – Bombay – Mauritius, Red Sea – Reunion – Red Sea – Australia.

The International Buoy programme of the Indian Ocean is now developing and, judging by the number of observations originating from this source, this programme looks promising.

In the light of the above, considerable effort should be made to develop and strengthen the marine and oceanographic data network in the region.

A proposed programme

TAO is now well established in the Tropical Pacific Ocean and PIRATA is being developed in the Tropical Atlantic. However no similar programme is being planned for the tropical Indian Ocean, besides the Japanese who have proposed two moored buoys on the Equator in the Eastern Indian Ocean.

The Tropical Indian Ocean has many peculiarities which are unique. For instance, the annual reversal of the wind and ocean circulation regimes should be studied in order to gain an understanding of climate variability in the Indian Ocean and its links with systems in other parts of the globe. To make the global tropical ocean observational network complete, it is imperative that a programme similar to TAO and PIRATA be established in the Tropical Indian Ocean. It could be given the acronym AMBITION (Array of Moored Buoys in the Tropical Indian Ocean Observation Network). It is proposed that an array of moored buoys be established every 15° longitude extending from 100°N to 150°S. An additional 5° latitude is proposed for the South Indian Ocean, particularly in the southwest Indian Ocean so that tropical cyclones, which have profound impacts on socio-economic activities in the region, be monitored more closely. From recent discussion with the Deputy Director of the National Institute of Oceanography of GOA, India, it is understood that arrays of moored buoys in the Indian Ocean have been proposed within the framework of lOCINDIO. It is hoped that information on the project will soon be forthcoming following arrangements made with GOA.

Coastal module

Several projects on coastal management are underway (examples are UNEP's EAF/14 Regional Seas programmes and the integrated coastal zone management programme of the Indian Ocean Commission) or are being proposed for the region. Agenda 21 of the Rio Earth Summit has emphasised that, for developing countries, coastal resources for sustainable development should be explored and exploited. The impact of climate change and sea level rise on coastal zones has given a new dimension to the vulnerability of this region. The regular monitoring of this area to identify changes so that remedial measures could be taken in time to avoid further degradation has now become a matter of urgency. However, not much has been done or nobody knows what to do to this end.

Constraints

- Lack of local expertise on coastal monitoring. Though many training workshops have been organised, none has been hands-on training on coastal monitoring.
- No methodology has yet been developed to provide clear guidelines on this issue.

Following the workshop on shoreline changes (Mombasa, January 1996), the follow-up action was the preparation of a manual on methodology for shoreline monitoring. The visit of an expert to gather information for this purpose has been a complete waste.

- No standard format for coastal data archives, if it exists, has been developed.
- Lack of equipment.

The IOC OCEAN PC software has not proved very useful and the assistance promised by lOC to develop a NODC in the region is still awaited.

Perhaps this is an excuse. A very simple method has been developed for coastal monitoring using cheap and simple instrument. Only proper guidance is needed.

Satellite monitoring and data transmission

The Indian Ocean is well covered by polar orbiting satellites, mostly the NOAA series, which are providing satellite images of cloud on a regular basis for operational and research purposes. These satellites and others have also the capabilities to transmit data on sea surface temperature and other oceanographic parameters (for instance, TOPEX/POSEIDON for sea topography). Unfortunately only a few countries in the region, such as Reunion (France) and South Africa, are equipped to receive SST data and the other ocean parameters.

With regard to geostationary satellites, the Indian Ocean is the only region which is not covered. Meteosat 5 has been shifted recently to cover that ocean within the framework of the INDOEX. However, its life span is only for another 18 months. Geostationary satellites have also the capabilities to make observations on other oceanographic parameters such as wave and ocean colour. Not many countries in the region have facilities to retrieve these observations.

In order to transmit short messages, meteorological communities are using Meteosat 6 and 7, which are currently over the Atlantic Ocean. This is a platform which could be considered by oceanographic communities for data transmission.

SPOT and LANDSAT satellites have the capabilities for monitoring the coastal region. Unfortunately exploitation of these images on an operational basis is still beyond the means of African countries and small island states. Both capacity building and financial constraints are issues which should be looked into in order to enable these countries to take advantage of this technology.

Funding

Funding is not considered a problem as GOOS has already been accepted as a programme to be developed under Agenda 21 of the Rio Earth Summit. Needed are well formulated coastal project proposals with clear objectives and convincing practical outputs which could contribute to the sustainable development of coastal resources.

Recommendation

There is no doubt that GOOS will be extremely beneficial to various socio-economic sectors for the exploration and exploitation of both land and marine resources. African countries and the small island states, assisted by regional groupings (e.g. IOCINCWIO, SADC, Indian Ocean Commission) and International Organisations – IOC/UNESCO, WMO, UNEP, ICSU and others) should contribute toward its development and implementation in the region. It is proposed that:

- A workshop/seminar on the economic benefits of GOOS-Africa be organised.

IOCINCWIO-IV (Kenya, May 1997) recommended the organization of a regional awareness workshop on GOOS. GOOS will gain global acceptance if policy-makers and governments are convinced of its economic implications. Hence it should be a forum for interaction among scientists, policy-makers and officials at the highest level. Emphasis should also be placed on the contribution for resources exploitation in the Exclusive Economic zone, which for some countries represents an immense wealth.

- A meeting to discuss regional VOS/SOOP, DBCP, GLOSS and AMBITION and identify the shortcomings of these programmes in the region and how to develop and integrate them into GOOS.

These two meetings should lead to the elaboration of a GOOS-Africa Action Plan.

Regional/sub-regional marine data information systems in the Mediterranean and NW Africa

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Socio-economic setting

The Mediterranean is a semi-enclosed sea between Europe, Asia and Africa and covers about 2,5 million km^2. North African countries (Morocco, Algeria, Tunisia and Libya), or the Maghreb, lie along the southern coast of the Mediterranean.

The Mediterranean marine area is composed of a narrow continental shelf, strategic straits, islands, estuaries, deltas, lagoons, wetlands, rocky coasts – including most of the well-known tourist resorts – and sandy beaches. It is a heavily travelled marine transportation basin, an over-filled sea with high biodiversity, an over-exploited tourist venue and a densely urbanised and industrialised coast. It is one of the most heavily populated regions of the World Ocean. According to the Blue Plan (1989), the population of coastal areas of the North African countries will reach one quarter of the total Mediterranean basin's population by the year 2025. Also a mosaic of different cultures and countries with different socio-economic development levels and technological capacities borders, the Mediterranean and the available human resources there should be taken into account in the future implementation of GOOS.

Marine environmental problems

Mediterranean countries face common environmental problems, calling for the development and adoption of a common strategy towards sustainable development of the basin. The rapid population growth in North African countries will create a good deal of stress on the coastal ecosystems, with the related consequences such as the increasing demand for marine living and non-living resources, the expanding industrialisation, the congestion of the coastal population, the intensification of navigation etc.

The Mediterranean coastal areas are facing the following problems:

- Habitat loss constitutes one of the most severe problems. During the last 50 years, the Mediterranean, as a whole, has lost one million hectares of wetlands.
- Sea pollution: The main reasons for increased levels of pollution are industrial activity, marine shipping and, in several cases, inadequately treated wastewater.
- Coastal erosion: Most of the beaches are estimated to be eroding.
- Sea level rise today presents probably the most severe threat for several countries.
- Extreme events which can damage tourism industry and structural coastal design.
- Water cycle variability (precipitation, river run-off), which is strongly linked to the Mediterranean SST variability.

Conflicts on the use of coastal resources, threats to natural habitat areas, pollution and resource degradation seriously affect the potential of coastal areas for the support of human activities. The long-term future of coastal areas depends on a rational management of coastal resources within the framework of ecologically sustainable economic development.

GOOS and related activities in the Maghreb countries

GOOS will be built on existing marine activities and programmes, capitalise on the availability of scientific data and information and transform them into products and services beneficial to governments, industry and the general public.

The Maghreb countries possess some national institutions and programmes with modest capabilities for the implementation of a sub-regional GOOS network, which is still in the design phase, but the existing scientific infrastructure is promising.

The major international agencies programmes involved in ocean science development in Northern Africa are: IOC, ICSEM, MAP, UNEP, WMO, FAO, and the Mediterranean Information Office (the clearing house of the Mediterranean NGOs). Furthermore, in the framework of the "Renovated Mediterranean Policy", the European Union has built a strong and solid basis for cooperation with North African states. The main purpose of this policy is to reduce the economical and social imbalance of the "Mediterranean Partner Countries" by building and strengthening human capacities.

Mediterranean and Black Sea Network for Sea-Level Observing System (MedGLOSS)

At the first meeting of the Joint IOC-ICSEM Group of Experts on MedGLOSS (1997), it was decided to launch the pilot stage of the MedGLOSS network operational activities. Foreseen within MedGLOSS are the use of satellite altimeters, assimilation of data in numerical models for weather, rain and ocean forecasting, and the establishment of warning mechanisms for vulnerable areas. Data gathered by the MedGLOSS network will be transmitted for quality control, processing and further dissemination and publication to five centres. To ensure quick availability of the regional sea-level data, a quasi real-time monitoring network system will be adopted, using a software package for quasi real-time monitoring and transmission systems.

The pilot network will include the five GLOSS sea-level monitoring stations available in the basin area, and a limited number of sea-level monitoring stations located in countries which already expressed their interest in joining MedGLOSS. Unfortunately none of the North African countries is presently a part of the MedGLOSS pilot network because none of them has reliable operational equipment for sea level monitoring.

Mediterranean Forecasting System (MFS)

The Mediterranean Forecasting System, Science and Strategy Plan has been formulated in the past two years by the EuroGOOS Mediterranean Regional Task Team. The general aims of MFS are to explore and quantify potential predictability of ecosystem fluctuations at the level of primary producers from the overall basin scale to the coastal/shelf areas and for time scales of weeks to months. MFS will show the feasibility of a Mediterranean basin operational system for predictions of currents and biochemical parameters and it will develop interfaces to user communities for dissemination of forecast results. Tunisia and Morocco will contribute to the third phase of this programme.

Mediterranean Action Plan (MAP)

The Mediterranean Action Plan (MAP) was established in 1975 to facilitate an effective implementation of the protocols of the Barcelona Resolution. MedPOL, the scientific and technical component of MAP, was initiated in 1975. Its first phase concentrated on the upgrading of technical capabilities in the institutions of the region. The major achievement of MedPOL Phase II was to set up and maintain national monitoring programmes in the Mediterranean. Certain North African coastal countries are active in this programme. MedPOL Phase III places emphasis on pollution control through the implementation of the land-based sources protocol without neglecting the assessment component, which focuses on trend and compliance monitoring.

Mediterranean regional GOOS (MedGOOS)

IOC organised a Workshop on GOOS Capacity Building for the Mediterranean Region in Valletta, Malta, (November 1997). The purpose of this workshop was to discuss and define steps for the establishment of a regional GOOS body for the Mediterranean, and to assess the needs and requirements for capacity building in the region. In order to meet the needs of GOOS, MedGOOS aims to:

- Promote the transfer of existing marine operational capabilities to operational services in the Mediterranean area, particularly for wave forecasting.
- Develop cooperation with IODE, EU-MAST and EU environment and climate projects and NODC's.
- Produce guidelines for near real-time data and exchange in the Mediterranean region.
- Identify the means and guarantee the availability of fully processed satellite data in near real-time for the Mediterranean region.

Regarding capacity building, it was recommended to promote GOOS awareness at the national level, and to provide training of new professionals for operational oceanography. Among the North African countries, only Morocco was represented at this workshop, but it is expected that Algeria, Tunisia, and Libya will join the MedGOOS network soon.

International Oceanographic Data and Information Exchange (IODE)

The overall purpose of the IODE policy on data management is to facilitate full and open data for global ocean research programmes. The global ocean programme to be carried out under GOOS requires an early and continuing commitment to the establishment, maintenance, accessibility and distribution of high-quality, long-term data sets.

The participation of North African countries in the IODE programmes is minimal. In the IODE Handbook (1994), only Morocco had a National Oceanographic Data Centre (NODC). In the *Information Service Bulletin* on Oceanographic Products issued by national centres of June 1997, Morocco and Tunisia provided a list of surface meteorological and oceanographic parameters monitored in their respective areas.

To increase the participation of the Member States of North African sub-region in the IODE programme, two major activities have to be undertaken:

- Strengthen national capabilities and assist in the development of NODCs,
- Develop a sub-regional data and information network, which shall provide a regional structure linking national oceanographic data centres.

Needs and requirements for GOOS in the region

At the national level:
In North Africa, the major obstacle for the development of a number of regional programmes has been inadequate and insufficient funding and support for infrastructure, training and education. The main needs are:

- political will and commitment to develop marine science in the region,
- increased vertical communication and coordination,
- necessity to transmit products from the ocean science and services community to decision-makers, planners, politicians and the general public, to have a real and efficient impact,
- a permanent action with the authorities concerned must be taken to reserve adequate resources for an efficient functioning of regional network in a time-frame exceeding political, economic and social contingencies,
- there is an urgent need to re-implement North/South partnership for education and training, and to stimulate the activities of the Mediterranean University in the field of marine sciences,

There is a need to establish a national GOOS committee, which will be responsible for defining the national needs, providing an internal network and infrastructure, and identifying resource requirements.

At the regional level:

- The implementation of GOOS in the Med/North African region, will require close collaboration between different national bodies, and close interaction with the marine user community.
- Substantial training, education and mutual assistance efforts and technology transfer initiatives need to be launched to enable all

countries in the Mediterranean to participate in GOOS and to interpret data and apply the resulting data, end-products and information. In this context, and to achieve their objectives, EuroGOOS and MedGOOS will promote transfer of knowledge and equipment from the more technologically advanced Euro-Mediterranean neighbours to the less advanced countries in closer proximity, for a strengthened and concrete "Cooperation-through-participation" scheme.

BENEFITS FOR NORTH AFRICA

North African countries have been faced with a lot of problems due to the underestimation of benefits of operational oceanography. The major benefits of GOOS are foreseen for:

1. Fisheries: The most important benefit for this economic sector will be a better understanding of the natural and anthropogenic factors that affect fish stocks and their variability, by improving models of water circulation, pollution transport etc.
2. Coastal operations: Port building and management, coastal protection etc. GOOS can help engineers to choose the most adequate and sustained design, which will lead to reduced dredging operations and a better protection of beaches against erosion.
3. Meteorological forecasting will produce benefits in improved seasonal and interannual forecasts which will create a statistical basis for improved management of agriculture and water supplies in North Africa and the Sahel regions, since rainfall is correlated to the Mediterranean sea state. Furthermore, improved offshore weather forecasts and sea state forecasts are important for maritime transport and routing of merchant vessels.
4. Public health and safety at sea cannot be preserved without accurate and continuous information about the state of the sea necessary to ensure safety and prevent catastrophic events such as accidental spills of oil and chemicals, toxic algae and blooms, red tides etc.

All these risks could be reduced if we fully adopt the concept of GOOS.

Workshop 3

EARTH RESOURCES AND SICOM*

* Note: Figures, drawings and photos appear at the end of the section.

Introduction

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In the coastal zone, i.e. areas which fringe the continents of the globe, the intricate terrestrial and marine systems become even more complex as they respond to the pressures created by man. Development of coastal earth resources has obvious and profound effects on this environment that can neither be predicted nor controlled without a full understanding of a particular coastal area.

Integrated management of geological resources in coastal zones requires consideration of various direct effects on its environment that may be classified into the following two categories:

- *Natural phenomena*: These comprise problems generated by the effects of natural phenomena on human settlements, for instance erosion, earthquakes and volcanoes.
- *Anthropogenic activities*: These comprise the direct effects of anthropogenic pressure on the environment, for instance the stability of the coastline (erosion and accretion), the viability of renewable or non-renewable geological resources and the pollution of littoral waters.

It shall be noted that professional geoscientists have many of the skills necessary to identify, predict and prevent environmental disasters, but they lack the public awareness that their skills are equally or sometimes even more important than those of other professionals who traditionally work in these fields. Additionally, geoscientists have experience in interpreting the geological record and can therefore apply its implications for future predictions. Traditionally trained geoscientists are most likely to be available in the mining sector where environmental concern is rampant. These personnel can be most easily trained to upgrade environmental awareness, planning and management in coastal areas.

Many environmental hazards are natural processes and it has to be acknowledged that absolute control of these processes is often neither desirable nor possible. Rather, man must learn to live with and adjust to the natural processes that have shaped the Earth through millions of years. The coastal zone, defined as the area at the boundary between the land and the sea and extending inland and seaward to a variable extent, represents an extremely dynamic and vulnerable ecosystem, where natural processes of very different origin take place. Erosion of beaches, for instance, may have been caused either by wave action, littoral currents or sea level changes and is of course undesirable to owners of hotels and cottages, who have made economic investment in beachfront development. On the other hand, it has to be anticipated that land-based sources of marine pollution represent about 75 % of the total, originating largely from human activities such as mining, agriculture and others. Another major hazard comes from the passage of tankers transporting oil and other hazardous substances along the African coast. It is therefore imperative to bring remedial action to the key pressure points. The presentations of this workshop may highlight the need for the African coastal states to develop national policies and management capabilities for integrating the development of multisectoral activities in this region.

The session and its presentations

Within this framework, a three-day long technical workshop on earth resources and sustainable integrated coastal management was organized and convened by UNESCO. In the opening address of the conference, Mozambique's Minister for Coordination of the Environment, Bernardo Ferraz, reminded over 100 invited experts of various scientific backgrounds, that "the coast is one of our most precious resources, but also one of the most vulnerable. Coastal management needs priority attention." PACSICOM brought together scientists, educators, and social scientists from all over Africa, with the aim to elaborate recommendations drawn up by four technical workshops to be used by the ministers as a background for the Maputo Declaration. The latter endorses a list of concrete actions aimed at better, integrated management of coastal resources. For the first time in a meeting of this kind, the week-long PACSICOM conference dedicated one of its major approaches to a workshop in earth sciences, resulting in a resolution that was subsequently incorporated into the joint report of all workshops submitted to the ministerial meeting, which adopted the so-called Maputo declaration.

The workshop on the geological background for sustainable management of earth resources in coastal zones of Africa took place in the setting of the Rovuma-Carlton Hotel in central Maputo from 18-20 July 1998. Invited speakers, under the sponsorship of UNESCO, were convened by the Nairobi UNESCO representative for earth sciences, Thomas Schlüter. Professor Sospeter Muhongo, Dar es Salaam, was elected chairman of the meeting, supported by Ian Wright (Durban) and Seydou Keita (Bamako) as rapporteurs.

Before the opening of the technical sessions, the Minister of Mines and Energy of Namibia, Andimba Toivo ya Toivo, gave a keynote address for the conference. He concluded that geological sciences are indispensable for minimizing the environmental impacts of economic activities and are instrumental for developing remedies for damages that have already occurred or are unavoidable. He discussed the effects caused by offshore diamond prospecting and exploration, for which the Namibian littoral waters are unique. Giving this example he pointed out that mining – by definition – is not sustainable in the long run, but can be seen as part of a sustainable development if it is strategically used to kick-start other developments. Capacity building in earth sciences is therefore required to assure first of all the reasonable exploitation of marine and coastal mineral deposits so that a maximum life of mining operations is assured without any overmining taking place.

The technical session was opened with an introduction by Thomas Schlüter who classified the various direct effects of geological processes on the coastal environment as natural phenomena and anthropogenic activities. Generally speaking, the development of coastal earth resources has obvious and profound effects on this environment that can be neither predicted nor controlled without full understanding of a particular coastal area.

The technical program included 13 presentations by researchers and scientists from 12 countries: Angola, Benin, Botswana, Ethiopia, Italy, Kenya, Mali, Namibia, South Africa, Swaziland, Tanzania and Uganda. Sospeter Muhongo gave an overview on the application of geological knowledge in the exploitation of coastal zone mineral resources with emphasis on the Tanzanian coast. His speech was followed by the presentation of Henri Kampunzu who highlighted the need of capacity building in earth sciences for sustainable development. Norbert Opiyo-Akech discussed environmental aspects of past, present and future mining activities along coastal Kenya. Erosion and human impact on the littoral environment of coastal Angola was the topic of Maria Duarte Morais. The problems involving integrated coastal management in Benin were presented by Sikirou Kola Adam. Herbert Roesener explained some details of offshore diamond mining in Namibia and coastal degradation associated with it. The small island of Zabargad in the Red Sea was referred to by Marco Taviani as an example of integrated coastal management. Ian Wright evaluated heavy metal placer deposits along the Indian Ocean coasts of Mozambique and South Africa. Implications for coastal zone management arising from environmental degradation in Swaziland were described by Patience Fakudze. Various mining activities – and their impact on environmental pollution – were illustrated in the contributions of Seydou Keita, Andrew Muwanga and Solomon Tadesse. A short, more philosophical note by Marco Taviani on past ecosystems as a key for present environmental awareness terminated the oral presentations, which were followed by a lively discussion.

The participants of the workshop then concentrated on the preparation of a document to provide an up-to-date review of the state of affairs concerning earth resources and sustainable integrated coastal management. This document aimed at facilitating discussion at the workshop and clarifying the issues for the benefit of the subsequent ministerial meeting. The contents of this document were adopted by the participants of the workshop as a resolution which is presented in these proceedings (see pp. 263 and 336). This resolution was subsequently incorporated into the joint report of the technical workshops of PACSICOM, of which a shortened version finally came into the executive summary of this conference.

DIAMOND MINING ALONG THE COAST OF NAMIBIA

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1. GEOLOGY

The intense erosion after the break-up of West Gondwana resulted in the formation of the bedrock level towards the end of the Cretaceous. Varying climatic conditions have resulted in the accumulation of a range of different sedimentary deposits and the current arid stage developed some 11 million years ago when the Benguela Current established itself (Ward and Corbert, 1990). The diamond deposits range in age from late Cretaceous to Quaternary but the main deposits are from Pleistocene or younger. The diamonds originate from the weathering of the southern African kimberlites and from the transportation of these sediments down the paleo-river systems westwards to the Atlantic Ocean. The Benguela Current, originating from the Antarctic and flowing northward along the southwestern coast of Africa, as well as along-shore drift, transported these diamonds northwards along the coast.

The diamond deposits occur as fluvial terraces along the paleo-river channel and on the submarine delta from where they were reworked to form beach deposits. The fluctuation in sea-level has resulted in the occurrence of several raised beaches, as well as near shore and offshore deposits. Wind action on the beaches reworked the beach deposits into aeolian deflation deposits, which tend to form in valleys parallel to the dominant southwesterly winds. The diamonds along the Namibian coast were transported over long routes during which the poor quality stones were destroyed and only the high quality stones survived. The result of this is that 95% of the diamonds mined are of gem quality and thus in high commercial demand. The size and abundance of the diamonds decreases northwards from the Orange River, and the largest stone found near Oranjemund weighed 246 carats. The average weight of the stones in the Conception Bay area, some 500 km north of the Orange River, ranges between 0.1 and 0.07 carats (Schneider and Miller, 1992).

2. MINING HISTORY

The first Namibian diamonds were discovered in 1908 in the Lüderitz area and were of the aeolian deflation type. The news of the discovery sparked a diamond rush from Oranjemund in the south to Conception Bay in the north (Fig. 1, p. 266). The continuous mining and exploration efforts led to the recognition of different geological settings in which the diamonds occur. Initially, mining focused mainly on those onshore deposits which where accessible to conventional mining methods. The slow depletion of these deposits as well as the advances made in technological developments allowed the exploration of the offshore areas (Schneider and Miller, 1992). Extensive exploration was conducted from the 1970's and mining started in 1990. Production soared from 29,000 carats during that year to 650,000 carats in 1997 (African Mining, 1998).

3. IMPORTANCE OF DIAMONDS IN THE NAMIBIAN ECONOMY

Diamonds are the most important mineral commodity of Namibia. Since the first mining started, over 60 million carats have been mined. Diamonds make up 72% of the country's mineral production and contribute to 12% of the total GDP. Furthermore, 60% of all export earnings are attributed to diamonds. Initially, all the production came from the onshore deposits, but as these are being depleted, the emphasis has shifted to the offshore areas so that about one third of the production now originates from these marine deposits.

4. Mining methods

Since the early discoveries of diamonds, the onshore mining methods have changed dramatically. Initial mining of the rich deflation deposits was by crawling on hands and knees and collecting diamonds on sight. This method was replaced by processing the sands with sieves and jigs, and as technology advanced, up-to-date mechanisation was employed in the mining endeavors (Fig. 2, p. 266). The amount of moved material increased over the years so that the company concerned was said to be the second largest earthmover in the world.

The beach placer deposits occur along the coastline where several terraces range from raised to submarine beaches. These diamonds tend to concentrate in trap-sites above the bedrock. In order to reach the diamond-bearing gravels, overburden has to be stripped and volumes as high as 58.7 Mt. per annum were moved at one stage. Where the deposits are proven to extend into the sea, a seawall is created which enables the mining to take place up to 19 m below sea level. Large-scale earth-moving techniques like bucket wheels and conventional mechanical methods are used to strip the overburden. The bedrock is then cleaned with handheld suction devices. All the ore is transported to centrally located treatment plants where the waste is dumped and the concentrate transported for further processing to the diamond recovery plants and sorting houses.

Currently, the only deflation surface deposit mined is the Elizabeth Bay deposit. Mining is by means of conventional mechanical excavators and dump trucks. The waste material of the plant is pumped onto the beach within Elizabeth Bay. The mining methods in the offshore environment range from diver-operated suction hoses to highly sophisticated mining vessels. The foreshore deposits are situated between the high and low water marks and are mined from the beach by diver-operated suction hoses. The inshore deposits are situated in the surf zone and extend to about 5 km offshore.

Mining in these areas is also by diver-operated suction hoses, but these are operated from small boats, which are generally converted fishing vessels.

The methods used commonly are hand-held suction hoses which pump loose sediments to shore- or boat-based rotary trommel screening units. In the case of the boat-operated units the waste is dumped overboard. In the shore-based units, the waste is dumped on the shore. The small boats can operate to water depths of about 30 m.

The exploration methods used in the offshore areas consist generally of various geophysical techniques like side-scan sonar, seismics etc. The scale of surveys is reduced over favorable areas and these may eventually be tested by vibro-coring and grab and bulk sampling. Explorations conducted from the 1970’s onwards confirmed the existence of large low-grade diamantiferous deposits on the continental shelf. In the offshore areas several mining methods are employed. The techniques used have evolved with time and advancements in technology have allowed more effective mining recoveries. Two main technologies employing either a drillship (vertical) or a crawler (horizontal) are used. The drilling technology employs a large drill bit (5 m in diameter) which systematically drills into the seabed and the loosened material is lifted to the vessel via a steel pipe. The horizontal technique employs a remotely operated submarine crawler with a mining tool attached to it. The crawler moves on tracks and is thus more mobile and able to cover an area more systematically. In both cases the diamond-containing sediments are airlifted to the boat where they are sorted, screened and the ore-containing concentrate is extracted and shipped to onshore processing plants. All gangue material is discarded overboard. Currently, mining technology allows exploitation of deposits in water depths of up to 200 m.

5. Environmental conditions and considerations

The southwestern coastline of Namibia is extremely arid with Lüderitz receiving an annual rainfall of between 1 and 2 mm. Most of the precipitation is from fog. The average wind speed is between 10 and 25 knots with speeds of up to 60 knots being possible (pers. com. Legnani, 1998). These extreme environmental conditions have resulted into a poorly diversified onshore fauna and flora in this area. The Benguela Current dominates the weather conditions along the south western coast of Namibia. It originates from the Antarctic Sea and flows Northwest along the southern African coast to north of Walvis Bay where its direction changes westerly again. The current is rich with nutrients, which attracts and supports a highly diversified marine fauna.

Upwelling suspends the nutrients and, in the presence of sunlight, phytoplankton flourishes. This results in a diversity of fish which in turn has led to the establishment of a well-developed fishing industry, which, in recent years, has expanded to become one of the cornerstones of the Namibian economy (O'Toole and Bartholomae, 1998). The Benguela System is affected by a variety of oceanographic and atmospheric processes. This in turn influences the long and short-term availability of fish in the coastal zone as the food chain is reliant on the current. The local weather, together with the regional weather patterns like the El Niño, may cause temporally unfavorable conditions for fish to exist or spawn.

The commercial fishing in Namibia ranges from shore to nearshore line fishing and lobster, pelagic mid-water trawling. Prior to independence, the marine resources were overexploited by foreign concerns. After independence, the Exclusive Economic Zone was extended to 200 km offshore. The Namibia fishing industry experienced an upward phase from 1990 to 1993. However, severe environmental conditions led to a downward phase of production from 1993 untill 1996, but normal conditions returned in 1997 (Ministry of Fisheries and Marine Resources (MFMR), 1998).

6. The effects of mining on the coastal and marine environment

The marine environment is dynamic and influenced by both marine and terrestrial factors. Storms on the ocean floor can be severe and change the sub-marine topography significantly (pers. com. Corbert, 1997). Sedimentation may occur in any marine environment, so marine life has to adapt to this. Upwelling cells as well as the regional water temperature change the nutrient and the oxygen availability, which, in turn, influences the food chain. Human activities also have to be considered as an obvious influence on the marine environment. These include mining, fishing, waste disposal, dredging etc. In the Namibian situation, the greatest concern is the effect that mining has on the rock lobster (*Jesus lalandii*) industry. There has been a decrease in the rock lobster population, and the Ministry of Fisheries and Marine Resources was approached by the rock lobster industry to investigate the source of this decrease. In cooperation with the German Agency for Technical Cooperation (GTZ), the Marine Environmental Monitoring Project (Marenpro) was started in 1993 to study these effects. The main effects of diamond mining on the marine environment as reported by Otte (1998) are best described in terms of the type of mining activity described earlier. The onshore mining technology of constructing seawalls and releasing sediments into the sea causes turbidity. Bottom fauna species cannot cope with the shifting and resorting of sediments and seem to have disappeared.

The "suction methods" which are used both from land-based operations and small fishing boats, cause concern where the physical habitat of the rock lobster can be destroyed by moving rocks, removing sediments or subsequently by fine silting. The process of sucking up into the treatment plant can kill the lobster itself. Fine silting may also smother sedentary benthic organisms, identified therefore as being the main area of concern especially in the deeper water areas (Barkai and Bergh, 1996). The same authors also suggest that the disturbance of bottom sediments could lead to the release of undissolved metal sulphides (if these are present in the sediments). The oxidation process may cause a reduced oxygen content of the water which would affect the non-mobile organisms.

When the Minerals Prospecting and Mining Act of 1992 was drafted, the Namibian Government acknowledged the fact that mining has an impact on the environment. According to this Act, Environmental Impact Assessment studies and Environmental Management Plans have now to be submitted prior to any mining licence being issued. As part of the commitment to the Act, most of the mining companies along the coast have submitted the necessary documents. The companies make use of either in-house expertise or specialised consultants to complete the environmental studies required. The Government of Namibia, through its Ministries of Fisheries and Marine Resources, Mines and Energy and Environment and Tourism, is also aiming to get a better understanding of the environmental conditions prevailing and the significance this has on the effective management of the natural resources.

A particular Environmental Management Plan, set up by the Council for Industrial and Scientific Research (CSIR) in 1997 for Ocean Diamond Mining, focuses on the suspended sediments. It is expected that this plume will have a concentration of 20 mg/l, which is much lower than the 100 mg/l required to affect the bivalves' filtering capacity (CSIR, 1998). The Marenpro study came to the conclusion that the decrease in lobster population was possibly caused by changing climatic conditions, as the lobsters in areas where no mining took place, were also affected. The suction pumping of diamonds only takes place over a small area. Some 50% of the material delivered to the boats or shore originated from benthos and, of this material, 95% is made of old shells. Therefore, the mechanical removal of sediments was not regarded as a critical issue. Further experiments have shown that lobsters can avoid being sucked up. However, the purposeful sucking up of lobsters by divers as a means of fishing can not be excluded. Of those experimentally forced into the pipe, the smaller ones survived, but their eventual survival rate was extremely low (Barkai and Bergh, 1996). In the shallow marine areas the destruction of kelp by mining activities causes also some concern, as kelp beds are highly productive biological systems. They provide a unique habitat for a diversity of life forms and any disruption in that particular ecosystem will certainly have an effect (Barkai and Bergh, 1996).

7. Conclusion

Diamond mining in a marine environment is unique to the southwestern coast of Africa. The exploration and mining techniques used were pioneered and developed in this area and large investments have gone into this industry. At the same time, the fishing industry has expanded to become one of the cornerstones of the Namibian economy. Recent global environmental awareness and the concerns raised by the fishing industry have resulted in all parties affected to have a look at the mining industry and assess the impact on the environment. The severity of the impact that offshore diamond mining has on the marine environment is not clear. Many studies still have to be done and, in the absence of historical data, the conclusions are often inferred. The importance of Environmental Impact Assessment studies is well illustrated by the fact that studies in the Namibian waters have cleared the mining industry from accusations of being responsible for the destruction of the rock lobster population. However, there is no doubt that offshore mining, like any other process that exploits natural resources, does have an impact on the environment. However, the balance between an acceptable impact and a negative impact will depend on the intensity and the scale of mining.

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South African east coast heavy mineral mining and the development of Mozambique's heavy mineral industry

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1. Introduction

The Indian Ocean region of southern Africa, although not a cohesive political or economic unit, has well-defined geographical and geological relationships which explain the regions dominance of the global US$ 7 billion a year TiO^2 pigment industry (Taylor and Moore, 1997). The recent political stability within Mozambique has rekindled foreign interest in its considerable heavy mineral reserves. In the past, extraction of heavy minerals has occurred in various small localities. At present, large deposits at Moebase are being assessed by Billiton and Angoche (Congolone) by a joint Kenmare Resource: BUP venture. Given that Billiton and Angoche are building an aluminium smelter in Mozambique, together with the abundant supply of hydro-electric power, suggests that Mozambique will become a major player in the heavy mineral market as it has the reserves and soon the infrastructure to develop them.

South Africa is an established major contributor to the heavy minerals market through Richards Bay Minerals. The Richards Bay Minerals (RBM) operation with its chloride grade ilmenite extraction plant has offered new technology to exploit the low grade ilmenite reserves that typify the regions of KwaZulu-Natal and Mozambique. Since 1990, RBM has been the world's largest producer of titanium feedstocks and the second largest producer of zircon (Taylor and Moore, 1997). Due to similar climatic, geological and sociological controls the South African east coast mining operation has the relevant technology to help Mozambique gain a foothold into the heavy minerals market. Their proven environmental record indicates that technology is available to ensure that heavy mineral mining does not compromise the many environmental issues at stake. Mining policy must ensure that in addition to environmental issues, the local population benefits from mining by ensuring that the relevant mining companies provide additional capital to the local economy for environmental and sociological upliftment, in addition to their contribution to the regional Mozambique economy through taxes etc.

2. Geological setting

The break-up of Gondwana during late Jurassic to early Cretaceous times caused rifting along the southeast African coastline, resulting in the formation of a basin into which rivers drained, from the western highlands. Large areas of hinterland were drained that are characterised by continental craton-type geology which includes granites, gneisses, pegmatites, greenstone belts and metamorphic terrains as well as younger lithified sedimentary sequences (Fig.1, p.267). From the Cretaceous to the present, these continental alluvial sediments have been deposited along the shoreline, gradually building out a coastal plain. Coastal processes, including surf and aeolian action, combined with rapid Quaternary sea-level change have resulted in these sediments undergoing a large amount of weathering in the form of cyclical erosion, transportation and deposition. This cyclical winnowing has preferentially concentrated the more resistant minerals, including the economic minerals of ilmenite, zircon and rutile into localised deposits.

A series of four palaeodune cordons, including the Late Pleistocene-Holocene coastal vegetated barrier dune cordon, that are associated with past sea-level stillstands, can be traced the length of the northern Kwazulu-Natal coastal plain into southern Mozambique (Wright, 1998). Quaternary sediments cover more than 80% of southern Mozambique (Cilek, 1985; Fig. 2, p. 268) and make up a large proportion of the northern Kwazulu-Natal coastal plain (Fig. 3, p. 268). Northeast of the Zambezi Delta, Quaternary deposits form a 50 km wide band as far as Ilha de Mozambique. Thickness of the Quaternary cover in Mozambique varies but is generally 0-200 m in the coastal plain whilst it is unknown for the Zambezi Delta. The most extensive Pleistocene unit in Mozambique is an unbedded terrestrial sand containing minor sand and gravel known as the Cover Sand, which may be analogous to the Kosi Bay Formation of northern KwaZulu-Natal, which forms part of an informal stratigraphy proposed by Botha (1997). The mid-Mozambique Cover Sand has been transported for over 400 km in a second Late Pleistocene to Holocene reworking. This reworking of the Cover Sand has formed extensive beach ridges of probable Holocene age that can be equated with Botha's (1997) Sibayi Formation from northern KwaZulu-Natal. Extensive beach ridges north of the Zambezi Delta and Vila Maganja (Pebane) are composed of longshore transported sediments from the Zambezi Delta. Locally, sand dunes overlie beach ridges north of the delta. Heavy mineral concentrations in the Cover Sand are normally < 1%. Sands from in and around the large rivers such as the Zambezi, Save, and Limpopo have a higher heavy mineral concentration than the Cover Sand but comprise less economic minerals and more amphiboles, epidote and garnet. Rivers that drain the Cover Sand have a heavy mineral concentration with increased economic minerals and less amphibole, epidote and garnet.

3. Coastal heavy metal mineral placer deposits

Although primary deposits of magmatic origin occur throughout Mozambique, the nature of the placer deposits make them by far a better explorat-ion target. Most of the major rivers, including the Tugela and Mfolozi rivers in South Africa and the Zambezi, Save, Ligonha, Luno and Rovuma rivers in Mozambique, have alluvial heavy mineral deposits in their beds, containing ilmenite, zircon and rutile. High concentrations of non economic minerals associated with the economic minerals, along with small tonnages mean that most alluvial deposits are not economically viable. Heavy mineral deposits are found along the entire Mozambique coastline, with the main mineral constituents being ilmenite, leucoxene, rutile, zircon, monazite, kyanite, andalusite and magnetite. The TiO_2 content of ilmenite is important from a benefaction point of view. TiO_2 varies by < 50% from the South African border through Xai Xai, the Save River to the Limpopo palaeodelta. Good quality ilmenite is found at Pebane (53% but with impurities), Angoche, Quinga, Gorai, Idugo, Moma and Moebase. The rutile TiO^2 has a content that varies from 89.5 to 99.0%, whilst Zircon has a ZrO_2 content of 46-60%. The known coastal deposits are described by locality, separating Mozambique into southern, central and northern parts. Fig. 4 (p. 269) indicates that for a large proportion of the Quaternary, sea-levels have been lower than at present. This means that there is a vast potential for heavy mineral deposits along the extensive continental shelf areas of Mozambique.

3.1. Eastern South Africa

The majority of heavy mineral deposits of KwaZulu-Natal are located in the Late Pleistocene to Holocene age coastal dune sequence (Kosi Bay and Sibayi Formations of Botha, 1997) which are mined by Richards Bay Minerals using pond dredge mining methods. This technique involves the dune vegetation first being cleared and then the dredger and primary separation plant moving through the orebody in an artificially created pond, separating the heavy mineral concentrate (HMC) from the quartz sand. The quartz sand is dumped

Table 1. Ore reserve calculations in million tonnes (Mt) for heavy mineral mining projects in Kwazulu-Natal.

Locality	**Deposit** (Mt)	**HMC** (Mt)	**Geological formation**
Richards Bay Minerals	3,500	175	Late Pleistocene-Holocene coastal dunes
Iscor Hillendale	560	26	Mid-Pliocene dune complex with high slimes
TOTAL	**4,060**	**201**	**At an average of 5 % HMC**

Table 2. Ore reserve calculations for southern Mozambique.

Locality	**Deposit** (Mt)	HMC (Mt)	**Geological formation**
Ponta d'Ouro-Maputo	108	3.24	Area of ecotourism-conflict?
Lagoa Pati	4	?	
Marracuene	?	?	Pliocene? deposit
Limpopo River Mouth	541	18.94	Marine and Alluvial, worked in past
Chongoene	?	10	Shoreline and aeolian
Massoro	19.8	1.39	Shoreline and aeolian, abandoned mine
Xai Xai	?	?	Beach and dune deposits
Maxecane	?	2	Aeolian
Ponta Zavora	?	0.3	High cones on beach and coastal dune
Jangamo	33	2.64	Abandoned shoreline and aeolian deposit
Baia Inhambane	?	?	Deposit in Pliocene? Dunes
Praia Morrungulo	?	?	High HMC in beach sand
Inhassoro	29	1.74	Abandoned aeolian placer mine
TOTAL	**734.8**	**40.25**	**At an average of 5.5 % HMC**

behind the mining operation where it is moulded into the original dune structure and then rehabilitated, with either natural vegetation or forestry, depending on the land owners' requirements.

Iscor has developed a strategy where they intend mining older, probable Pliocene age dunes (the Umkwelane Formation of Botha, 1997), inland of Richards Bay. Due to the higher mud content (± 23 %) of the older dunes, different mining techniques to RBM will be employed, with a potential for a greater environmental impact. Table 1 shows an estimate of ore reserves available to the two companies that have proven reserves along the KwaZulu-Natal coastal plain. Reconnaissance studies offshore have shown a large potential but to date no finite ore reserve calculations are available.

3.2. Southern Mozambique

Little is known about these reserves, but the fact that the coastal plain is approximately 80 km wide, together with the presence of heavy mineral deposits on the beach, make it a worthwhile target for heavy mineral exploration.

Possible conflict between ecotourism and mining may occur as the area has been targeted for game reserve expansion and SCUBA diving recreation, although available technology means that the two entities are compatible. The source material for the heavy minerals comprises vegetated to open coastal dune formations that vary in age from Pleistocene-Holocene, except for the Marracuene deposit which occurs in a probable Pliocene age palaeodune cordon. The coast from Beira to the Zambezi River mouth is extremely flat, comprising swamps, mangroves and sand-flats. An unusual association of heavy minerals with a high content of both rutile (11.3 %) and zircon, makes it a potential exploration site (Cilek, 1985). Table 2 tabulates preliminary ore reserve calculations for areas along the southern Mozambique coastline. The data has been gleaned from a variety of sources and should be regarded as tentative.

3.3. Central Mozambique

According to Cilek (1985) central Mozambique is the most important area of heavy mineral reserves. The coastal plain is 100 km wide in the Zambezi delta region. The richest deposits occur about 600 km from the Zambezi River delta, in the direction of Cabo Namatungo near Mogincual. An extensive system of sand-flats occur in the vicinity of Quelimane, comprising five distinct fields of differently orientated beach ridges approximating one hundred in total. The Pleistocene "Decksand or Cover Sand" is an important transitional source for heavy minerals with ilmenite and zircon dominating. The original fluviatile sediments from the Zambezi River have characteristic high silicate heavy mineral values, up to 80%, being found from the Zambezi River mouth to Pebane, especially from the Zambezi to Vila da Maganja. Yellow to red dunes between the Decksand and Holocene sediments described from this area may correlate stratigraphically with their KwaZulu-Natal and southern Mozambique counterparts (compare Figs. 2 and 3, p. 268). Historically, a number of small workings have taken place along this stretch of coastline. New, larger deposits such as the Billiton deposit at Moebase will use new mining techniques similar to those used in KwaZulu-Natal as the local geology is very similar. The crucial factor in the mining is that the economic heavy minerals are located within unconsolidated sand, close to the surface, ensuring a relatively simple and cost-effective extraction process. Table 3 provides an estimate of the heavy mineral potential for central Mozambique.

3.4. Northern Mozambique

The coastline is dissected, cliffed and coralline, thus sand bodies that are suitable for heavy min-

Table 3. Preliminary ore reserve calculations for central Mozambique.

Locality	Deposit (Mt)	HMC (Mt)	Geological formation
Micuane and Deia	259	50	Aeolian and beach deposits
Quelimane	24.9	2.5	Aeolian and beach-ridge deposits
Zalala	15	1.5	Shoreline and dune placer
Raraga and Gorai	59	29?	Very high HMC on beach and beach-ridges
Pebane and Idugo	?	2.74	Aeolian placer
Moebase	1,253	47.58	Pleistocene-Holocene beach and dune placers
Moma	6.24	0.42	Shoreline deposit
Angoche	207	9.11	Aeolian
Congolone	167	5.34	Aeolian and shoreline placer
Quinga	1246	23.44	Abandoned shoreline and aeolian deposit
TOTAL	**3,237.14**	**171.63**	**At an average of 5.3 % HMC**

Table 4. Tonnages of ilmenite, zircon and rutile converted into millions of US dollars using a value of US$ 72, US$ 360 and US$ 525 for each mineral, respectively.

	Ilmenite (Mt)	Zircon (Mt)	Rutile (Mt)	TOTAL	Ilmenite (US$M)	Zircon (US$M)	Rutile (US$M)	TOTAL
South Africa	160.8	30.2	10	201	11,577.6	10,872	5,250	27,699.6
South Mozambique	32.2	6.1	2	40.3	2,318.4	3,603	1,050	6,971.4
Central Mozambique	137.3	25.7	8.57	171.6	9,885.6	9,252	4,499.3	23,636.9
North Mozambique	-	-	-	-	-	-	-	-
Offshore	171.2	32.1	10.7	214	12,326.4	11556	5,617.5	29 500
TOTAL				**626.9**				**87,807.8**

eral accumulation occur in a few places only and are not thought to be economically viable.

3.5. Offshore Mozambique

The potential for offshore heavy mineral deposits associated with past sea-level low still-stands is vast. One such deposit is the heavy minerals distributed along the outer and middle shelf off the Zambezi delta described by Beiersdorf et al. (1980) who calculated approximately 4,415 Mt of continental shelf sand that hold approximately 214 Mt of economic heavy minerals, comprising primarily of ilmenite, zircon and rutile. The hostile offshore environment and logistical problems have meant that these deposits have remained subeconomic but recent advances in offshore mining technology combined with the opening of local harbours may, in the future, mean that these reserves become economically viable (Fig 4, p 269).

Although the southern African west coast (South Africa and Namibia) offshore diamond mining took a long time to mature, now it plays a major role in the diamond industry, proving that similar technology is available to exploit offshore heavy mineral deposits.

4. Environmental issues

Mining, an extractive utilisation of non-renewable resources, is not a sustainable process, although it is an integral part of most countries' economy. Table 4 provides a conservative estimate of the heavy mineral potential of Mozambique. Heavy mineral mining often plays a major role in the coastal zone, but because it is non-sustainable it is often ignored in sustainable integrated coastal management (SICOM) processes. It is often for this very reason that the implementation of most SICOM plans fails because it does not recognise or address mining issues adequately. Coastal placer heavy mineral mining provides a vast deal of wealth to a country's economy and due to its relatively easy and clean mining procedure, if carried out correctly, does so with minimal detrimental effects to the environment.

In order for mining to be recognised and incorporated into the SICOM procedure, various strategies should to be implemented by mining companies interested in utilising coastal ore reserves. These include a responsibility to the local environment that includes the local population, by providing the present population with the tools to improve their future well-being, thereby contributing to the SICOM process. It is only when these issues are adequately addressed that mining will be seen as an acceptable partner in the SICOM process. Dune mining along the Northern KwaZulu-Natal coastline has provided an enormous amount of environmental and sociological information that should be utilised when similar projects are implemented in Mozambique.

5. Conclusion

Production of titanium feedstocks in the Indian Ocean Rim are expected to grow strongly to 2005 (Taylor and Moore, 1997). The need for a new feedstock supply beyond that time will provide opportunities for the development of major new projects in the region. Heavy mineral deposits of Mozambique are estimated to be worth US$ 60 000 million (Table 4), providing major potential wealth and social upliftment. These values are conservative as according to Cilek (1985), only approximately 3% of Quaternary deposits have been evaluated.

Table 4 provides a first estimate on the potential wealth of the various regions discussed. It is recognised that each individual ore body encountered will have its own ilmenite, zircon and rutile ratio, but for the sake of the studies the ratios have been averaged and thus the following figures must be regarded as preliminary.

It must be ensured that the scenic and environmentally sensitive coastline must not be compromised whilst exploiting this enormous potential wealth. Mining technology, including rehabilitation, gained from heavy mineral mining projects in KwaZulu-Natal, must be applied in Mozambique as their vegetation cover, geological formation and mining procedure are similar. In addition to safe-guarding the local physical environment, the relevant mining companies must implement a socio-economic upliftment programme for the local community, thereby contributing to the SICOM process.

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GEOLOGICAL DEVELOPMENT AND MINERAL RESOURCES OF THE COASTAL BASIN OF TANZANIA

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1. INTRODUCTION

The sediments in the coastal basin of Tanzania belong to the so-called “Somali Basin” of eastern Africa (Fig. 1, p. 270). Their ages range from Jurassic to Recent. The western boundary of this basin is defined by a major fault zone which extends from Tanzania through Kenya and Somalia, to Ethiopia (Fig. 1, p. 270). In Tanzania, this fault zone has two major trends: NNE-SSW (Tanga fault zone) and NNW-SSE (Lindi fault zone) (Figs. 1 and 3, pp. 270-271). The coastal zone of Tanzania encompasses a narrow strip along the mainland Tanzania coast and the islands of Pemba, Zanzibar, Mafia and Songosongo (Fig. 2, p. 271). These islands are made up of mostly clays, marls, fossil-rich calcareous sandstones and coral limestones of ages ranging from Miocene to Recent (Mpanda, 1997).

The opening of the “Somali Basin” took place in the Jurassic. It resulted from the break up of the Gondwana Supercontinent which commenced in the Triassic (Kent and Pyre, 1973; Coffin and Rabinowitz, 1987). Most of the tectonic movements were vertical displacements related to extensional rifting which led to the development of the present coastal basin in Tanzania (Kent, 1972; Mpanda, 1997). The sedimentary sequence includes the Karoo sediments of ages ranging from Permo-Carboniferous to Early Jurassic (Wopfner and Kaaya, 1992). The basal part of the sequence consists of continental deposits, mostly derived from the eroded neighbouring Precambrian basement of the Mozambique belt. The upper part of the sequence is represented by fluviatile arkoses, conglomerates and shales (Mpanda, 1997). In Middle Jurassic a continental shelf was well developed along the whole of the Tanzania coast and marine sedimentation commenced (Kent and Pyre, 1973; Kuprina and Maera, 1989). Thereafter, several subsequent transgression and regression events took place. It was during these events that concentration of some heavy minerals in the coastal basin of Tanzania occurred.

2. GEOLOGICAL SETTING

Geological studies and the assessment of the mineral economic potential along the coast of Tanzania began as far back as during the German colonial area, e.g. Bornhardt (1900). Hennig (1937) described the stratigraphic sequence of sedimentary rocks in the Mandawa-Mahokondo anticline in southern coastal Tanzania, NW of Lindi (Figs. 2 and 3, p. 271).

From 1938 to 1950, no documented geological investigations were carried out in the coastal basin of Tanzania. Thereafter, geological investigations and hydrocarbon exploration activities have been undertaken by numerous companies (e.g. BP, SHELL, AGIP) and individuals, notably, Quennell et al. (1956), Aitken (1961), Kent et al. (1971), Kajato (1982) and more recently by Mpanda (1997).

2.1. Stratigraphy

The general stratigraphic sequence of sedimentary rocks in coastal Tanzania is schematically presented in Fig. 4, (p. 272). The oldest sedimentation in present coastal Tanzania is marked by the deposition of continental Karoo sediments (Wopfer and Kaaya, 1992) (Fig. 2, p. 271). The uppermost part of this sequence is ascribed to the

Early Jurassic and comprises of fluviatile arkosic sandstones, conglomerates and occasionally marls and/or shales. During the Karoo sedimentation there were occasional marine incursions as evidenced from the occurrence of evaporites in the Mandawa basin (Fig. 3, p. 271) (Kajato, 1982 and references therein). The Karoo sediments were mainly deposited in low relief areas and in areas adjacent to the Precambrian basement of the Mozambique belt.

2.2. Karoo sediments

The Karoo sediments are of continental origin ranging in age from Carboniferous to Early Jurassic (Wopfner and Kaaya, 1992). They form the basal part of the sedimentary sequence and overlie unconformably the Precambrian basement complex of the Mozambique belt of Tanzania (Fig. 2, p. 271). In northern coastal Tanzania, NW of Tanga town (Figs. 2 and 3, p. 271), the Early Jurassic is represented by fluviatile arkosic sandstones and siltstones resting on basal conglomerates. These sedimentary rocks dip uniformly to the east with angles increasing from 5° to 10° inland to as much as 30° at the coast (Kent et al., 1971). According to Quennell et al. (1956), the thickness of the Tanga beds is at least 900 m.

In the hinterland of Dar es Salaam, arkosic cross-bedded sandstones and siltstones as well as conglomerates with occasional shales and mudstones (known as the Ngerengere Formation) crop out between the Ngerengere and the Kidugallo areas (Fig. 2, p. 271). Total thickness of this unit is about 760 m (Hennig, 1924) and it is correlated with the Karoo Group of the Tanga area. In southern coastal Tanzania, particularly in the Mandawa basin (Fig. 3, p. 271), a different depositional environment prevailed in the period between the Triassic and the Early Jurassic (Kent et al., 1971). This environment was characterized by an evaporitic sequence of gypsum, halite and anhydrite intercalated with silty shales (the Pindiro Group). This evaporitic sequence developed in a very rapidly subsiding part of the basin in which a restricted marine incursion took place; whereas the continental Karoo sequence accumulated in the slow sinking part of the basin (Kent et al., 1971). The intercalation of these evaporites and continental Karoo sediments advocates for a post-Karoo marine incursion in the coastal basin of southern Tanzania.

2.3. Karoo rifting

At the end of the Pan-African Orogeny, during Cambrian times (ca 550 Ma ago), the southern hemisphere continental fragments amalgamated together forming the Gondwana Supercontinent. During the development of the Indian Ocean, three major tectonic events occurred in coastal Tanzania: (i) Karoo rifting during Permian; (ii) the breakup of the Gondwana Supercontinent which started with rifting in the Triassic, and (iii) finally the opening of the Somali basin in the Middle Jurassic (Kent and Pyre, 1973; Coffin and Rabinowitz, 1978; Mpanda, 1997). Rifting and development of a thermal dome in the present coastal Tanzania might have triggered the initial breakup of Gondwanaland in East Africa (Mpanda, 1997, Fig. 1, p. 270).

The Karoo rifts developed through extensional tectonics, which affected the coastal Tanzania by producing NE-SW trending grabens (Figs. 2 and 3, p. 271). Normal vertical faults, with throws of up to 6,000 m (Kent et al., 1971) in the Tanga Fault Zone, mark the western boundary of these grabens. The Tanga and the Lindi faults together with the Utete-Tagalala and the Aswa lineaments (Figs. 2 and 3, p. 271), played a major role in controlling the deposition and distribution of the Karoo sediments in the varying lacustrine, fluvial and deltaic environments in coastal Tanzania (Kajato, 1982; Mpanda, 1997). These terrestrial sediments were largely deposited in the NE-SW trending grabens on mainland Tanzania as has been documented in the Tanga, Mikumi, Ngerengere and the Selous areas (Figs. 2 and 3, p. 271) (Wopfner and Kaaya, 1992). Kuprina and Maera (1989) reported on a similar sedimentation style along the western coast of Madagascar.

2.4. Breakup of the Gondwana supercontinent

The Karoo rifting created weak zones which led to the breakup of Gondwanaland. The rifting started in Triassic but the fragmentation of the supercontinent commenced in Early Jurassic and continued into Early Tertiary (Windley, 1986). The breakup of the continental crust followed the pre-existing Karoo rifts. During this period the extensive intra-continental rifting along the East African coast was associated with widespread magmatism.

As the separation of the continental plates increased, more and more marine water invaded the older basins through periodic differential uplifts and marine incursions. These tectonically controlled processes led to restricted depositions of marine sediments as evidenced from the Mandawa basin where evaporites and marine shales (the Pindiro Group) of Triassic? – Early Jurassic age are out-cropping (Kajato, 1982; Mpanda, 1997).

Coffin and Rabinowitz (1987) reported on evaporites of the same age from the eastern coast of Kenya and Somalia and along the northwestern coast of Madagascar. In certain areas in the coastal basin of Tanzania thick oolitic to oncolitic limestones with intercalations of gypsum developed during this time, e.g. the Kidugalo oolites and the Tanga limestones (Fig. 4, p. 272) (Moore, 1963).

However, the first widespread marine incursion in East Africa occurred in Middle Jurassic (Bajocian - Bathonian) times (Kent et al., 1971). It was during the Middle Jurassic that the marine transgression covered the whole of the coastal basin of Tanzania from the Kenya boarder in the north down to the Matumbi hills in the south (Fig. 2, p. 271). It was through this transgression that a continental shelf characterized by littoral coral limestones and basal detrital sandstones developed in coastal Tanzania (Kent et al., 1971). The transgression lapped a short distance across the Tanga Fault Zone onto the Precambrian basement complex of the Mozambique belt (Figs. 2 and 3, p. 271). Pemba, Zanzibar, Mafia and Songosongo islands off the coast of the mainland Tanzania (Fig. 2, p. 271) are built up of Miocene sediments and all these Indian Ocean islands developed through prolonged periods of faulting (Figs. 3 and 5, pp. 271/273).

3. Post-karoo sediments

3.1. Middle jurassic sediments

The stratigraphic interval corresponding to the early part of the Middle Jurassic (Aalenian) is missing in many places in coastal Tanzania. However, from a borehole in the Kidugalo village (Fig. 2, p. 271), Kapilima (unpubl. data) collected from shales ammonite genera of Aalenian age. Underlying the "Posidonia shale" in the same area, is a thick deposit of oolitic limestones ("Kidugalo oolite"). Associated with these oolites occasionally occurs a gypsum deposit suggesting a sabkha environment.

Table 1. Estimated beach sand deposits in Tanzania (from Cilek, 1976).

Locality	Total HM%	Ilmenite	Garnet	Rutile	Zircon& Kyanite	Magnetite	Beach Sand Reserves (tons)	HM Reserves (tons)
Pangani North	33.66	12,05	15,59	0,78	4,28	0,96	509,000	169,000
Pangani South	21.21	6.83	10.88	0.63	2.22	0.65	2,680,000	678,000
Sadani	15.50	4.00	6.00	0.60	4.90	-	5,030,000	518,000
Dar es Salam – Bagayamo	30.53	7.80	14.40	0.66	7.67	-	2,028,390	664,260
Dar es Salam – South	17.32	2.52	9.85	0.45	3.80	0.70	975,000	259,000
Kisuju	21.71	9.44	2.86	1.76	7.54	0.11	1,425,000	540,000
Mafia	23.23	12.10	2.20	1.80	7.10	0.03	1,417,000	316,000
Kiswere	24.40	7.10	13.30	0.40	3.10	0.50	1,816,000	259,000
Mtwara	19.40	8.20	6.10	0.80	4.30	-	17 to 50 m.	3,600,000
Zanzibar & Pemba	-	-	-	-	-	-	1 million (?)	200,000 (?)

The coastal basin of Tanzania developed into a stable continental shelf during Bajocian-Bathonian times when the first widespread transgression involved the continental Karoo sediments. At certain localities, the Bajocian-Bathonian sediments rest unconformably on the Precambrian basement of the Mozambique belt (Figs. 2 and 3, p. 271).

In the area between Msata and Lugoba, north of Chalinze (Fig. 2, p. 271), Middle Jurassic sediments unconformably overlie the Mozambique belt basement. The sediments in this area are characterized by detrital conglomeratic limestones at the base of the sequence and of coral reefs at the top. The Tanga fault (Figs. 2 and 3, p. 271) was rejuvenated after the deposition of the Bajocian - Bathonian sediments (Mpanda, 1997 and references therein). Evidence for this rejuvenation is the occurrence of limestones and siltstones on top of the Precambrian basement, e.g. in the Ruvu Valley trough (Fig. 5, p. 273). These sediments were derived from the overlying Middle Jurassic sediments and were deposited onto the basement during the rejuvenated fault movements. Another evidence for the reactivation of the Tanga fault in Middle Jurassic times comes from the Msolwa sediments (Figs. 2 and 5, pp. 271/273). These sediments are medium to coarse grained, thick bedded litharenites at the base whilst at the top, intercalations of fine grained, thin-bedded bioclastic sandstones and marls occur. This sequence lies unconformably on red conglomeratic-arkosic sandstones of continental Karoo origin (Mpanda, 1997). Sedimentary structures such as slumping, graded bedding and imbrications are indicative of allochtonous deposition associated with reactivated fault movements.

3.2. Late Jurassic sediments

The Bajocian-Bathonian marine transgression continued into Callovian-Tithonian times (Kent and Pyre, 1973). During this period, A neritic environment characterized much of the coastal basin of Tanzania. The depositional environment was deepening and the extensive open marine environment influenced the development of a large diversification of fauna and flora. Shales, marls and ammonite-bearing septarian marls accumulated in a low energy marine environment. However, in southern coastal Tanzania, south of Kipatimu (Fig. 2, p. 271), buff sandstones and red clays more than 600 m thick crop out (Quennell et al., 1959) suggesting their origin from an estuarine deltaic environment.

In the northern costal basin of Tanzania (e.g. in the Tanga area, Figs. 2 and 3, p. 271), the Callovian sequence is represented by shales overlying the Amboni limestone. In the hinterland of Dar es Salaam, the Callovian sediments are largely represented by ammonite-bearing septarian marls intercalated with calcareous siltstones and sandstones.

From the fossil evidence, Aitken (1961) confirmed the presence of marls of Callovian age in the Mandawa basin (Fig. 4, p. 272) in southern coastal Tanzania. Oxfordian and Kimmeridgian sediments are well documented in the Mandawa basin and in some places in the hinterland of Dar es Salaam. The sediments consist of intercalations of septarian marls and calcareous sandstones rich in fossils such as ammonites, belemnites and pelecypods. Zeiss (1979) described several ammonite species suggesting that are of Tithonian age.

3.3. Cretaceous sediments

The Early Cretaceous period of coastal Tanzania was marked by a regression which was presumably controlled by worldwide eustatic movements. This was partly associated with an end Jurassic-Early Cretaceous faulting (Kent et al., 1973). A large part of the Early Cretaceous is therefore represented by continental sediments particularly in southern coastal Tanzania where they are known as Makonde-Beds. The sediments are predominantly sandstones.

Along the banks of the Wami river (Fig. 2, p. 271), sandy limestones, calcareous sandstones and conglomerates representing a nearshore facies of Late Cretaceous (Neocomian) age are present. Fine to medium grained, cross-bedded sandstone of the same age crops out around the Chalinze area. The Chalinze exposure is correlated with the gas-bearing sandstone at the Songosongo Island. The Late Cretaceous sediments are largely represented by sandstones and clays rich in *Foraminifera*.

3.4. Tertiary sediments

The Early Eocene sediments consist of marine shales interbedded with thin layers of limestones and occasionally sandstones. During Middle Eocene a new regressive phase began. Lithologically, this period is characterized by the occurrence of carbonates deposited directly on top of marine shales. The Early Miocene and younger sediments, made up of sandstones with intercalations of clays and limestones, form part of a turbidity series in the coastal basin of Tanzania.

3.5. Quaternary sediments

The contact between the Tertiary and the Quaternary is expressed by a regional unconformity, the so-called Pliocene unconformity. Overlying this unconformity are carbonate rocks rich in corals and also clastic materials transported by rivers from the hinterland to the coastal basin of Tanzania.

4. Mineral resources

The coastal basin of Tanzania is endowed with minerals and fossil fuel of socio-economic importance. The exploration for these earth resources began during the German colonial era (1890-1918). These earth resources can be grouped as follows.

4.1. Construction material

Limestone is abundant and is being mined in the outskirts of Dar es Salaam and Tanga for the manufacture of Portland cement. The Kidugalo limestone (Fig. 2, p. 271) is used as aggregates for construction purposes. Coral limestone which is abundant along coastal Tanzania is used for house construction and for the manufacture of lime. Sand and gravel are ubiquitous in the coastal basin of Tanzania and are mined for construction purposes. Dar es Salaam city alone uses about 7.5 million tonnes of sand per annum for the construction industry.

4.2. Heavy minerals

Black sand deposits along the beaches, the continental shelf and on older marine terraces above the present sea level have enormous deposits of heavy minerals (HM) (Cilek, 1978). It is estimated that about 34 million tonnes of beach sand have about 7 million of reserves of HM (Table 1; Cilek, 1976). The main economic HM types are: (i) Ti-bearing minerals — ilmenite, rutile, anatase and brookite. Rutile has about 85-99% TiO_2; and these minerals can be used as a source of Ti and for the manufacture of white pigment. (ii) Monazite which can be used as a source of rare earth elements (e.g. Ce, La, Y, Th). (iii) Magnetite as source of Fe and Ti. (iv) Kyanite can be used in the refractory industry and as a gem. (v) Zircon as a source of Zr and as a gem, and (vi) garnets as gems. The provenance of these HM are the igneous and metamorphic rocks of the Precambrian basement (e.g. the Mozambique belt) and sometimes the Phanerozoic sedimentary rocks (Figs. 2 and 3, p. 271).

4.3. Fossil fuel

Karoo sediments in the Selous and the Tanga basins (Figs. 2 and 3, p. 271) have a high potential of coal (Wopfner and Kaaya, 1992) which may be mined and used as a source of energy. Oil seeps in coastal Tanzania indicate that hydrocarbons are preserved within the coastal sedimentary basins. The most significant discoveries so far are the offshore Songosongo and Mnazi Bay gas fields (Tanzania Petroleum Development Corporation, TPDC, 1995). Gas from the Lower Cretaceous sands tested up to 23 million cubic feet per day of gas (methane-rich) and minor volumes of oil. The Mnazi Bay gas (almost entirely composed of methane) rates up to 14 million cubic feet per day from Oligocene sands (TPDC, 1995). At the moment there are several companies which are exploring for oil in the coastal basin of Tanzania.

5. Conclusion

Generally, the development of the present coastal basin of Tanzania and the Indian Ocean was tectonically controlled. It resulted from the breakup and dispersion of the Gondwana Supercontinent. This fragmentation which began in Triassic and continued into Early Tertiary (Windley, 1986) followed the pre-existing zones of crustal weakness (e.g. along the Karoo rifts). The coastal basin of Tanzania developed into a stable continental shelf in Middle Jurassic (Bajocian-Bathonian) times. Numerous transgressions and regressions along this continental shelf partly influenced the depositional environments, types of deposits (i.e. sediments) and the diversification of fauna and flora in coastal Tanzania.

Sediments that make up coastal Tanzania are both of continental and marine origins. Their age ranges from Jurassic to Recent. The oldest being the continental Karoo sediments that unconformably overlie the Precambrian basement complex of the Mozambique belt. Karoo rifting developed NE-SW trending grabens in which sedimentation took place. Post Karoo sedimentation and the development of deposits along coastal Tanzania were also tectonically controlled.

The coastal basin of Tanzania is endowed with minerals and fossil fuel of socio-economic importance. Limestone, sand and gravel are mined for construction purposes (e.g. limestone is used for the manufacture of Portland cement). About 34 million tonnes of beach sand has about 7 million tonnes of heavy minerals (Cilek, 1976), e.g. ilmenite, rutile, monazite, magnetite, zircon, kyanite. These black sand deposits in the coastal basin of Tanzania are one of the future targets for the rapidly expanding mining industry of Tanzania. Exploration for oil is continuing in the coastal basin of Tanzania. Enormous gas deposits, testing up to 23 and 14 million cubic feet per day of gas (TPDC, 1995) have been discovered in the Songosongo and the Mnazi Bay areas (southern coastal basin of Tanzania), respectively. Plans to develop this gas as a source of energy for domestic and industrial uses are underway.

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KENYA: ENVIRONMENTAL ASPECTS OF PAST AND EXPECTED COASTAL MINING ACTIVITIES

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1. INTRODUCTION

In general terms, the rocks at the Kenyan coast can be classified into consolidated and loose unconsolidated materials. Geological mapping of the coastal strip has been done by several geologists, notably Caswell (1956) and Walsh (1960). The unconsolidated materials are the more recent, ranging in age from Pleistocene dune sands to recent deposits. There are several reported mineral deposits and occurrences along the Kenyan coast (Fig. 1, p. 274). These include baryte, zinc and lead at Vitengeni, lead at Kinangoni, baryte at Goshi and more recently reports of large finds of heavy mineral sands at five sites by TIOMIN Ltd. along the Kenya coast. It is therefore expected that there will be increased mining along the Kenyan coast in the near future. The factors to be addressed by those intending to undertake mining ventures must include a look at the effects and mitigation factors governing the general land degradation and as to whether such land can be rehabilitated. Other factors include soil erosion, siltation, blockage and diversion of streams. There is also the factor of disposal of mine waste that may result in heavy metal pollution in the water systems. In cases of such large operations, there is expected to be air pollution from dust and gases, noise and vibration resulting from blasting and earth moving operations that must be addressed.

2. GENERAL GEOLOGY

The rocks of the Kenyan coast are predominantly sedimentary. They range in age from the Permo-Triassic sandstone formations of the Taru grits, Maji ya Chumvi, Mariakani and Mazeras sandstones. These Permo-Triassic rocks are collectively known as the Duruma sandstones. These four formations of the Karoo System are conformable to each other and their mode of deposition was variably marine, shallow water, or lacustrine to fluvio-deltaic.

They form a continuous strip of sediments of about 50 km in width that is exposed in an area stretching from the Tanzanian border to the Sabaki River in the north.

The coastal zone contains different mineral deposits that are structurally controlled by Karoo-Jurassic faults (JICA, 1991). The faults are extensively developed in the directions of NNE-SSW to NE-SW with major ones bordering the Mazeras Formation and the Kambe Formation for a long distance along the coast. Overlying the Kambe Limestone Series are the Miritini and Rabai Shales, followed by the Changamwe Shales. The latter formation consists mostly of calcareous shales. Most of the faults are developed at the boundary of the Mazeras and Kambe Formations (Walsh, 1960).

The Cretaceous rocks of the Kenyan coast are represented by localized beds, consisting of well-bedded muddy and siliceous limestones. Sediments of Tertiary age rest uncomformably on the Mesozoic formations. They include sandy marls, limestones and sands. The Baratumu beds exposed around the Malindi area are overlain unconformably by the late Pliocene Marafa beds and the Magarini sands. These Pleistocene deposits occur along or near the present coastline, and consist of a range of sediments laid down during fluctuations of the sea above and below the present level. A distinct reef limestone occurs along the coast at 13 m above the present sea level, behind which lagoonal sediments accumulated. About 13 m dune sands have accumulated behind the littoral zone in some areas.

There are a few intrusives in the Palaeozoic and Mesozoic sediments of the Kenyan coast. These include the alkaline complex of the Jombo Hill and the carbonatite intrusion of the Mrima Hill. Occurrences of economic minerals on these hills, particularly manganese and rare earths, were reported by JICA (1991).

3. Mineralization

The sandstone formations of the Karoo System in the coastal region of Kenya have been found to have concentrations of minerals of economic significance such as manganese and sulphides comprising galena, pyrite and sphalerite. Sulphates of barium and calcium have also been found in association with metal sulphides with baryte being mined at various localities. Rare earth oxides together with niobium are moderately concentrated in residual soils from the Mrima Hill carbonatite plug. Silver has been recovered as a by-product of the lead extraction of galena mined at Kinangoni of the Kilifi district. Mineralization of lead, zinc and baryte is evidenced in the Duruma Sandstone Series (JICA, 1993). The main occurrences at Kinangoni, Vitengeni, Lungalunga and Bamba appear to be fault controlled. Similarly related to the faults are the major geochemical anomalies in the Maji ya Chumvi and the Mazeras Formations. Mrima Hill is a carbonatite intrusive in the Maji ya Chumvi Formation of the South Coast and contains mineral prospects for manganese, iron ore, radioactive minerals, niobium and rare earth elements. Kinangoni area is known for lead mining over the last twenty years. The Kinangoni lead mine is in the Mazeras Formation in the North Coast, characterized by hydrothermal mineralization within a fault that separates the two formations of the Mazeras and Kambe limestone. The same faulting continues northwards to Vitengeni where another mining is conducted for baryte, lead and zinc. The pollution of natural waters and soils was probably caused by this mineralization (Odero, 1977; Bugg, 1982).

4. Mining activities

4.1. The cement industry

The production of cement from limestone and other rock materials found at the Kenyan coast started at Bamburi in 1954. This was done after extensive work to locate suitable materials. There is an abundance of pure limestones together with suitable argillaceous rock. The major raw materials used in this factory consist of approximately 85% of Pleistocene coral limestone and 15% of Jurassic shale. Gypsum and iron ore necessary for the production of cement are also located within the coastal sediments. Large open pits are left behind from excavation of the material for the cement industry. The Bamburi cement factory has made attempts to rehabilitate these pits by turning them into crocodile farms. During mining and processing of the material into cement, dust is emitted during blasting, crushing, milling and blending of the limestone ore. The dust produced is related to various health problems.

4.2. Lead-zinc-baryte-copper-mercury

Small deposits of galena-baryte veins containing pockets of sphalerite and traces of copper and mercury minerals are found at Vitengeni to the north of Mombasa. This deposit was discovered in 1919. The ore has been mined on and off since 1922. The largest deposit so far mined at the Kenyan coast is the lead-silver mine at Kinangoni. This deposit lies at the faulted contact between the Jurassic sandstones and limestones. The estimates for the ore reserves stand at about 1 million tons at grades of 9 % lead and 4.5 ounces/ton of silver (Clark and Hickley, 1970). The deposit of Vitengeni has been exploited irregularly, depending on demand and world mineral economics. The last mining activities were in the early ‘80s. It is reported that the wastes from these mining activities have entered into the local drainage system. It is apparent that mining and processing of the ores has led to considerable environmental degradation. Along the coastal strip, the rocks have been used as an aggregate for concrete foundations, while others have been used extensively as ballast aggregates for concrete work and as road materials.

4.3. Sand harvesting

Along the Kenya coastline water wells are situated in a shallow aquifer. In most places this aquifer is less than 2 m below the surface. It is important that the aquifer be not exposed to the surface in order to avoid risk of exposure contamination by pollutants, including animal and human waste.

Sand harvesting has been going on for a number of years along the Kenyan coast. Because of the increasing population also, the rate of harvesting has increased dramatically in the past few years. The area along the coast has several confined freshwater aquifers. The freshwater aquifers serve the coastal communities with their potable, domestic and livestock water requirements. However, continued sand harvesting activities will expose the unconfined aquifers in the area to natural degradation. For instance, as a result of sand harvesting, Timboni Wellfield has been exposed to human and animal waste. Exposing the freshwater aquifers to natural degradation could result in permanent pollution of the respective freshwater aquifers. Apart from bacteriological and chemical pollution, the aquifer is also exposed to evaporation, resulting in increased depletion of the valuable freshwater resource.

4.4. Salt harvesting

Common salt (NaCl) is produced by solar evaporation of seawater by the Mombasa Salt Works Ltd at Gongoni, north of Malindi, being the second largest salt work in Kenya after the production from evaporites at Magadi in the Kenyan Rift Valley. This product is mentioned here because of its potential to pollute surrounding soils and fresh water aquifers. At Gongoni, there is a proposal to extend the salt works towards the aquifer field. This activity, if not properly managed and checked, could result in permanent pollution of the freshwater aquifer. However, recent studies have defined safe distances for salt ponds and lagoons. Thus if the recommendations are strictly adhered to, the Mombasa Salt Works (MSW) extension may not adversely affect the freshwater Timboni Wellfield aquifer.

4.5. Proposed titanium mining by TIOMIN

Following the discovery of five large titanium deposits, large-scale open cast mining at the Kenyan coast may commence soon (Fig. 2, p. 274).

TIOMIN completed an integrated exploration programme and is now ready to start exploitation of the deposit at Kwale. The mining method proposed by TIOMIN will be carried out by excavating sand and feeding it into a concentrator. At the concentrator the economic minerals are separated from the sand by using water. The sand will be placed back into the excavation from which it came and the surface will be restored. Rehabilitation will be a continuous process as mining progresses and land will be returned to the original form for farming activities. The concentrate containing the economic minerals will be transported by road to the harbor. At the harbor, the concentrate will be treated in a mineral separation plant by using electrical and gravity methods. The company has indicated that there will be no pollution produced at either the concentrator or during the mineral separation process as no harmful chemicals will be used. However, it has been difficult to assess the environmental impact of this mining method as an independent study has not been available.

5. Environmental impact

Regular water supply constitutes one of the most important problems in coastal geology. It is also important that the supply points not be contaminated. The chemical composition of a groundwater system is a reflection of its geological environment, and of the climatical, biological, hydrological and geochemical processes operating in this environment. In addition to the natural factors such as geological, hydrological and hydrogeological factors, the quality of groundwater resources can greatly be influenced by human activities for example through the disposal of wastes. Generally, the impacts on groundwater resources at a certain mine area are projected to be big with the expected increased mining activities. Thus, the potential pollution on the groundwater at the mine areas needs to be addressed.

6. Suggested mitigation

The critical problem facing development of mining at the Kenyan coast is the limited knowledge of the sub-surface geology and its relationship to the groundwater aquifers. Planning for future activities is therefore extremely difficult. The following policies are suggested for adaptation to minimize the severity of the impacts of exploitation of the mineral resources in the coastal areas of Kenya:

- Special priority should be given to comprehensive geological investigation and acquisition of knowledge of the groundwater systems at the coast.
- A monitoring programme should be set up to evaluate the influence of mining, and the long-term effects of assumed sustainable mining.
- Backfilling of mined-out areas.
- Revegetating of the reclaimed land.
- Mitigating actions to spillage of mine affluent in the ground and surface systems.

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Management of the coastal zone of Benin

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1. Introduction

Situated between longitudes 2° and 4°E and latitudes 6° and 6°30'N, the coast of Benin is a low coastal plain (maximum altitude less than 10 m). It is 125 km long and covers about 375 square kilometres. It consists of several coastal bars separated by many swampy lowlands, shallow lagoons and several recent or old arms of sea through which the hydrological circulation takes place. Indeed it is a real and complex coastal ecosystem which is very productive and diverse, also acting as a buffer between the open sea and land, offering great aesthetic and recreational potential. This region is one of the most densely populated in the country. More than 30% of the population of Benin lives in this area which covers approximately 5% of the total area of the country.

Despite the increasing degradation of the environment caused by the obvious and rapid advance of the sea, giant floods, loss of marine productivity and pollution of lagoons, the coast of Benin is increasingly the site of important human activities and constitues the economic pillar of the country. We can therefore understand why this region, which has become a strategic asset, is the focus of many people's attention who wish to protect it. Different studies conducted have suggested various coastal protection strategies which seem more or less efficient and require significant means. But at what cost and for how long? The constant degradation of this coastal complex and the environmental and social conflicts in this ecosystem, together with the threat of a sea level rise in the long-term, brings us to consider an alternative form of management to prevent irreversible catastrophes. This new approach requires changes and improvements in the distribution of work of all those concerned. An effective management of the coastal zone needs a sound scientific basis which takes into account new institutional instruments (decentralized structures, the private sector, the society) and GIS techniques. The new environmental management structure, ABE (Benin Agency for the Environment) seems to be an effective structure for the challenge.

2. Degradation of ecosystems

The challenges in the coastal zone of Benin can be sumarized as the degradation of ecosystems, population growth, pollution and decreased coastal productivity. But the current situation is less serious when compared to the expected growth of the coastal population coupled with the potential devastating effects of a sea level rise.

2.1. Geomorphological dynamics

Different studies carried out on the west coast of Africa have shown that erosion has not been observed everywhere at the same time. In some areas it appeared a few centuries ago whereas other areas have been subject to erosion for only a few decades. On the coast of Benin, these differences can be observed over a period of 40 years, as shown in table 1, p. 222. The shore can be subdivided into three sections having widely varying characteristics and which are subject to different types of erosion.

a) The coast from the border of Togo to Grand-Popo is quite narrow (approximate width 1km which narrows down towards the east). The altitudes vary between 3 and 5 metres. Three different types of profiles are observed and depend on hydrodynamic parameters:

Table 1. Evolution of the coast from 1954 to 1995.

Years	1954-64	64-69	69-75	75-81	81-84	84-90	90-95
W to E sectors							
Hillacondji-Grand-Popo	=	= +	-	-	+	=	=
Grand-Popo-Djondji	=	=	=	=	=	=	=
Djondji-Ouidah	=	=	=	+	+	+	+ =
Ouidah-Cotonou Port	=	= +	=	+	+	+	+ =
Harbour-PLM Hotel	=	+	+	-	=	=	=
PLM Hotel-SOBEPRIM	=	=	-	-	-	-	-
SOBEPRIM-Klaké	=	=	=	=	=	=	-

Legend + :Advance of the coast; - : Retreat of the coast; = : Stability

- Straight ridge profile, abrupt slope, short pool (less than 3 m), contouring above 1 m, reverse side flat. This is a profile resulting from strong waves which are currently causing erosion.
- Strong wave profile, rounded ridge, slight contouring with slope facing the sea, reverse side inclined towards an inter-arrow trough (in the case of an arrow, the reverse has a steep slope facing the lagoon).
- Shelf profile with a straight or rounded ridge characterizes the transition between a strong wave and a medium wave.

b) From Grand-Popo to Godomey the altitudes of the bars vary between 3 and 5 m. They are serrulated by the lower waterway and the mouth of the Mono, coastal lagoons and the tides. The width of the bars are small (less than 200 m). The same types of profiles are observed as in the previous case.

c) From Godomey to Kraké the bars are subdivided into a series of successive parabolically shaped ridges which are rigorously parallel and face an east-west direction (maximum altitude 6 m). The granulometric (medium and fine sand) and morphoscopic (shiny and dull sand) characteristics favour a marine origin. The fine sand, generally well sorted, has been generated under homogeneous hydrological conditions, even if some local disturbances are observed.

2.2. Conflicting uses

Diverse human activities (such as intensive agriculture, fishing, diverse industries, tourism and transport) generate direct effects and even tend to provoke important degradations on:

- the environment which is monitored by the quality of water, living matter and the atmosphere,
- the natural integrity of the coastal area,
- the stability of the coastal profile (coastal erosion) and
- the viability of the renewable natural resources (living) and non-renewable resources (mineral).

These human activities in the large marine ecosystem of the Gulf of Guinea are organized into groups of interest which are sometimes opposed. This is due to bad management and/or bad organization (for example, the fishermen complain of industrial waste from the phosphate factory of Kpémè, and the disappearance of fish, according to Euxàla, is due to the construction of the Nangbeto barrier). These activities also cause other specific actions such as conflictual spatial occupations, contradictory uses, and controversial regulations.

3. The actors

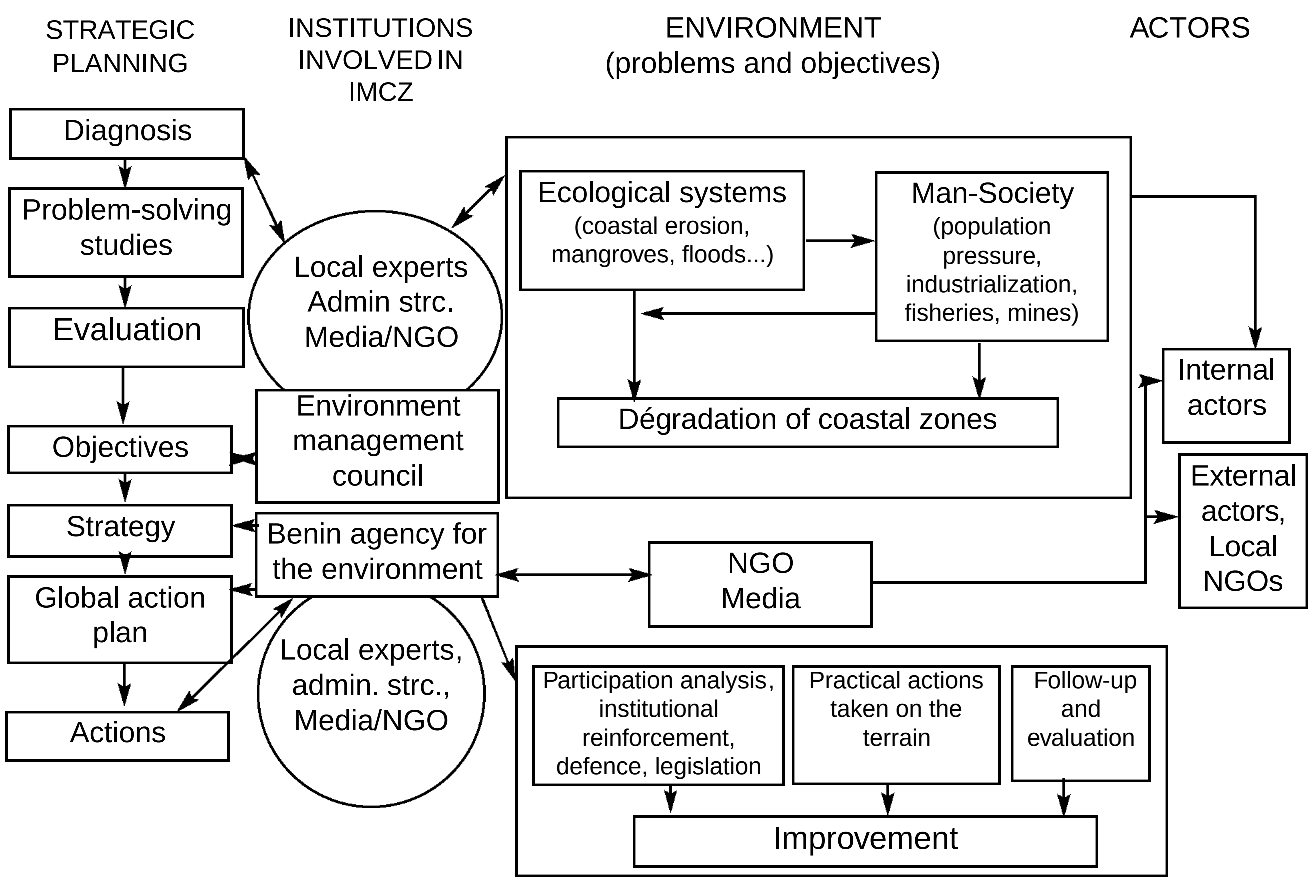
Without precise identification and without a well defined management plan that has an integrative objective, all the misunderstandings will persist. For this reason it is useful to define the roles of the various actors (Fig. 1, p. 223) that intervene in the coastal zone of the Gulf of Guinea, and especially the local communities which are often parallel and rigid without much hope of agreement. In general, according to a country's practices where laws exist and are applied, the roles of the different actors are defined as follows:

- The managers (decision-makers and planners) of the area are today limited to the State services and are theoretically responsible for the elaboration and application of the regulation, the monitoring and the control of the quality of the uses of the coastal environment.
- The scientists, often attached to research institutions, are responsible for getting to know the environment and the people better. In the same category are the few NGOs for the defence and protection of nature and for environmental management, as well as representatives of the civil society.
- The users concerned are the coastal populations that frequent the coastal area, as well as economic agents (producers of goods and services), and tourists.

3.1. The communities

In the framework of an integrated management policy for coastal areas, there is a need to find the best way to involve the local urban and rural communities. The efficiency of the action taken in these areas depend on a good knowledge of the interrelationships established between this environment and the human groups that inhabit it. Contrary to pre-conceived ideas, the communities have a thorough knowledge of the ecology of coastal environments thanks to the century-old ties between them and the environment which have been passed down from one generation to another. If these communities were able to develop appropriate systems of exploitation not

Fig. 1. Proposed structure of integrated coastal management in Benin.



so long ago which ensured the integrity of the coastal environment and means for the populations' existence, it is certain that a lot of problems could be solved if their example were followed. Following their example means listening to them to increase their participation in coastal environment problems.

3.2. NGOs and OCB?

The success of a strategic plan and the implementation of operations calls for a synergy between several types of actors as well as the population's participation. NGOs have an essential role to play in this participation and at different stages— diagnostic, elaboration of a strategy, as well as taking action. NGOs are known for their close relationship with populations, namely rural populations and the poorer urban populations. They have a good knowledge of the environment and use methods of analysis, planning and participatory operations. Nevertheless, the experience of young African NGOs is often limited to small projects and does not always deal with questions relating to ecosystems and their equilibrium, and notions which are as complex as the integrated management of the coastal zone. There is a need to reinforce them through appropriate training. Despite the initial difficulties encountered in understanding the mission, NGOs have to be trained to play their part in the project in two main ways:

- Share experiences and information among NGOs working towards sustainable management of coastal and marine ecosystems, and
- Sensitize communities on the impact of their socio-economic activities on the ecosystems and on the means to be applied for their improvement.

4. Integrated management of the coastal zone

4.1. Strategic withdrawal

On the coasts of Benin, aside from the Ambassadors' quarters in a luxury residential area at Cotonou, strategic withdrawal is the rule for the coastal population. Strategic management of the coast is seen by everyone as having, as much as possible, respect for the coastal environment. This is a wise approach given that a rise in sea level is a reality to be taken into consideration. Whenever rigid infrastructures are not present on the coast of Benin, a gradual withdrawal is required such as is proposed by the National Committee for coastal management. Then again the recommendations must not only be followed by the coastal populations, but also by the competent authorities and at all levels too!

4.2. Institutional reinforcement/creation of the ABE

The Benin Agency for the Environment (ABE) is an institution responsible for the implementation of proposed strategies in the environmental action plan to improve the rational capacity of management of the environment, and the general level of sensitization and knowledge on the subject of the environment. The ABE constitutes an institutional reinforcement which allows the application of environmental laws, facilitates the integration of environmental perspectives in sectorial strategies and programmes, and in the follow-up of evaluation and information management. The ABE is also a follow up tool in the regular framework of environmental impact assessments and quality control of these studies.

The ABE is also responsible for undertaking studies on the management of the coastal zone with the aim to better evaluate the present constraints and risks that exist in this strategic zone that groups together almost 30% of the population.

In this framework, it is suggested that a map of the coastal zone be drawn up to scale of 1/50,000, and to carry out the specific studies required. The essential role of the cartographic tool for coastal management is clear as is predicted by the ABE. The Agency gives a lot of importance to the Geographic Information System (GIS), which is an improved graphic synthesis of the classic cartography and of remote sensing, carried on respectively by IGN Benin and the National Centre for Remote

Table 2. Main agreements, treaties and conventions to which Benin has adhered to in the field of coastal environment.

Date of adhesion	Conventions Place and date of adoption
1984	Convention on the international trade of endangered species, Cites, Washington, 1973
1994	Convention on biological diversity, Rio de Janeiro, 1992.
1986	International convention on civil responsibility for damage caused by pollution, Brussels, 1969.
1986	International convention on civil responsibility for damage due to pollution from hydrocarbons (and amendments), Brussels, 1969.
1986	International convention for the creation of an international compensation fund for damage due to pollution by hydrocarbons (and amendments), Brussels, 1971.
1985	International convention for the prevention of pollution by MARPOL ships, London, 1973.
1983	United Nations convention on the law of the sea, Montego Bay, 1982.
1993	Convention relating to the protection of the ozone layer, Vienna, 1988. Montreal protocol, 1987. London Amendment, 1990.
1994	Convention on climate change, Rio de Janeiro, 1992.
1983	Convention relating to cooperation concerning the protection and development of the marine environment and coastal zones of theWest and Central African region,WACAF, Abidjan, 1981.
1994	Protocol relating to cooperation for the fight agains pollution in a crisis situation, Abidjan, 1981.
1995	Fight against water pollution and conservation of biological diversity in the marine ecosystem of the Gulf of Guinea, Vienna, 1992.

Sensing (CENATEL). Specific studies can be undertaken by research institutions such as the specialized laboratories of the National University of Benin (UNB), the independent Port of Cotonou, the Benin Centre for Scientific and Technical Research (CBRST), the Hydrological Service of the Hydraulic Board, the Benin Centre for Sustainable Development (CBDD), several NGOs (Benin 21, Benin Nature, CEDA etc). Concerning this is a management scheme shown in Fig. 1, p. 223.

In the legal context, Benin has ratified the various international treaties and conventions relating to the environment, as Table 2 shows.

5. Conclusion

The fragility of the coasts of Benin is worrying in more ways than one. Half a century of 'blind' management of the coast to cope with increasing demographic pressure and human activities, sometimes uncontrolled, makes appropriate management of these areas a must before an irreversible situation is reached. In order to try to preserve the coast, it is necessary to know it better. Studying the beach-rock allows us to discern it's capacity and limits in protecting the shore, either by directly acting as a wave-breaker, or indirectly by serving as a stronghold for setting up works.

But today the rising sea level is an unavoidable parameter which has to be taken into consideration in all coastal management approaches.

All sources of information are useful. A new geographical tool – the geographic information system GIS – combining spatial remote sensing and graphic information, complements existing tools and gives an improved cartography. At this level, our point of view is clear. A new approach to the problem based on systematic pluridisciplinary research taking into account both natural processes and impacts of inhabitants on the coast, is needed. Geologists and geomorphologists have a primordial role to play in these research teams to manage this threatened coastal space. The results of the research have to be taken into account by the decision-makers through major information and awareness campaigns for the coastal populations. It is a never-ending task.

Possible destructive effects of sea-level rise on small coral islands: Maziwi Island (Northern Tanzania)

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1. Introduction

During recent years the expected sea level rise resulting from atmospheric warming has caused considerable concern over its possible effects on small, low-lying coral islands. A number of reports on Indian and Pacific Ocean islands dealing with this topic have been prepared by the Commonwealth Expert Group on Climatic Change and Sea Level Rise (Lewis, 1988 a,b; Edwards, 1989). Predictions on what will happen to the sediments which make up most of the small islands situated on coral reef flats involve uncertainties ranging from erosion and loss into the lagoons to accretion against existing and/or building up of new islands (McLean, 1989, p. 68 and fol.). The fate of Maziwi Island, an islet off the coast of northern Tanzania, may contribute to a better understanding of this problem.

The Maziwi reef is located at the northern end of the Zanzibar Channel approximately 50 km south of the town of Tanga and 8 km southeast of the mouth of the Pangani River (Fig. 1, p. 275). It bore a small island (sand cay), which was famous as the single most important nesting ground in East Africa for three species of endangered marine turtles (Frazier, 1974; Shedd, 1974). The Tanzanian Government intended to protect the islet by game laws ("Maziwi Island Reserve"). In 1982 it was reported that Maziwi Island was submerged and therefore unsuitable for nesting of turtles (IUCN/UNEP, 1982, p. 36; Mainoya and Pratap, 1988). In this paper the history of its destruction is reconstructed.

2. Coastal setting

The coastline in the northern part of Tanzania (Pangani-Tanga area) is characterized by beaches composed of siliciclastic sands alternating with raised coral reef limestone forming cliffs, and estuaries or small deltas with extensive growth of mangroves. Calcareous sands occur in pocket beaches. The Pangani mouth is an estuary partially fringed by mangrove swamps.

Locally, fringing coral reefs are developed. At a distance of usually 5 to 8 km from the shoreline a NNE-SSW trending barrier reef occurs, interrupted by channels to a depth of 40 m and several kilometres wide (Fig.1, p. 275). Some of the reefs are attached to raised ancient limestones, others could have grown up from the sea floor during the post-glacial rise of the sea level 15,000 to 5,000 years ago. Assuming a sea level rise from 40 m to its present position during the period 9000 to 5000 years B.P. (Seibold and Berger, 1982, p. 117) and a maximum vertical growth rate of hermatypic corals of 1 cm/year (Schuhmacher, 1976, p. 179; Edwards, 1989), coral growth could have coped with the rising sea level.

Of all reefs along the Pangani coast only Maziwi bore a small wooded island. However, intertidal sand bars composed of carbonate particles are found quite commonly on reef flats. In the vicinity of the Maziwi reef, intertidal sand spits occur on Fungu Ya Zinga and Eungu Ushongo. According to oral reports of Pangani fishermen, these sand bars have not borne any higher vegetation during this century.

2.1. The Maziwi reef

The coral reef structure on which Maziwi Island was situated has a nearly oval shape with a length of 2.2 km and a width of 1.35 km. The island was located on its western side (photos 1 and 2, p. 279 and 280; Fig. 2, p. 276). The largest part of the Maziwi reef is a shallow reef flat, which is exposed to air only during neap tides. This reef flat is characterized by coral species showing massive growth forms (e.g. *Porites, Goniastrea, Montastrea*). Branching types of stony corals (e.g. *Acropora cf. scandens)* and octocorals *(Tubipora musica)* occur less frequently. Crustose coralline red algae contribute considerably to the framework of the reef. The voids between the coral colonies are filled with calcareous sand and gravel originating from the destruction of the reef by breakers, swell and boring organisms as well as from the decay of the skeletons of calcareous green algae (i.e. *Halimeda*) and articulated coralline red algae. Nodules of crustose coralline red algae (rhodolites) contribute to the sediment, too. An approximately 12 m deep interior lagoon is situated close to the centre of the reef. There are no open passes that connect this lagoon with the open sea. Typical inhabitants are quiet-water corals (pers. comm. L. Werding). The maximum water depth in the lagoon between the mainland shore and the island is 40 m. The base of the Maziwi coral reef lies at 30-35 m depth. On the fore-reef side (E) the sea floor, beneath the base of the reef slope, continues dipping steeply towards a submarine canyon, reaching the 200 m depth contour at a distance of 4 km. This corresponds to an average gradient of the sea floor of 3°.

3. Methods of investigation

3.1. Source of information

Although Maziwi Island was the best known sand bay along the coast of Tanzania due to its proximity to a major settlement (Pangani town) and its famous turtle population, accurate cartographic, geomorphologic and oceanographic data have never been obtained. However, the terrestrial part of the island has always been sufficiently small to let people who regularly visited it (fishermen) notice any major changes of the beachline configuration. Four fishermen from Pangani town, who fished in the waters around Maziwi Island since 1924, 1926, 1948 and 1955, respectively, were interviewed about the history of disappearance of the island and about the current and wave regimes in the study area. Furthermore, a few zoologists visited Maziwi Island for studies on the marine turtle population, and reliable information could be taken from their unpublished scientific reports (Frazier, 1974; Shedd, 1974). Determined and described samples of the former vegetation of the island are kept in the collection of the Department of Botany, University of Dar es Salaam and were examined. Several photographs showing the beaches and the distribution of the vegetation in several years during the 1970s were available. Vertical aerial photographs of Maziwi Island, taken in 1975 and 1982 as well as oblique amateur photographs taken in 1978, 1981 and 1989 (see pp. 279/281), were compared and used for reconstructing the beachline development.

3.2. Field work

Field studies on the island were done on five days between 4th and 10th November 1989. The size of the terrestrial part during low and high tides, inclination angles of beach slopes, ripple patterns and other sedimentary structures, the boundary to the surrounding reef flat and the distribution of remnants of the former vegetation were studied. The subtidal part to a depth of 35 m was investigated by scubadivers. The water depths on the northern and western side of the cay were determined by echo sounding. Samples for laboratory studies (sieving, thin sections) were taken from the supratidal, intertidal, and subtidal parts of the sand cay. A preliminary report of the field studies was given by Fay (1992).

4. Physical conditions

The climate of the entire Tanzanian coast is warm and humid with mean daytime temperatures ranging from 22 to 30° C and an average precipitation rate of 1100 mm per annum. The coastal area is affected by seasonally blowing winds, the directions of which depend on the position of the equatorial trough: the SE monsoon from March to September/October and the NE monsoon from October to March. Between March and May winds are generally weak and accompanied by heavy rainfall (long rainy season). From June to September/early October winds are strong, often stormy, and the precipitation rate reaches its minimum. From late October to December winds are usually weak and directions tend to vary. This is the period of the “short rainy season”. From January to March winds blow constantly from NE with variable, but usually low intensity. This period is commonly dry and very hot (Bryceson, 1977). The area is influenced by the generally north-flowing East African Coastal Current, the velocity of which varies between 0.25 and 2 n/s, the higher speeds occurring during the period of the SE monsoon (Newell, 1957).

The general wave pattern around Maziwi Island is oriented E-W, varying slightly with the season (wave approach from NE to S during the NE monsoon, from SE to E, occasionally also S during the SE monsoon). Waves break during low tides at the reef front on the eastern side of the island. Due to refraction along the reef edge and on the reef flat, waves approach the western part of the island from N and S (Fig. 3, p. 276). During high tides waves do not break at the eastern margin, but travel across the reef flat causing loose sediment to drift in a westerly direction.

Wave periods observed during field work ranged from 6 to 8 seconds, corresponding to deep-water wave lengths of 50 to 100 m. According to the information given by the Pangani fishermen, normal deep-water wave heights are generally less than 0.5 m. During storms, i.e. in September, waves heights rarely exceed 2 m. Tides are semi-diurnal with a maximum spring tide range of approximately 4 m.

5. The history of Maziwi island

Until the 1960s a sand island several hectares large existed on the Maziwi reef flat. It is mentioned on maps dating back to the early colonial times of East Africa (Stuhlmann, 1894). Small-scale maps or reports describing the size and shape of the island during this period do not exist, but it seems likely that its beachline has always been within the limits of that part of the reef flat presently still covered by a thin blanket of calcareous sand. Moreau (1939) describes the island as “a roughly circular sandbank, about two hundred yards across... It is waterless, but covered with bush and fine Casuarina trees”. An attempt to reconstruct the approximate beachline during the 1950s to early 1960s is shown in Fig. 4 (p. 277). During this time the dry part of the island probably covered an area of about 3.5 hectares. The island was elevated a few decimetres above spring tide level, its base was the reef flat surface, about 4 m below spring tide level.

Generally sand cays or sand islands on coral reef platforms are formed by sweeping of calcareous sand from the interstices of a reef flat into mound-like structures by vagaries of wave refraction around and on a coral reef (James, 1980). During storms even material from the fore-reef slope may be washed up onto the reef flat. Maziwi Island was built up in this way more than 100 years ago. The island was situated on the western, more protected leeward side of the coral reef platform. Such a position seems to be typical for cays on the majority of the small Indian Ocean Islands. Milliman (1974, p. 195) presumes that this feature is due to the lack of coralline algal ridges on most of the Indian Ocean reef flats which result in a greater exposure to wave and swell energy than on the more protected Pacific Ocean reef flats where algal ridges are usually well developed, resulting in cays usually forming on the windward side of the reef flats.

According to the description of samples of the Maziwi Island flora charted by Frazier in 1974 and kept at the Botany Department, University of Dar es Salaam, the vegetation comprised trees up to 25 m high of *Casuarina equisetifolia* and woody shrubs to 3 m high of *Brexia madagascariensis*. Shedd (1974) reported also *Ipomea pescaprae*, a beach pioneer species, to occur. Wilmot-Dear (1985) characterizes *C. equisetifolia* as a “tree quick growing in dry and infertile areas and therefore widely planted for ornament, firewood or soil stabilisation and shelter”. It commonly occurs in supratidal sandy areas and in coastal bushland. The German colonizers planted these trees along beaches; examples are the harbour road in Pangani town, where the trees are also 20 to 25 m high, and the sea fronts in Dar es Salaam. It is therefore possible that Casuarina trees were planted on Maziwi Island during the German colonial period. However, the possibility of self-sowing by seaborne fruits cannot be excluded.

Noticeable erosion of the Maziwi Island beaches seems to have started during the second half of the 1930s. Moreau (1939), in a brief note, describes one situation as follows: "In 1934, when Mr I. W. Kirkpatrick visited the island, he found a German sailor's tombstone in the bush, apparently in its original site, some distance from the shore. In August 1938, it was on the seaward side below tide-mark, half buried in sand. Numbers of fallen Casuarina trunks showed that a considerable part of the island had been lost, certainly in the space of four years". The German sailor died in January 1889.

According to oral reports of the Pangani fishermen, the rate of erosion increased considerably during the second half of 1960. The most intensive erosion took place during high tides concurring with storms between June and September. Most affected were the eastern and northeastern sides, but the other beaches underwent erosion as well. Several tens of metres of beach were lost within one year. The eroded sand was carried westward by beach drift forming new beaches closer to the western margin of the coral platform. Shrubs started growing in the supratidal zone of the newly formed beaches. Part of the sand reached the western reef edge and moved down the reef slope into the lagoon forming a submarine fan.

Until 1975 the wooded cay island had shrunk to the size shown in Figs. 4 and 5 (p. 277/278). Frazier (1974) describes the situation as follows: "Erosional forces cause the island's terrestrial area to be constantly shifting, keeping the vegetation in a continual state of flux. Consequently there are large building beaches and beach platforms where sand has been recently deposited, and climax woodland with dense vegetation does not have the opportunity to dominate".

Shedd observed between July and October 1974 that "Unusually high spring tides were eating away metres of shoreline. Nests (of turtles, author) that were two and three metres above the crest were entirely washed out before the incubation period (48 to 62 days, author after Shedd, 1974) was over, and nests that were ten and fifteen metres inland were flooded during these tides" (1974, p. 6f.). The zoologists transferred eggs of turtles that were laid below the beach crest: "We dug them out... and we transferred them to a safer place inland. All of these sites were eroded away before a week passed... The east side of the island was surrounded by fallen trees which formed an effective impasse (for the turtles, author) from sea to beyond the beach crest. The west side was the only side with a deep water approach - no reef surrounding it. There was very little vegetation on the west as it was often flooded by high tides. The north and south sides were surrounded by the reef" (l.c.). According to Shedd's figure 2, the northern side was fringed by fallen trees, too (see photo 3A, p. 281).

The last high Casuarina tree fell most likely in late 1977 (photo 3B, p. 281). In 1978 the entire area of the "original" cay island was submerged (photos 2A and B, p. 280). The newly formed sand spit to the west bore only shrubs and trees which were not higher than about 2-3 m and, therefore, not older than a few years. The average diameter of the vegetated part of the spit was 50-70 m. Between 1978 and 1982 the sand spit shifted westward approaching its present position (Figs. 4 and 5, pp. 277/278). The 1981 aerial photograph still shows a tiny sand patch covered by low vegetation (photo 2C, p. 280), while no vegetation could be detected on the photographs of June and December 1982.

5.1. The sand cay in 1989

From the air the sand spit looks tongue to hook-shaped during low tides, its convex side pointing north and westward (Fig. 4, p. 277). Its easternmost portion is founded on the reef flat, while its central and western parts cover the back-reef slope and the adjacent parts of the back-reef lagoon. (NW-SE cross-section shown in Fig. 6, p. 278.)

Supra- and intertidal part of the sand spit: During neap tides the reef flat and the sand spit are exposed to air. The size of its uppermost part, which is usually still positioned above high tide level, is about 70 m (E-W) by 40 m (N-S). Submergence also of this part of the sand spit during extreme spring tides or by wave set-up prohibits growth of terrestrial vegetation. Angles of inclination of the beach slope, measured at approximate midpoints between low and high tide levels, are uniformly 6° on the northern, western and southern flanks, and 1° to 2° on the eastern flank. The uppermost part of the sand spit is nearly horizontal and flat. Slightly asymmetrical, ladderbacked oscillation ripples with truncated crests characterize the easternmost, lowest portion of the sand spit (photos 2B and C, pp. 280). The crests of the wave ripples are oriented E-W; the average ripple length is 20 cm.

The sand is entirely composed of carbonate particles derived from the surrounding reef. Terrigenous constituents, such as quartz, are missing. The sand is medium-grained and moderately well to well sorted (see Table 1). Gravel-sized fragments of corals and abraded rhodolites are found scattered on the surface of the beach slope; accumulations of rubble occur close to the foot of the beach slope.

The grain size/beach slope relationship can be used to estimate the degree of exposure of a beach to wave attack (Wiegel, 1964, cit. Pettijohn et al., 1973, p. 481). According to this relationship, the northern, western, and southern flanks of the sand spit are classified as “protected”, the eastern flank as “exposed”.

Subtidal part of the sand spit: To the north, west, and southwest the dry part of the sand spit is fringed by a very gently inclined platform, which is built up by medium-grained calcareous sand characterized by oscillation ripples and patchy growth of seaweeds. At a distance of 70 to 100 m from the beachline and at a water depth of 3 to 4 m below low tide level a sharp break

Table 1. Grain-size parameters (moment measures) of calcareous sands from the Naziwi cay. All data are given in phi units. Sieving was done at 0.5 phi intervals.

Sample n°	Position on sand spit	Median (Phi/mm)	Mean(Phi/mm)	Sorting (Phi)	Skewness (phi)	Kurtosis (phi)
051189/3	base of slope W. side, depth 5m	-0.34/1.27	-0.55/1.46	1.16	-0.14	-0.93
051189/2	base of slope W.side, dept 10m	0.57/0.67	0.54/0.69	0.93	-0.29	0.083
041189/1	base of slope N.side dept 25m	2.72/0.15	2.68/0.16	0.72	-0.49	1.14
051189/1	lagoon, N. side of spit, dept 35m	2.69/0.15	2.64/0.16	0.69	-0.89	3.10
101189/1	N. side, mid-beach slope, 6°	1.28/0.41	1.13/0.46	0.72	-1.00	1.28
101189/2	E. side, mid-beach slope, 2°	1.52/0.35	1.41/0.38	0.47	-0.66	0.05
101189/3	S. side, mid-beach slope, 6°	1.56/0.34	1.40/038	0.55	-0.94	0.96
101189/4	W. side, mid-beach slope, 6°	1.68/0.31	1.59/0.33	0.46	-1.04	2.33
101189/5	Top dry beach	1.40/0.38	1.27/0.42	0.58	-0.68	0.02

occurs. The slope of the sea floor rapidly increases from less than 2° to a maximum of approximately 40°, and oscillation ripples are replaced by a plane bed. At one point along this slope, close to the southern margin of the sand spit at 8 m depth, a still living coral colony was observed, which was just about to be covered by sand. No sessile fauna or flora has developed, indicating rapid, still continuing sedimentation of sand. On the southwestern flank of the sand spit the base of fan slope lies at 5 to 10 m water depth. The sand at the base is coarse-grained to very coarse-grained and contains a high proportion of coral rubble (see Table 1).

Towards the lagoon the sea floor is only weakly inclined and composed of medium- to fine-grained sand and isolated coral colonies. On the western and northern side, the slope angle decreases again at depths of between 25 and 30 m, and here the medium-grained sand is replaced by a slightly silty, fine-grained carbonate sand (Table 1), which is strongly bioturbated by Callianassa-like crustaceans (lagoonal facies below wave base). Also this sand consists nearly of up to 100% biogenic carbonate particles. In a thin section of one impregnated sample from this place only very few siliciclastic grains were seen. The terrigenous influence on sedimentation in this area is, therefore, very little. Besides its smaller grain size, the lagoonal sand differs from the fan deposit in its content of tests of calcareous foraminifera and about 0.1 mm large, oval, micritic particles which are probably faecal pellets. The entire structure of this part of the sand spit resembles the leeward side of a large sand dune migrating across a reef slope. In the vicinity of the sand spit, particularly to the north, remains of trees, some of them more than 6 m long, give evidence of the former vegetational cover of Maziwi Island. The wood of the stems is in an advanced stage of decay, intensively drilled and penetrated by marine organisms (mainly Teredo).

Conclusions: The sand spit at the western edge of the Maziwi coral reef can be regarded as a fan deposit shifting from east to west across the back-reef slope into a 40 m deep lagoon, covering fine-grained lagoonal sands. Only a small proportion of the fan (<5%) is exposed above high tide level. The sand is derived from more central parts of the reef flat, from those areas which are still covered by a thin blanket of sand.

The strongest wave attack takes place on the eastern side of the spit during high tides, when the waves are not broken at the reef front. Sediment transport in the intertidal zone is by beach drift (swash-backwash towards west), in the shallow subtidal zone by wave drift, and along the slopes of the underwater fan by gravitation (grain flow). The measured maximum slope of 40° corresponds to the angle of internal friction (“angle of initial yield”) which can be expected for moderately to poorly sorted sands (Allen, 1982, pp. 60ff.). Kenter (1990) reports similar values for various carbonate platform flank deposits with grainy, mud-free, cohesionless fabrics.

6. CAUSE OF DESTRUCTION OF THE MAZIWI ISLAND

Milliman (1974, p. 195f.) classified carbonate sand cays on reef flats into six types: (i) submerged sand bar, possibly only emergent at low tide. (ii) the simple low-lying sand or shingle cay. (iii) the low-lying cay with pioneer strandline plant communities, such as creepers and shrubs. (iv) higher standing cays with more complex and better-developed plant cover, often including trees. (v) sand cays with mangrove growth and sometimes mangrove swamps and (vi) cays with exposed platforms or interiors of older rocks.

The survival of a sand cay on a reef flat depends mainly on its ability to stabilize the accumulated carbonate sand. A high degree of stability can be attained by growth of a dense and deeply rooted vegetational cover (Milliman, 1974, p. 196). A cay may thus reach a state of labile, dynamic equilibrium with regard to the eroding forces and sediment supply from the surrounding reef. Maziwi Island had reached this state, when it was covered by a Casuarina forest. During this period it belonged to type no. (iv) of Milliman’s classification. During the 1930s a disequilibrium situation occurred, which resulted in a rapid degradation of the sand cay to type no. (i) by retrogradation of its beaches, partial flooding during spring tides, and a net loss of sediment due to migration of sand towards the back-reef lagoon.

Maziwi Island has never been inhabited by humans. Therefore, certain causal factors of beach erosion, such as sand extraction, considerable devegetation, and marine construction works can be excluded. When questioned as to whether the vegetation on Maziwi Island was cut by people for firewood or other purposes the Pangani fishermen answered that only dry wood was collected by fishermen during their stopovers on the island for making small camp fires.

The fishery officers in Pangani reported that dynamite fishing was a common practice in the area before nets were introduced in the 1980s. This fishing method has definitely damaged the ecosystem of the coral reef community, and it might have reduced the overall growth rate of the reef, i.e. the capability of the hermatypic organisms to cope with a rising sea level. It has, however, not destroyed the existing “coral reef” morphological structure.

Since direct interference of humans with the ecosystem of Maziwi Island can largely be excluded as a main causal factor, possible reasons for the disappearance of the terrestrial part of the island might have been:

a) Rapid tectonic subsidence, e.g. caused by an earthquake.
b) Erosion due to extraordinarily heavy storm events.
c) Wave erosion due to a higher sea level or due to a significantly changed long-term wave climate.
d) A combination of a-c.

Early speculations about the reasons for the erosion of Maziwi Island focused on local sinkage (Moreau, 1939). The seismic data available for this section of the East African coast, however, largely exclude the possibility of rapid subsidence caused by an earthquake. There has not been any earthquake tremor during the last decades with epicentres close to Pangani and of magnitudes high enough to initiate such movements. The movements along the NNE trending Tanga fault (vertical throw of more than 3,000 m), which resulted in the formation of a submarine canyon or graben between the mainland and Pemba Island, are of pro-Middle Jurassic age. Subsequently only minor warping occurred, and there is no indication of any reactivation of this fault during the Holocene (Kent et al., 1971, p. 98).

The general trend of crustal movements along the East African coast since the Pleistocene has been positive. Raised Pleistocene coral reef terraces, which occur almost everywhere in the coastal belt from Mozambique to Somalia, give evidence of this process. Furthermore, Maziwi Island is situated at a sufficiently large distance from any river delta (80 km from the Wami River delta) to exclude the possibility of local subsidence due to rapid deltaic sedimentation. The Pangani river mouth is an estuary with low sediment discharge into the sea.

All fishermen interviewed rejected the possibility that wind, current, or wave regimes around Pangani have changed significantly compared to the time when they started working in their profession. In contrast to this, their impression was that the present sea level is higher than in former times. They estimated a rise by 1 to 1.5 feet (30-45 cm) since the 1920s. Although these figures seem to be overestimated, their observations conform with the globally observed trend. An eustatic rise of the global relative sea level by 10 cm during the period 1920 to 1980, seems to be a realistic estimate (UNEP, 1987, p.113, Table 2.6). According to tide gauge records in the Pacific sea level rose at a rate of 1.5 mm per year between 1940 and 1975, or 11 cm during the last 70 years (Lewis, 1988a, p. 30). Such a rise will inevitably affect the balance between sand supply and sand removal along beaches, will cause sand to be deposited further off-shore, and retreat of most low-lying coastlines composed of unconsolidated sediment by a horizontal distance hundreds to a few thousands times the amount of the vertical rise (Pilkey, 1983). Even a small rise of the sea level will disturb the sensitive state of dynamic equilibrium under which a vegetated sand cay like Maziwi Island can exist.

The extremely rapid erosion of the beaches of Maziwi Island occurred only during high tides in the stormy period between July and October.

During low tides waves and swell approaching from east broke at the reef front. During high tides waves had to travel across the only very gently inclined reef flat for more than half a kilometre before they reached the beach of the island, dissipating a large proportion of their energy by friction with the reef flat surface. Since the orbital diameter of a wave decreases exponentially with the distance from the surface of the sea, a rise in sea level of only 10 cm, which cannot be compensated by upward growth of the reef-building organisms due to various reasons, e.g. damages to the ecosystem, caused by dynamite fishing, would diminish the losses of wave energy due to friction with the reef flat. The amount of wave energy dissipated at the sandy beach will increase and will affect the sensitive balance between the various physical parameters which permitted the existence of the island. The sediment was especially suitable for being eroded easily, once a disequilibrium situation occurred. It was not only unconsolidated (loose sand), but also incohesive (no clay, fine silt or organic components).

The history of the destruction of Maziwi Island probably began during the late 1930s. This dating fits Alexander's (1969) report that already during the 1940 decade the general trend of coastline development in the area north of Dar es Salaam had changed from progradation to retrogradation. It may be regarded as a response to the strongly rising sea level in the 1930s. The island entered its final and most destructive period in the late 1960s. About the same time an increase of the rate of erosion of many beaches in Tanzania was observed. The Pangani fishermen reported that in Buyoni, a village close to Pangani, people had to shift their huts to places further inland since 1963. There was no erosion before this time. Erosion of the Funguni beach, a few hundred metres north of the Pangani river mouth, started in the early 1970s and is still continuing. Heavy mineral placers and fallen vegetation are clear indicators. This beach was prograding before this time. South of Pangani the first coconut palm trees fell into the sea in 1987. The road along the Pangani harbour was probably flooded for the first time during the 1960s. In September 1987 and September 1988 high floods occurred in the Pangani estuary and damaged the embankment. This 3 km long protection wall, which was built at the end of the 19th century, is now collapsing making Pangani town, which is situated on low-lying ancient beach sands, vulnerable to flooding. Oral reports of sea front residents around Dar es Salaam suggest that the rate of beach erosion in this region also has increased since the 1960s. It has meanwhile reached a disastrous magnitude: ocean roads in Dar es Salaam and several places along other beaches in this area were flooded during a spring tide in September 1987. According to oral communications of villagers, the dry parts of sandy beaches on Mbudya and Bongoyo Islands north of Dar es Salaam were flooded during this tide for the first time. Some beaches retreated 80 to 100 m between 1975 and 1989 (Fay et al., 1992). It must be assumed that the situation is similar for most parts of the Tanzanian coast, but unfortunately little research has been done until now.

7. Possible implications for other coral islands

The erosion history of Maziwi Island demonstrates what might happen to similar islands in the near future if the sea level continues to rise. Particularly vulnerable are islands whose terrestrial area consists entirely or largely of unconsolidated sediments, like many atolls in the Indian and Pacific Oceans. Compared to these islands Maziwi Island was very small, and it was never inhabited by people. Many of these atolls are densely inhabited. Examples of the probable fate of some of the smaller South Pacific Islands are given by Huim (1989).

Maziwi Island was situated on a coral platform in an area of high tidal range. Most of its sand was lost when high tides were accompanied by strong winds of the SE monsoon. The situation is different for most of the islands in the Indian and Pacific Oceans. Tidal ranges are usually much smaller (e.g. approx. 0.6 m on Mauritius, Fagoone, 1988; 1.4 m on the Maldives, Edwards, 1989), and coral reefs are, therefore, more efficient in breaking waves and reducing surge energy than along the East African coast. On the other hand, the impact of storms is generally greater on these islands, especially on those that lie within the latitudes favoured for the occurrence of cyclones. The spectacular example of the destruction of Maziwi Island, however, shows that the rate of erosion on such islands can be much higher than along beaches of mainland, which may result in the disappearance of a whole island within a few years. Low-reef islands such as the Maldives, which lie almost entirely within 3.5 m of mean sea level (Edwards, 1989), are particularly endangered.

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Geological parameters for environmental protection of Africa's coastal environment: Nigeria, a case study

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1. Introduction

A broad spectrum of the coastal environment of the African continent tasks involves a comprehensive protection of the natural environment and the rational use of natural resources, and requires intensive international cooperation for mutually beneficial agreements. Nigeria like other African countries has been involved and playing an active role in many local and international fora with respect to environmental protection. In 1987, Nigeria was included along with 27 other countries, in the first worldwide annual international environmental monitor survey. It is likely that the mounting of intensive global campaign for about two decades, for safe environment is fast catching up with big companies concerning both solid minerals and fossil fuels in Nigeria.

The three predominant sedimentary basins in the Nigeria coastal environment are the southwestern sedimentary basin, the Anambra basin and the Niger delta basin ranging stratigraphically from Cretaceous to Recent. The geology of these areas is highly related to mineral resources such as oil, gas, glass sand, clay, lignite, gypsum and limestone. Exploration and mining activities along the coastal environment lead, however, to environmental pollution and degradation. A major aspect of environmental pollution in the Niger delta is gas flaring and oil spillage. Major towns affected along the coast are Abeokuta, Lagos, Ilaro, Ewekoro and Shagamu, Benin City, Warn, Calabar, and Port Harcourt.

2. Recommendations of policies and options

Almost all companies in Nigeria do not maintain environmental protection standards, except a few companies like Shell and Chevron. This is so because environmental departments are not given sufficient support as compared to those in developed countries. Companies like Mobil, Texaco and other multinationals must be advised to take environmental standards seriously as maintained in advanced countries for a sustainable development.

In communities where oil operations are taking place, compensation only should not be the ultimate target, but an effort to rehabilitate the area must be carried out to put the place back to normal. Sustainable development means that the exploitation of minerals or fossil fuels meets the need of the present without compromising the ability of future generations to meet their needs. Although it is generally agreed that mining is not providing a sustainable development because ore or oil is not renewable, it is realised that earnings from mining can be used for rehabilitation purposes. For solid minerals like limestone and coal, the precautions given below are recommended to have a positive impact on the environment.

(a) Land must be rehabilitaded and converted into garden or fertile agricultural farm land, fishing ponds and tourist attractions.
(b) Water quality must be maintained in rivers, oceans and underground water.
(c) Manufactured materials must be recycled.
(d) Dam overflowing must be prevented.

(e) Environmental laws/regulations must be strictly enforced in Nigeria by enhanced and strong political will, *i. e.* a concerted effort must be made to enforce all laws by the Federal Environmental Protection Agency and other governmental agencies.

(f) Individual private organizations or non-governmental organizations such as Earth Resources Improvement Agency Limited must be appointed on a continuous basis by the government to monitor all laws governing environmental protection.

On 28 May 1998, the “National Concord” declared that only two of the six major oil-producing companies (Chevron and Shell) have surpassed an environmental regulation by incorporating Environmental Evaluation Reports (EERs) and Environmental Impact Assessments (EIAs) on all projects whether major or minor. A regulation of FEPA (Federal Environmental Protection Agency) made EIAs and EERs mandatory for major projects from exploration to exploitation (drilling or mining) onwards.

It is proposed that the state government should set up a new board to control and manage water works and to provide treated water for consumption. In view of the legislative inadequacies and constraints in water sources laws, all previous laws should be repealed and a new legislation on water sources should be enacted to provide the highest possible water standard along the coastal zone of Africa. A legal framework for water use should take into account the need for the conservation of water in the States of coastal Africa. The establishment of a water supply authority for sustainable management of water should be formed by involving an agency with the aim to protect water sources from pollution. River basin authorities should be made more functional and relevant to the rural population especially during the construction of dams, bridges, and land control measures.

3. A conceptual framework

A conceptual framework involving environmental impact assessments is meant to identify the environmental consequences of improving projects or activities at the conceptual stages with the objective of preventing the adverse effects of such projects on the environment. Environmental evaluation reports also perform a similar function but the differences are that EIAs focus on new projects, whereas EERs are carried out only on existing operations. Both EIAs and EERs cover the whole environment from physical to socio-economic and health impacts on the host community.

Major donors for projects to safeguard the environment include oil companies like Shell, Chevron, Mobil and Texaco, the Federal Government Ecological Fund, various Relief Agencies, the Environmental Conservation Foundation, the Water and Sanitation Association etc. A State Environmental Protection Agency should be properly funded with equipment to enable it to perform the task of assessing and evaluating the state of the environment.

4. Recommendations concerning capacity building

There are no doubts that more work needs to be done in ensuring a safer environment. Wapco, Shell, Statoil, Exxon, Mobil, Ado, Elf etc. are expected to increase their efforts to make the southern Nigeria coastal environment safe for its dwellers in order to enhance large scale economic activities.

Geologists should be more equipped for safety design, planning, executing and monitoring of borehole assessments to prevent contamination of water perculating into the ground as more claws will be added to avoid perculation. Environmental scientists (e.g. hazard engineers) should be employed to manage domestic and industrial waste so as to remove environmental hazards. Consulting project engineers should be trained/employed to remediate dump sites. Preferably, biologists should be employed during the cleaning of pits when the process of bio-remediation treatment is applied, a highly recommended method as it permits activities of microorganisms in place. Companies should be advised to convert gas flares into gas for both domestic and industrial uses, thus protecting environmental pollution and degradation. Mining engineers and other earth scientists who specialise in environmental restoration especially in reclaiming open mining sites like Ewekoro, Shagamu, Calabar and Nkalagu should be engaged. These sites could be converted into tourist centres, agricultural farms and human settlements.

5. Conclusion

Problems working against environmental protection in Nigeria's coast, as in other parts of Africa, are evident from the analysis given above. The Federal Environmental Protection Agency must exercise its authority in order to enforce law with a sufficient political will. To achieve results, financial resources are crucial from federal, states and local government sources as well as from companies.

MINING AND THE ENVIRONMENT IN SWAZILAND

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1. INTRODUCTION

Research in several countries has shown that mining contributes to land deterioration if not properly managed. Land disturbance resulting from mining is related to the mining activities, and the waste products (tailings) emanating from the mining operation. In mining, environmental impacts occur through improper disposal of waste rock, tailings and slurry from cleaning plants (Ripley et al., 1982). The host rock, low grade ore and waste reagents from extraction and processing of minerals undergo some chemical changes on exposure to air. This results in changes in the chemical properties of the surrounding soil and a disruption of the physical properties such as loss of soil structure, nutrient imbalances and increased trace element content. Changes in the chemistry of the surrounding soil lead to poor plant establishment hence erosion of waste piles.

Eventually, the soil components and eroded materials may finally contaminate surrounding water sources. Pollution of water systems is caused by mine drainage from waste streams, ground water seepage or rainfall passing through waste piles. Generally, mine drainage is the primary vehicle through which waste constituents migrate through the soil (Fuller et al., 1976). Apart from high concentrations of elements, mine drainage also contains high levels of suspended and dissolved solids, which are distributed to the surrounding water systems (Bell, 1975). The presence of small quantities of residual reagents and waste material from mining processes can therefore cause serious water pollution.

Changes in soil chemistry and water pollution can affect future land-use systems within inland river basins. In addition, erosion problems within inland mining sites can lead to increased sediment yield. Rapid change in sediment supply in a river causes instability downstream and increased fish kills. Since inland streams and rivers serve as migratory routes for fish, any impacts on inland river basins have serious implications on coastal zone management systems. Understanding the behaviour and movement of material in mine waste dumps is important not only for rehabilitation measures and restriction of inland water pollution but also in the management of coastal areas. This paper outlines the effects of mining on the soil and water quality in Swaziland.

2. MINING AND RELATED POLICIES IN SWAZILAND

Mining is among the main export earning industries in Swaziland. In 1993, this sector contributed 12% of the total (1.9 million) export earnings in the country. Swaziland has been involved in the mining of asbestos (Havelock/Bulembu), coal (bituminous (Mpaka) and anthracite (Maloma), diamonds (Dvokolwako) and iron ore (Ngwenya). In accordance with the fact that mineral deposits are non-renewable, and mines have a finite life, some of the mining operations are now closed. Therefore, it is essential to consider possible environmental impacts which might result from mining activities as well as possible ways to counteract the impacts. However, environmental problems emanating from mining activities have received less attention in national policies in the past.

The most important laws governing mining and the control of environmental impacts in Swaziland is the Mining Act (1958). The Mining

Act (1958) provides for the restoration of land surfaces in mining areas. According to the Act, shafts, pits, holes and other excavations should be filled in within 30 days from the date of termination. To date, not a single mining company has observed this provision. For example Ngwenya iron ore mine ceased operating in 1979, but the land was never restored. The shafts at Mpaka coal mine whose operations were terminated in 1992 are still open. The same applies for Dvokolwako where the waste dumps were not rehabilitated following closure of the mine in 1996. In most cases, the land surface is not restored in the belief that operations are likely to continue in the near future. Generally, most mines in Swaziland are not properly managed or rehabilitated to control the spread of the impacts during operation and after the mine has closed down. This could be because of the perception that mining activities are localised. Such perceptions are unfortunate because "although mines at any point in time are not as widespread in comparison to other land uses, they dramatically change the landscape and tend to leave evidence of the past" (Marshall, 1982).

The Swaziland Environmental Authority (SEA) Act (1992) empowers the Swaziland Environmental Authority, a body under the Ministry of Tourism, Environment and Communication to develop policies and monitor environmental problems in the country. Presently, the SEA is understaffed to fulfil its mandate. For example, although the magnitude of possible environmental impacts emanating from mining are recognised in the Swaziland Environment Authority regulations and procedures on environmental impact assessment and audits (Legal notice no 58, 1996), none of the existing operations have submitted audit reports yet.

3. Environmental impacts of mining in Swaziland

Some studies have been conducted to assess the environmental impacts in Swaziland. For example, Fakudze (1987) looked at the environmental impacts of asbestos and bituminous coal waste in Swaziland. The results of the study suggest that the asbestos tailings are characterised by a high pH, nutrient imbalances and high concentrations of trace elements such as nickel. Increased pH is not favourable for plant growth as it is likely to affect chemical reactions and nutrient availability in the soil (Michaud, 1981). The tailings also have a higher concentration of magnesium (Mg) ions compared to normal soil conditions where calcium is the most dominant cation. The dominance of Mg ions is noted (Adriano, 1986; Pendias and Pendias, 1984) to inhibit the availability of K and Ca to plants. With respect to trace element content, the asbestos tailings have high concentrations of readily available Ni and Zn. As a result of the nutrient imbalances and the high concentrations of trace elements, the low fertility status of the soil is affected. This contributes to poor plant growth and erosion problems on the asbestos tailings. At Bulembu, the erosion problems are manifested by the rills and gullies found on the waste piles.

The conditions on the waste dumps affect the water quality in neighbouring river systems. In Bulembu, the effect of the asbestos mine waste on water quality is illustrated in the Dvudvusi (or Mzilanti) river that flows below the mine (Table 1, p. 243). Water samples taken below the tunnel contain high concentrations of dissolved solids, suspended solids, alkalinity, hardness, calcium, chlorides and sulphates. According to the production manager at Bulembu, there are sludge dumps constructed to contain the waste material downstream but these fill up with time. Desludging has not been carried out since 1991. The sludge dumps now require some attention since material from sludge dumps is encroaching onto the Mzilanti River. This is clearly demonstrated on the aerial photographs of the area.

The coal tailings are characterised by high pH, organic carbon, salinity, nutrient imbalances and a high iron content. Normally, coal waste is characterised by low pH, especially in the presence of framboidal pyrite minerals

(Caruccio, 1978). At Mpaka, the high pH is due to the presence of carbonate minerals that neutralise sulphuric acid to sulphate salts. This explains the high salinity levels within the waste piles and tailings. Regarding the nutrient imbalances, the tailings had a low magnesium and potassium content hence poor growth of vegetation. However, there were no visible erosion features on the waste piles due to the low rainfall conditions at Mpaka. The main concern would be mine drainage and seepage during heavy rains. Off-site changes in underground water quality were noted at Mpaka (Table 2). Most importantl are the high levels of chloride, sulphates and dissolved solids in the water.

4. Implications for coastal management

Although the waste from the coal mining operations in Swaziland has high pH values, Förstner (1993) notes that when the neutralizing or buffer capacity of pyrite - containing minerals is exceeded, pH values may be lowered. The production of acidity can lead to an increased trace element content in riverine and estuarine sediments thus affecting biota within these systems. Trace elements are also noted to either enhance or inhibit marine phytoplankton growth, as per (Granéli and Haraldsoson, 1993). For example, these authors note that excess iron has been found to limit phytoplankton growth in marine waters. According to

Table 1. Water quality in the Dvudvusi River above and at the mine tunnel (Source: Water Resources Laboratory).

	1984		1994	
	Above tunnel	Below tunnel	Above tunnel	Below tunnel
pH	6.87	9.46	6.83	7.78
Dissolved Solids (mg/l)	29.5	118.56	22	76
Suspended Solids (mg/l)	18.2	100.4	62	183.1
Hardness (mg/l, $CaCO_3$)	22.4	155.7	28	95.8
Alkalinity (mg/l)	17.5	84.1	27	64
Calcium (mg/l)	8.5	59.05	17.8	46.57
Magnesium (mg/l)	1.69	13.41	nd	nd
Chloride (mg/l)	8.9	30.7	2.8	11.1
Sulphate (mg/l)	1.74	21.72	1.1	32.67
COD (mg/l)	10.0	37.6	24.5	34.8

them, excess macronutrient availability also regulates biomass accumulation and species composition in marine waters.

5. Conclusion

Unless serious measures are taken to control the spread of waste material, the impacts of the mines on the environment will be witnessed in distant places, especially estuaries and intertidal zones. Although the waste dumps are partially colonised, the existing plants are not effective in controlling the prevailing erosion problems on the waste dumps. There is need to consider effective policy measures to control the spread of the impacts to neighbouring environmental systems. Mining companies and relevant Government departments should ensure that mine waste and sludge dumps are stabilised and rehabilitated during and after closure of the mines. Chemical processes and the movement of chemical constituents in the waste and neighbouring rivers need to be monitored.

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Table 2. Properties of EmaSwati (Mpaka) coal mine domestic (underground and surface) drinking water sources (Source: Fakudze, 1987).

Parameter	Underground	Surface	Recommended Standard
pH	8.3	7.7	6.0 - 9.0
Conductivity	680	164	250
Dissolved Solids (mg/l)	4 865	1 1182	500
Suspended Solids (mg/l)	16	38	0
Alkalinity (mg/l)	308	530	100
Hardness (mg/l)	1 080	302	200
Calcium (mg/l)	340	140	100
Magnesium (mg/l)	740	162	100
Chloride (mg/l)	1 552	248.2	250
Sulphate (mg/l)	1 599	348.5	250
Sodium (mg/l)	1 199	330.8	50
Potassium (mg/l)	15.3	3.4	10

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The effects of artisanal mining in Ethiopia – A review

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1. Introduction

Mining for gold in the southern region of Ethiopia dates back to the mid 30s. Since then nearly 50 tons of gold were produced from placers of the Adola area alone up to the end of 1996. No record is available on the gold produced in the western and southwestern regions. However, it is believed that a few kilograms of gold are being produced annually by the local mines.

Until the establishment of modern methods for the mining of primary gold deposits of Lega Dembi and Sakaro, mining was carried out by primitive panning methods employing a significant number of labour. The introduction of semi-mechanized mining methods such as the use of hydraulic monitors and dredging has made significant improvement to the gold production in the Adola area.

The eluvial-alluvial placers have been commercially the most important in the Adola gold field. Diluvial gold is known to occur on the hillsides of the Legadembi and Sakaro primary gold deposits and the Kumudu ore occurrence. Gold placers are widespread and occur in the Bedakessa, Shanka, Wollena, Wollebo, Bore, Legadembi, and Kelecha valleys and in a number of small tributaries of the Awata and Mormora rivers. A total of 173 placer deposits and occurrences of gold are known in the Adola area comprising 7,200 km^2. In the Adola gold field, placers with contents averaging 0.1g or more of gold per cubic meter of gravel, and with gold reserves of over 30 kg are classified as “placer deposits”, while those with lesser gold values and reserves are termed “placer occurrences”. All gold placers are concentrated in the N-S trending belt of the Megado. The economic gold concentrations of the placers occur in gravel-sand-silt-clay sediments of dry streams, river flats, old valleys, and terraces. They are derived from the primary veins, lode type deposits, and quartzites associated with rocks of the Adola group and from the conglomerates of the Kajimiti beds. The gold is distributed in placers as nests or combinations and paystreaks. The largest gold placer has been explored in the Bore valley with calculated reserves of 4,000 kg of gold. This placer has been mined since the late 1950s and its exploitation is still in progress.

2. General characteristics of artisanal mining

Currently, in the Adola area the total number of artisanal miners is estimated to range between 80 to 100 thousand. Digging and planning activities may involve as many as 20,000 people in the whole regions. The main sources of the work force are ex-soldiers, students who could not get jobs since a long time and school aged boys who don’t want to go to school. There are also farmers, who live in different administrative regions, and local people. These miners prefer to work individually or in small groups using very primitive equipment like hoes, spades, crow bars, buckets, ropes and wooden bates. Their activities are uncontrolled since they do not fulfil the legal requirements of the mining proclamation. Thus, the local or the central government does not get any direct benefit. Besides, the artisanal miners do not pay license, rental, renewal fees and for a loyalty. There is no control on the gold trade. Therefore, a considerable amount of gold is estimated to have been sold illegally each year, especially from the Adola area.

2.1. Unsafe work practices and conditions

The artisanal miners do not follow any security procedures. They work without ventilation, the air being extremely humid. The illumination is in the majority of cases insufficient. There is a lack of protective measures that prevent landslides in the pits. Also, the excavating, transporting and washing of gravel are done manually under very difficult conditions.

2.2. Anti-economical

The exploitation of gold in different places by artisanal miners is anti-economic from all rational points of view. They work only on the richest parts of the deposit leaving aside the ones with a lower content (grade), so that in future, it will not be economically feasible to exploit those alone. Recovery is extremely low, probably about 50 % of the gold is not mined. It has been observed that no systematic exploration work, mapping, sampling or technical documentation is carried out by the miners.

2.3. Gold trade

The artisanal miners sell the raw gold to small traders who offer a certain price, directly on the site, while conventionally all gold traders follow world market price daily and set the price accordingly. Cheating is therefore widespread. Consequently, the miners always lose because they do not get world market prices, they are not free to sell their gold to whomever they want, and are forced to sell the gold only to indigenous people.

2.4. Social impact of unsanitary living conditions

Referring to the living conditions in the settlements, there is no planning carried out to establish the houses and villages. The artisanal miners live in small huts in almost all types of places. These huts are made from dry sticks, and the roofs are covered with grass and plastics unable to protect them from the sun, the rain or the cold at night.

Medical care is given by uncertified physicians who do not have proper medicine and medical facilities. The villages are dirty, human and house disposals are thrown all over the place, and used water runs freely within the living areas. A continued bad odour is added, coming from animals slaughtered by the villagers.

On top of this, the artisanal miners wash the gravel in used and stagnant waters which are sources of many diseases. Therefore, many of them have been killed, severely injured, or have acquired different diseases.

3. Impact of artisanal miners and small-scale mining

3.1. Utilisation of mercury

In Ethiopia mercury is used in the Adola region by artisanal miners who exploit the old tailings accumulated in the 50s and 60s, and by Adola Gold Mine Enterprise in its placer operations and in the primary gold mine. Mercury is a well known toxic metal used in gold amalgamation. It can be a major pollutant in waterways, and potentially enters the food chain, particularly in small scale gold mining areas where mercury is often prevalent. Concentrations are measured in mg/l. However, there are no estimates of how much mercury is used by artisanal miners.

Mercury is used in placer operations to recover small quantities of gold. It gets into the environment in two ways; when used in sluice boxes, it is lost to the tailings; and when burnt off from amalgam in open containers, it is vaporised into the atmosphere.

The artisanal miners retort the amalgam at open air by heating it and loose all mercury. The Adola Gold Mine enterprise retorts the amalgam using a retorting furnace in safe conditions.

3.2. Land abuses

Top-soil removal and forest destruction represent other environmental problems created when the artisanal miners apply ground sluicing methods of mining and semi-mechanised methods in placer operations. Also deep and shallow pitting result in the rearrangement of the morphology of the natural ground, having an impact on farming.

More mechanised operations often remove the overburden completely and leave behind a rough hummock surface with a mixture of coarse gravel and fine tailings unsuitable for agriculture. Also, the resulting poor drainage often leads to the formation of stagnant ponds which become in turn ideal breeding grounds for malaria mosquitoes and other diseases.

3.3. Water quality

The water quality worsens from alluvial gold operation to downstream where it becomes unsuitable for drinking. Many artisanal miners are engaged in digging, washing and panning activities along the rivers Awata, Mormora and Dawa. The inhabitants in these areas are highly affected by the water quality and it becomes a major problem.

4. Conclusion

Although artisanal mining in Ethiopia has brought a considerable input into the country's economy, its effects on the physical environment were sometimes devastating. Especially the traditional land use and the quality of drinking water suffer from the unqualified methods of mining operations that are being undertaken by the artisanal miners.

ENVIRONMENTAL DEGRADATION DUE TO MINING ACTIVITIES: UGANDA CASE STUDY

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1. INTRODUCTION

Environmental problems arising from mining activities are receiving increasing attention particularly in the industrialised nations but less so in the developing countries which, however, continue to be the world's major producers of raw materials. This is further complicated by the fact that the developing countries have to depend on these raw materials to support their economies. It is thus necessary when developing such resources to keep in mind the environmental implications. In many cases, the consequences affect a broad area, which may include the sea. Wastes generated in the hinterland are usually transported by rivers and eventually find their way into the sea and may also affect coastal areas.

Kilembe, the area of this study is situated in Western Uganda (0°12' N, 30°06' E) in the foothills of the Ruwenzori Mountains. Although Uganda is a landlocked country, the findings from this study are relevant to coastal areas that could be affected by mining activities in the hinterland.

In Kilembe, the mining of copper left a legacy of metalliferous material (tailings, rockfill, rockwaste etc.) dumped within the mountain river valley. Up to 15 million tonnes (Mt) of waste was generated during the processing of the copper-cobaltiferous pyrite ores. The exposure of the sulphidic components in the wastes to an oxic environment (especially under tropical weathering conditions) leads to complex oxidation processes resulting in a marked increase of acidity and mobilisation of sulphates and metallic elements towards the surrounding river basins and soils (Neumann-Mahlkau, 1993; Schneider and Elliot, 1997). This has great implications for the population of Kilembe valley and Kasese town who depend on the quality of the soil for agriculture and some of whom obtain their water for domestic use from the river flowing through the mine area. The Queen Elizabeth National Park (ca. 2000 km^2) and its wide diversity of fauna and flora may also be threatened as shown by the arid patches in its northwestern part. The Lake George basin which receives some sediments from the Kamulikwezi and Rukoki Rivers (partly from the Kilembe wastes and Kasese cobalt stockpile) is also prone to contamination. Wetlands bordering Lake George play an important role in climatic balance and its fish is the main source of nutrition and economic mainstay of the population living in the fishing villages on its shores. It is thus important to identify the pollutant metals and assess their likely toxic effects on the environment. This paper is aimed at assessing the influence of mine wastes of the heavy metal contents in sediments and soils within the Kilembe valley. The sediments are finally transported into the Lake George-Edward basin.

2. GEOLOGICAL SETTING

The geology of the area under study is shown in Fig. 1 (p. 282). The Kilembe Cu-Co mineralisation occurs within the amphibolitic unit of the Kilembe Series rocks. The series is part of the lowest unit of the Middle Proterozoic Toro Supergroup, which together with the Buganda Group form the Ruwenzori fold belt (Tanner, 1970, 1973; Cahen et al., 1984, Petters, 1991; Schlüter, 1997). Enveloped within K-rich biotite (Basement) gneisses, the series is composed of three major units namely:

- The Lower Kilembe Schists consisting of variegated biotite schists and banded quartzo feldspathic rocks.

- The Middle Kilembe Amphibolite consisting chiefly of amphibolite with less common lenses of dolomitic or Mg-rich marble. The mineralisation of chalcopyrite and cobaltiferous pyrite is associated with this unit.
- The Upper Kilembe Chlorite-Biotite Schists composed of a suite of rocks including chlorite-biotite schists, quartz-sericite/chlorite schists and meta-arenites.

3. Mineralisation and mining

The ore grade mineralisation was worked from a cluster of 5 deposits of which two are almost exhausted and only one still contains reasonable reserves (Warden, 1985). The primary sulphide ores are essentially pyrite, chalcopyrite and pyrrhotite in the approximate ratio (12:7:1). Rare amounts of linnaeite, sphalerite, siegenite, pentlandite (sometimes containing Co) and molybdenite also occur (Bird, 1968).

Production commenced in 1956 and ceased in 1978 when 16 Mt of ore averaging 1.95% Cu had been mined yielding 265,000 tons blister copper and 1,113,000 tons of cobalt concentrate by-product (Warden, 1985). Production during this period is shown in Fig. 2 (p. 282). During the 1960s, after coffee and cotton, copper ranked as the country's most important foreign exchange earner providing jobs to 6,000 people. After 1978, the mine was kept on "care and maintenance" basis, retaining 700 workers. Production ceased due to a number of reasons including a fall in prices, logistical problems and political aspects. An intensive exploration programme is now underway to resume copper and cobalt production in Kilembe. Kasese Cobalt Company Ltd. was formed in 1992 to extract cobalt from the Kasese stockpile. Chalcopyrite and pyrite/cobaltiferous pyrite concentrates were produced at the mine using standard froth flotation technology. The flotation feed was maintained at 45% below 200 mesh (75µm). The mill concentrator was designed to process 3000 tons of ore per day assaying 1.65 – 2.0% Cu and 0.2% Co. The final concentrates were transported by a slurry pipeline to the filter plant at Kasese (ca. 7 km away). The pyrite/cobaltiferous pyrites were dumped in settling ponds or open dams while the copper concentrates were fed into thickeners, then filtered and dried under infra-red heaters after which they were dispatched to the smelter at Jinja, about 400 km to the east of Kilembe by rail. Apart from the concentrates of copper and cobaltiferous pyrite, tailings and other wastes, making up nearly 90% of total mill feed, were produced.

4. Materials and methods

To assess the impact of the wastes on the environment, soil and sediment samples were collected at various points within Kilembe valley. Stream sediment samples were taken from the main Nyamwamba River and its tributaries (Fig. 1, p. 282). Soils were sampled from various locations within the mining area, around mine waste disposal sites, in mineralised areas and outside these zones at regular intervals. The samples were air dried, packed in polyethylene bags and later sieved (to 125 µm size for soil samples and 63µm for sediments) using nylon sieves. They were digested with aqua regia and analysed for heavy metals using inductively coupled plasma-optical emission spectrometry (ICP-OES). The pH was determined by mixing the samples with water (2 g of solid sample in 5 ml of distilled water) and measuring the pH of the supernatant liquid. Carbon was determined using a LECO RC 412 Carbon-Phase-Analyser.

5. Results

5. 1. Stream sediments

Sediments potentially serve as an important source of, and sink for, heavy metals in the aquatic system. Establishment of metal levels in sediments can therefore play a key role in detecting sources of pollution in aquatic systems. Moreover, contaminants that are not readily soluble (e.g. Pb and Cr) may not be detected or evaluated through the sampling and analysis of water. These could, however, under certain physicochemical conditions dissolve into the water column and eventually enter the food chain. In this study, 79 stream sediment samples were collected for analysis. The analytical results of stream sediments are shown in Table 1 (p. 255) . Fig. 3 (p. 283) shows the distribution of metals along the Nyamwamba River while metal contents in samples from tributaries are shown in Fig. 4 (p. 283). From Fig. 3 (p. 283), it can be seen that the metals follow an almost similar trend along the river. The highest concentration of metals is found in stream sediments from tunnel portals (Table 1, p. 255). Metal contents of samples from tributaries (Fig. 4, p. 283) are higher than those from along Nyamwamba River.

5. 2. Soils

The average metal contents (and other parameters) in the different categories of soils are given in Table 2 and are compared to tolerable limits of trace metals in culture soils (Kloke, 1980). The mean concentrations of Cu, Ni, Co and Zn in relation to tolerable limits are plotted in Fig. 5 (p. 284). The lateral variation of metal contents from a tailings dam was investigated by taking samples along a NNW profile from dam F to the River Nyamwamba bank. Samples were taken 10 m, 100 m, 200 m, 300 m, 600 m and 700 m from the tailings dam. The last sample (700 m) was taken at the river bank. Samples were taken at depths of between 0 and 20 cm, 20-40 cm and 40-60 cm. The results of the metal contents in the topsoils are shown graphically in Fig. 5 (p. 284). Distribution diagrams of the metal contents in the topsoil and 20 - 40 cm layers were also plotted to visualise the metal concentration with depth. An example for Cu is given in Fig. 6 (p. 284).

6. Discussion

6.1. Stream sediments

When sediment samples taken upstream of the mine area are taken to represent natural (“background”) values, the relative enrichments of the metals compared to upstream values are shown in Table 1. Within the mining area, average Cu contents are 20 times above “background” levels followed by Co (8.4) and Ni (2.8). Cr (enrichment factor 2.3) most likely due to weathering of the basic country rocks which were crushed with the ore-bearing rocks. Zn which is very mobile in the weathering environment is not so strongly enriched in the sediments although it is also present in significant amounts in the tailings. Although Fe apparently shows a weak enrichment, its concentration is 1.5% higher in samples from mining area compared to upstream. Pb, which is not associated with the sulphide mineralisation, is present within the same order of magnitude in both upstream samples and those from within the mine area.

Fig. 3 (p. 283) shows the variation of metal contents along River Nyamwamba. All the metals follow a more or less similar trend along the river. Metal concentrations increase significantly as the river enters the mining area (at 3.8 km). The highest concentration of Cu is recorded at 4.7 km. The sediments at this location comprise effluent from the mine (tunnels and former concentrator plant) as well as erosion products from tailings dams. The Cu concentration drops at 6.7 km (upstream of tailings dams C, D and E) as the river flows through a predominantly residential area and increases again at 7.7 km below tailings dam C. The concentrations remain high until 15.7 km where, after mixing with less contaminated material, the Cu content is reduced but still higher than upstream of the mine area. These are sediments, which eventually end up in Lakes George and Edward. Co and Ni are one to two orders of magnitude less than Cu. Average parameters of the tributary sediments are shown in Fig. 4 (p. 283). Although they are of the same order of magnitude as those from River Nyamwamba, the metal contents are clearly much higher. Samples UBHG and MCG, which were collected outside the mining area, have the lowest contents of heavy metals. Relative to “background” values, sample UNSG that was taken outside the active mining area has elevated metal contents. This is attributed to the effect of mineralisation. The sediments are derived from weathered rocks of the mineralised zone. LNSG, OT, BHG and LBHG were taken from within the active mining area and they have the highest metal concentrations with almost 0.5% Cu in sample BHG. These samples also have correspondingly high Fe and to some extent high Mn concentrations. The metals may be partly adsorbed onto Fe and Mn oxyhydroxides. The ratios of Cu, Co and Ni concentrations between samples from the active mining area (excluding those from tunnel portal drainage channels) and that from the mineralised zone (UNSG) vary between 1.5 and 9. The metal contents of the sample from the mineralised zone may serve to indicate the geogenic contribution to the heavy metal loads in the sediments. Comparing this with those from the area where active mining took place, it can be seen that the contamination due to mining activity by far outweighs that due to mineralisation. Muwanga (1997) has reported similar trends in waters.

Stream sediments from tunnel portals have the highest concentrations of all the metals concerned. Still the most highly enriched metals are Cu, Co and Ni. Zn and Cd are enriched more in the tunnel drainage sediments than in the rest of the mine area. The material from the tunnel portals is mainly derived from sandfill material that was used for cut and fills stopping (Bird and Kottler, 1969) and erosion products of the ore horizon and enclosing rocks. Visually, the sediments contain blue and greenish particles or aggregates. These are most likely secondary minerals such as malachite or copper hydroxides, which are products of weathering of the sulphides (cobaltiferous pyrite, chalcopyrite, pentlandite and possibly traces of sphalerite). The high calcium content and alkaline pH illustrate the influence of the concrete used in construction of the drainage channels. In this pH range Ca may be an important buffer in the tunnel drainage sediments.

6.2. Soils

The metal contents of soil samples taken from outside the mine area are below tolerable limits and can be regarded as background (Table 2, p. 256 and Fig. 4, p. 283). For comparison, Clews (1962) reported values of 50 to 70 ppm Cu, 15 ppm Co and 20 ppm Ni for soils derived from barren rocks in Kilembe. The soils from the flood plain and hill slopes within the mine area have elevated concentrations of Cu, Ni and Co. Compared to background values (outside mine area), Cu (150 ppm) is enriched by about 5 times, while Ni (53 ppm) and Co (46 ppm) are enriched by about 1.5 and 2 times respectively. The rest of the metals do not show much difference with background values (Fig. 5, p. 284). The elevated contents of Cu, Ni and Co are linked to erosion and deposition of metalliferous wastes in the flood plain. On the hill slopes, heavy metal enrichment is either due to creep from mineralised horizons or from waste piles created by open cast mining. Since the waste heaps are made up of finer grained material, more contamination is expected from the wastes than from mineralised horizons. The most contaminated soils are those from around the tailings. They contain up to 1.1% Cu, 234 ppm Ni and 807 ppm Co. On average, these soils contain 55 times as much Cu and 2 times and 4 times as much Ni and Co, respectively, as the background soils. As expected, the soils immediately surrounding the tailings dams are contaminated to the greatest extent by heavy metals. This is also seen in Fig. 6 (p. 284). The metals concerned (Cu, Co and Ni) are those that are enriched in the sulphide ores that were processed in Kilembe. Cu, followed by Co and Ni shows the highest pollution. The rest of the trace metals though slightly enriched in soils near the tailings, occur within tolerable limits.

Considering the lateral variation of metals from the dumps, the soils near the tailings are highly contaminated with Cu (Fig. 7, p. 284). Close to the tailings, 10 m to 200 m away, the concentrations of Cu are in the range of 4,700 to 6,050 ppm. Between 200 m and 300 m, Cu concentrations decrease by a factor of about 20 and remain low up to 700 m, at the River Nyamwamba bank. Cu contents in the bottom layers show a similar pattern. Co and Ni occur almost in equal concentrations in the soils along the sampled profile. They show a similar trend to that shown by Cu but their concentrations are almost two orders of magnitude less. Further than 300 m, Ni contents are slightly higher than those of Co. Zn and Mn on the other hand, increases at 300 m away from the tailings. The soils around the tailings are also generally acidic.

7. Conclusion

The potential pollution of the environment in the study area is reflected in the heavy metal contents of the sediments and soils within the mine and waste disposal areas. Compared to upstream of the mine area, the metals associated with the ores (Cu, Co and Ni) in Kilembe are highly enriched in the stream sediments in the mine area and mineralised zone, e.g. up to 2.2% Cu in tunnel drainage channels. Metal contents in the mineralised zone are

Table 1. Statistical parameters of stream sediment samples from upstream, from within mining area and from mine tunnel portals. All metal contents in ppm.

	A Upstream (n=14)			B Within mining area (n=30)		
Parameter	Mean	Std. dev.	Range	Mean	Std. dev.	Range
Cu	57	23	26 - 101	1150	670	206 - 2264
Ni	29	4	22 - 35	81	26	47 - 144
Co	20	5	14 - 31	167	57	55 - 264
Cr	33	9	27 - 62	75	30	42 - 163
Pb	17	8	9 - 41	19	3	13 - 27
Zn	73	15	55 - 99	108	33	49 - 174
Cd	1.1	0.4	0.3 - 1.6	1.7	0.7	0.6 - 3.6
Fe	25,796	2,993	17,260 -28,820	39,976	16,148	21,300 - 94,200
Al	8,872	1347	6,902 - 11,990	10,726	3,195	4,300 - 18,050
Mn	510	74	400 - 620	676	236	300 - 1420
Ca	2,447	304	1,946 - 2,890	2,455	949	1,100 - 5,180
Mg	4,340	500	3,200 - 5,060	5,719	2,023	2,700 - 12,300
Org. C%	1.8	0.7	0.8 - 3.7	1.1 (27)	0.6	0.4 - 2.9
Inorg. C%	0.02	0.01	0.01 - 0.07	0.01 (26)	0.006	0.003 -0.023
pH	6.6 (13)	0.2	6.2 - 6.7	6.7 (26)	0.5	4.8 - 7.2
	C Tunnels (n =10)			Enrichment compared to upstream		
Parameter	Mean	Std. dev.		Range	Ratio B:A	Ratio C:A
Cu	21,850	11,599	9,071 - 41,291	Cu	20	159 - 724
Ni	614	282	147 - 1,025	Ni	2.8	5 -35
Co	2,834	1,454	394 - 5,081	Co	8.4	20 - 254
Cr	147	23	97 - 168	Cr	2.3	3 - 5
Pb	47	22	21 - 95	Pb	1.1	1.2 - 6
Zn	699	321	129 - 1167	Zn	1.5	1.8 -16
Cd	5.2	1.9	2.2 - 8.9	Cd	1.5	2 - 8
Fe	13,2357	68,538	67,220 - 26,0820	Fe	1.5	2.6 - 10
Al	20,680	10,094	9,300 - 40,990	Al	1.2	1 - 5
Mn	4,462	2,215	2,020 - 8,100	Mn	1.3	4 - 16
Ca	7,035	2,074	3,967 - 11,300	Ca	1.0	1.6 - 5
Mg	6,540	2,276	3,917 - 9,458	Mg	1.3	1 - 2
Org. C%	0.6	0.19	0.3 - 0.9	Org. C%	0.6	0.1 - 0.5
Inorg. C%	0.08	0.05	0.02 - 0.15	Inorg. C%	0.5	6 - 7.5
pH	7.5	0.2	7.1 - 7.9			

(n = number of samples; where this varies from the one given at the top of the table, they are indicated in brackets after the average of the parameter concerned). Ratios B:A and C:A are the relative enrichment within mining area and tunnel portals, respectively.

lower than those in the mining area, indicating that the pollution due to mining activities outweighs by far that due to mineralisation.

The soils from the flood plain within the mining and waste disposal areas and especially those from near the tailings are to varying extents polluted by the heavy metals. The high concentrations of Cu, Co and Ni reflect the mineralogy of the sulphide ore residues, which are present in the tailings. The values of these metals exceed those recommended for culture soils (Kloke, 1980). Although the metals could be adsorbed on soil components such as Fe and Mn hydroxides/oxyhydroxides, clays and organic substances, they could still pose a danger to the environment.

Compared with results obtained elsewhere (e.g. Edroma, 1974; Bowen, 1979), Cu and Ni occur in amounts that may affect the growth and yield of plants. High concentrations of Cu in sediments have been reported to be greatly toxic to aquatic organisms (Hodson et. al., 1979; Flemming and Trevors, 1988, 1989; Hettler and Lehmann, 1995). This has important implications for coastal areas with mining activities in the hinterland. Increased metal contents in the sea may reduce fish stocks, which would deprive the coastal population of an important source of income and nutrition. Soils in the coastal areas which would be acidic may be rendered unproductive thus adversely affecting agriculture and other activities. In such situations, measures should be taken to minimise the pollution potential. This could either be by placing covers of soil and vegetation to prevent generation of acid mine drainage and erosion of the waste surfaces, or if possible, extract the metals from the wastes.

Table 2. Statistical parameters of soils in Kilembe. All metal contents in ppm.

	Soils from outside mine area n = 36		Soils from flood plain within mine area n =23		Soils from near the tailings n = 14		Tolerable limits (after Kloke, 1980)
Variable	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	
Cu	33	10.6	150	48	1,829	862	100
Ni	35	13.8	53	18	69	24	50
Co	23	6.6	46	23	84	41	50
Cr	43	19.3	56	23	70	42	100
Pb	11	4.1	13	4	13	4	100
Zn	55	14.5	58	1	70	18	300
Cd	1.06	0.3	1.2	0.3	1	0	3
Fe	30,180	9,077	37,192	9,150	32,214	11,180	
Al	17,096	4334	18,723	5,981	15,828	3,570	
Mn	724	341	698	288	614	591	
Ca	2,381	1,581	3,011	2,181	2,573	2,723	
Mg	5,390	1,466	6,774	3,899	5,527	1,120	
Org. C %	1.98	1.05	2.1	1.3	3	2	
Inorg. C%	0.02	0.02	0.01	0.01	0	0	
pH	6.05	0.61	5.63	0.75	5	1	

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The application of hydrochemistry as a parameter for the protection of the mining environment

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1. Introduction

The general challenge concerning the environment makes it indispensable to take decisions and initiatives to reinforce the protection of the environment, especially during the current spectacular industrial development in the different African countries.

Such a development often causes environmental problems which are sometimes very serious, and which more often than not, are badly resolved. Following recognition of these problems, environmental protection appears as an integral component of scientific and development projects. This objective can only be reached if all professionals involved in environmental development and protection (engineers, geologists, hydrogeologists, biologists, agronomists, teachers and educators) are sensitized and informed on the processes that lead to ecological disasters and on the tools and geological parameters that can contribute to the protection and the rehabilitation of the environment. In this context, specialist geoscientists in the geological field have the necessary competence to identify, forecast and contribute in a sustainable manner to remedying environmental damage and to the protection of our ecosystem. But their knowledge is not sufficiently applied in the field of environmental protection.

The aim of this paper is to compensate for this deficit by applying knowledge of hydrochemistry as a tool to aid the prevention and formation of acid mining drainage (AMD). This paper does not cover in detail this vast subject; rather it is a summarized contribution of the methods, means and application possibilities of technical knowledge of certain parameters and mainly of the geological and geochemical tool, to forecast and reduce the environmental consequences of the exploitation of natural resources.

2. The formation process of acid mining drainage

Acid drainage is formed when sulphur minerals from spalls or mining residues are exposed to air and water, or are oxidized in the presence of certain bacteria such as *Thiobacillus ferrooxidans*. The oxidation products, sulphuric acid and newly formed sulphurized metals are washed down by rainwater into the environment in the form of acid drainage. It is known that rocky masses, roads, runways and civil engineering works that are naturally exposed are areas where acid drainage problems tend to occur. However, the main source of acid drainage remains the mining residues (Fig. 1, p. 260). Acid drainage coming from mining sites is often known as acid mining drainage (AMD) or as rocky acid drainage (RAD), in order to distinguish between the different sources of acid drainage. The mining industry expels several million tons of spalls and residue each year. The major part of this material comes from the exploitation of sulphur deposits from which lead, zinc, copper, nickel, gold or carbon is extracted.

If acid mining drainage is not controlled, it can contaminate underground water, rivers and lakes, thus harming fauna and flora. The responsibility tied to the elimination of AMD constitutes the most costly environmental problem with which the mining industry is currently trying to deal.

3. Methods of control and treatment of AMD

In mining sites, procedures for the prevention, treatment and elimination of AMD, from mining residues and spall deposits, can be set up in order to protect the environment. These procedures include:

- The primary treatment of AMD with lime;
- The elaboration and evaluation of oxygen barriers as water and ground covers in order to avoid the oxidation of sulphur residues;
- The use of humid soil and other passive treatment procedures to limit residual acidity and precipitate metals so the continued control and maintenance is no longer necessary;
- The setting up of analytic norms monitoring procedures and sampling methods for the control of AMD.

4. Other AMD control techniques

Other AMD control and monitoring programmes exist and these pertain to three vast technical domains:

- tests of acute and chronic toxicity;
- biological surveillance methods in receiving waters;
- water and sediment surveillance methods.

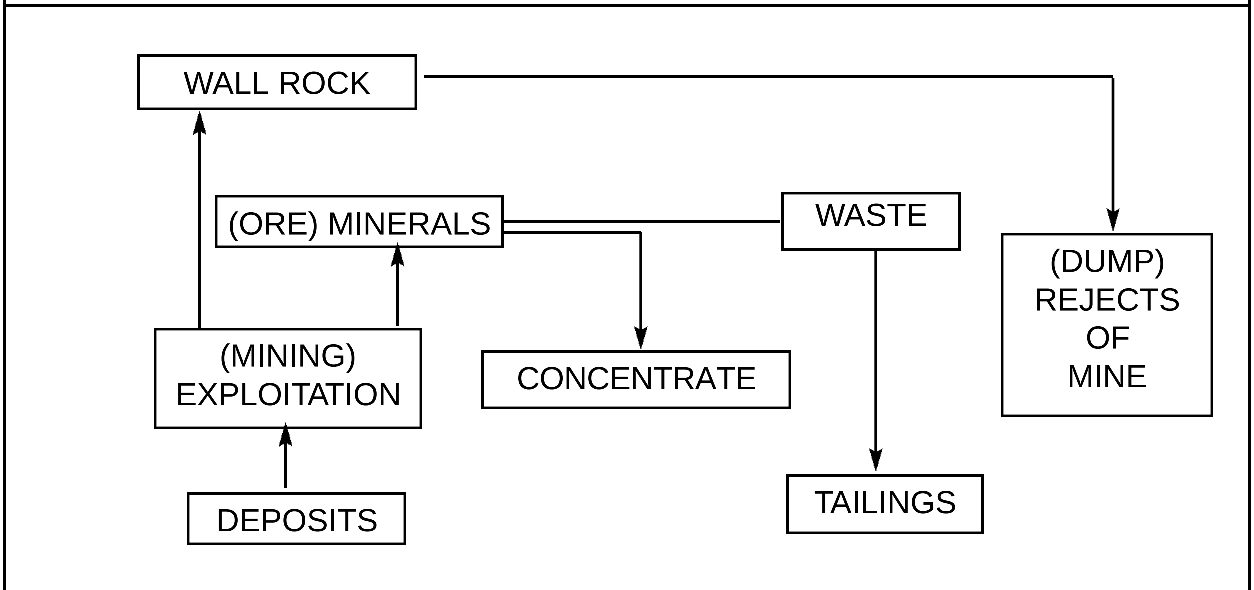
This monitoring programme is not at all intended to include methods used mainly for research. Its purpose is to produce a set of methods that enable the effective and economic monitoring of acidic mining effluents in receiving waters. First and foremost, it seeks to evaluate the impact of mining activities on receiving waters, and not to conduct research on the elements of the ecosystem.

4.1. Toxicity test

The toxicity test has two objectives, the first is to evaluate techniques other than biotests with fish which are largely used to determine the toxicity of mining effluents at their point of discharge. The second objective is to evaluate the efficiency of chronic toxicity tests that aim to determine the sublethal impact of effluents and to discover methods to efficiently evaluate sublethal effects at a low cost. This search for new acute toxicity tests is justified by the fact that the present methods (in particular tests with fish) are slow and costly.

Even if we resort to chronic toxicity tests less than to acute toxicity tests, its future generalization is predicted. It is important to study the efficiency of each and to determine their cost. The effluents will represent the complete series of typical characteristics of mining discharges, in particular concerning metal concentrations, pH, alkalinity or hardness.

Fig. 1. Mining activity and production of acid mining drainage (AMD).



4.2. Biological monitoring

The technique of biological monitoring consists of evaluating biological methods that enable one to determine the impact of mining effluents on receiving waters. Many of these tests are costly, difficult to interpret (which implies subjective and biased evaluation), difficult to apply, and also the reproduction of their results poses a problem.

Thus we have to determine which tests, or which series of tests can define in a feasible and economic manner, the impact of effluents on receiving waters. Standardization would imply a reduction in monitoring costs for mining societies while allowing a more advanced and objective control and description of the impact on receiving waters.

The large number of biological monitoring techniques available is the main obstacle to their standardization. The eventual categories of organisms include the fish, the benthos, the zooplankton, the phytoplankton, the macrophytes and the bacteria. In each category of organisms, the tests can be carried out at the level of the cell, the tissue, the organism, the population and the community. Even in the sub-groups mentioned above, we notice enormous differences in the choice of methods and in their interpretation. This diversity is indispensable and fits in with research programmes on aquatic ecosystem elements taken individually, but it is not enough, costly and a source of confusion in the search for what should be a standardized description of the impact of effluents on receiving waters.

Evaluation will be carried out in mines according to the conditions found there. Sampling sites will be chosen according to the existence of witness sites (in preference upstream or downstream), the facilities, the representativity (geographic and industrial), the presence of lakes and running water.

4.3. Water and sediment monitoring

The programme of water and sediment monitoring will be to evaluate the methods that aim to determine the incidence of mining effluents in receiving waters and on their sediments. The samples of sediments and filtered water are until now hardly standardized for impact assessments. A great number of tests currently carried out on sediments are not suitable for useful environmental data collection despite feasible methods. However, tests on one effluent reveal different concentrations of contaminants according to the filters used, even if they have the same pore sizes.

The evaluation of eventual techniques will take the following factors into consideration:

- the costs;
- accuracy of results;
- data reproducibility;
- the possibility to determine important impacts.

Evaluation will be carried out in mines according to the conditions found there. The sampling sites will be the same as those used for biological monitoring. It is recommended that data from different types of tests be integrated in order to minimize costs of fieldwork and to maximize interpretation of the data.

4.5. Integration methods

An integrative work will enable the incorporation of results obtained for the three tests and will determine the recommended techniques to efficiently monitor, on an environmental and economic level, the incidence of mining effluents on the local and/or regional environment. This synthesis will include detailed instructions on the recommended methods and on the procedure to be followed (sampling methods, sample collection, analysis and interpretation) to evaluate the impact of mining effluents on aquatic environments.

5. Conclusion

The impact of mining activity on hydrochemistry results essentially in a disturbance of the oxydoreduction equilibrium. The accumulation of rejected substances brings reduced materials to the surface, and underground works unwater and aerate lands initially protected from oxydation. The importance of the impact is modulated by the hydrogeological context and the geological environment. Therefore the remedies to search for have to consider these two contexts and also have to take into consideration the time factor.

Report on the resolutions of the technical workshop on "Earth resources and SICOM"

Introduction

The first segment of the Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM) was a set of four workshops, held from 18 to 20 July. All of the workshops addressed the "master theme" of Sustainable Integrated Coastal Management (SICOM). The following resolution is the result of the deliberations of the workshop on "Earth Resources and SICOM" that was declared after the presentation of the technical papers by its plenum.

Sustainable management of earth resources in coastal zones of Africa

1. Situation

The coastal zone is a broad area where continental and marine processes interact. Coastal areas are different in type, shape and size. They are dynamic systems and do not lend themselves to strict definition by spatial boundaries. The coastal zone is characterised by the co-existence of biotic and abiotic earth resources. Coastal zones are valuable areas exposed to natural (erosion, sea level changes, earthquakes etc.) and anthropogenic pressures, and therefore deserve to be protected. Minerals of greater economic importance such as diamonds, gold, heavy minerals, industrial materials, (e.g. sand, gravel, limestone, kaolin) and phosphates occur widely in coastal zones of Africa. Fossil energy (oil, gas and coal) is also found in the same environment. Additionally, the coastal zone contains a substantial amount of fresh groundwater. The sustainable management of coastal areas is influenced by both natural and anthropogenic processes.

The current role of geoscientists is incorrectly perceived to be restricted to exploration and economic aspects of the mining industry. The mining industry is a major factor in the economic development of most African countries. The professional potential of geoscientists for SICOM is underestimated and under-utilised.

2. Problem identification

The coastal zone represents one of the earth's most complex and dynamic ecosystems that is compounded by natural and anthropogenic pressures. The workshop identified the following problems:

- Mineral exploitation affects quality and quantity of catchment and groundwater resources.
- Rapid population growth and tourist industry along the coastal zones compromises the sustainable use of groundwater resources.
- Encroachment of salt water into freshwater reservoirs is a major problem in the coastal zone.
- Mining activities in the coastal zone contribute substantially to environmental degradation and health hazards leading to loss of lives. There is an inadequate integration of artisanal mining in the economic growth of African countries.
- There are insufficient human resources and scientific infrastructure in the field of environmental geosciences.
- The causes of natural hazards in coastal zones are poorly understood.
- Existing mining and other land use policies and legislation are often inadequate for the sustainable management of the coastal zones and for the protection of the socio-economic interests of the local population.
- Undesirable side effects of mineral exploitation in coastal zones may lead to local and regional conflicts.
- Important geological and archaeological sites in coastal zones are not properly protected.

- There is insufficient exchange of information and lack of standardised environmental geo-data.

3. Recommendations

The workshop made the following recommendations:

- To define and undertake sound environmental management strategies and proper hydrogeological investigations in groundwater utilisation.
- To carry out environmental impact assessment-type procedures on mining and other land use.
- To develop and implement capacity building programmes in the field of environmental geosciences and to establish regional centres of excellence with functioning scientific infrastructure.
- To formulate and implement mining policies and legislation that guarantee and protect the socio-economic interests of local population.
- To conduct a proper rehabilitation during and at the end of mining operations, leaving the site in the same or better state than before mining operations began.
- To identify and document significant geosites in the coastal zones and protect them.
- To fully integrate the expertise of geoscientists into SICOM.
- To create national and regional geoscientific data banks for SICOM.

4. Follow up

The working group identified the following priority areas for action:

- To continue the evaluation of mineral resources potential for socio-economic development.
- To initiate research projects on earth resources management and environmental geo-sciences in coastal zones including a capacity building component.
- To provide funds from national and international institutions for research and training facilities.

EARTH RESOURCES AND SICOM

Diamond mining on the coast of Namibia

(cf page 197 and following)

Fig. 1. *Map of sourthern Namibia indicating mineral licences and important fish occurrences.*

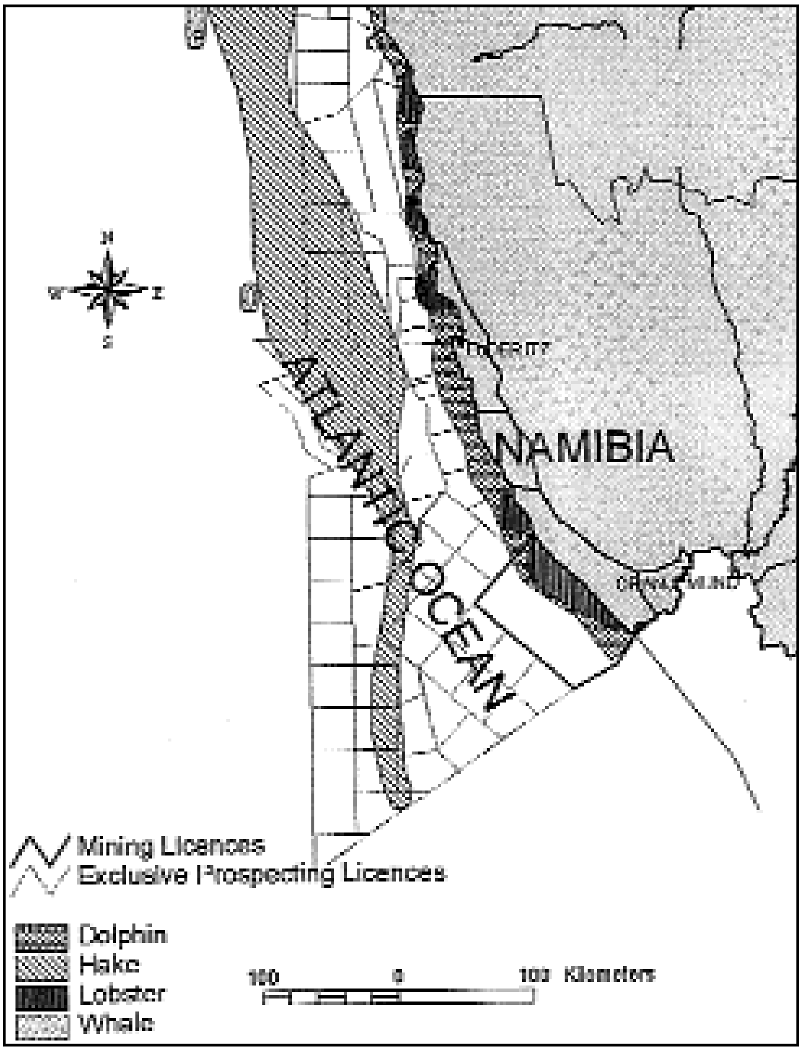
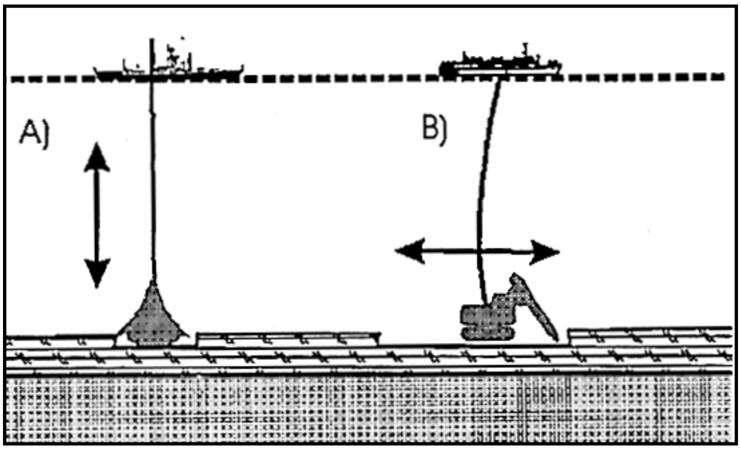


Fig. 2. *Bucketwheel excavator used for overburden stripping in the onshore mining areas. (Picture Nameb).*



South African east coast heavy mineral mining and the development of Mozambique's heavy mineral industry (cf page 203 and following)

Fig. 1. A simplified geological map of southeast Africa showing the extent of the main geological units.

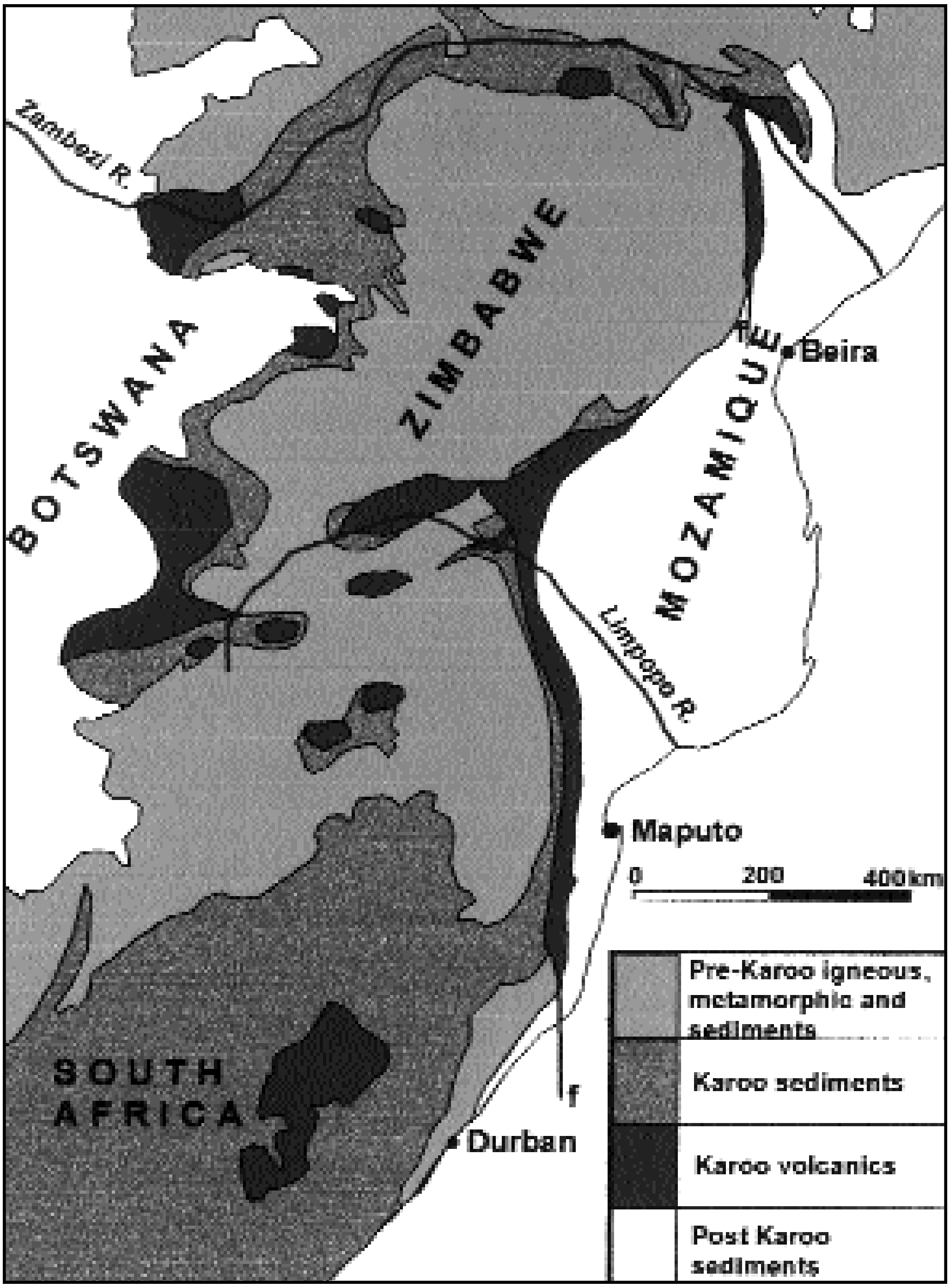


Fig. 2. A schematic cross-section of southern Mozambique (after Cilek, 1985), showing the various quaternary depositional units that correspond to Fig.3.

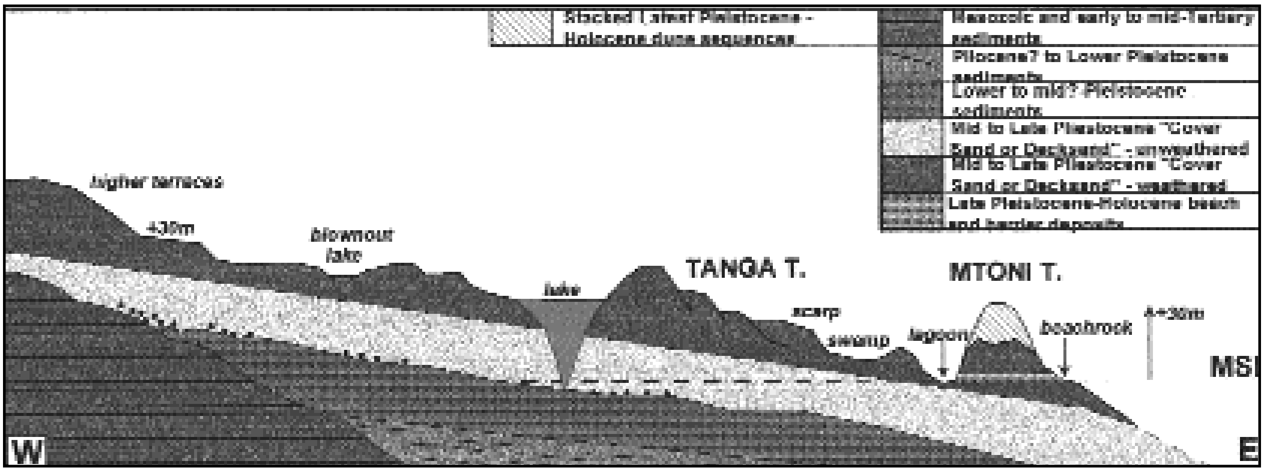


Fig. 3. Quaternary deposition model for the Kosi estuarine lake system, analogous to the northern KwaZulu-Natal coastal plain, showing a transgressive barrier sequence separating the lake system from the sea.

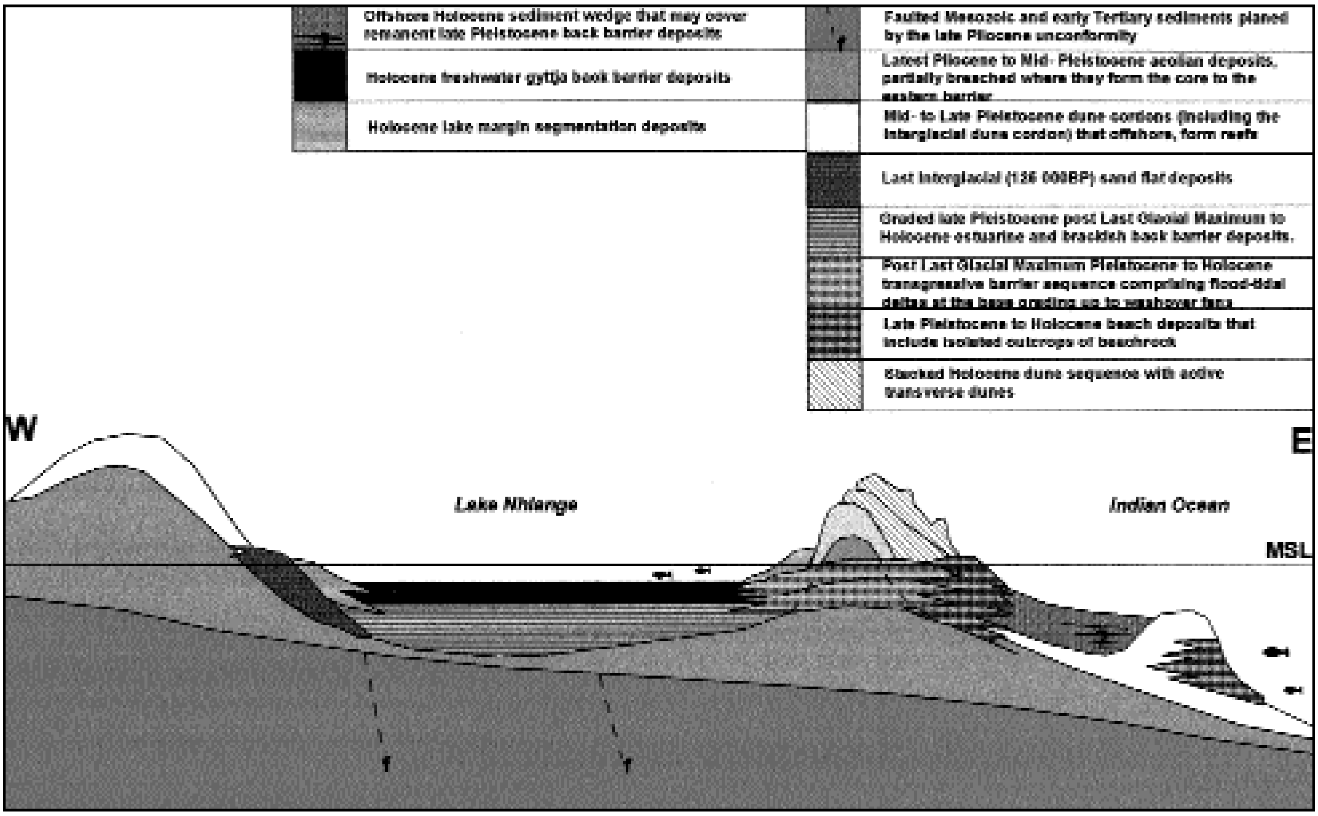
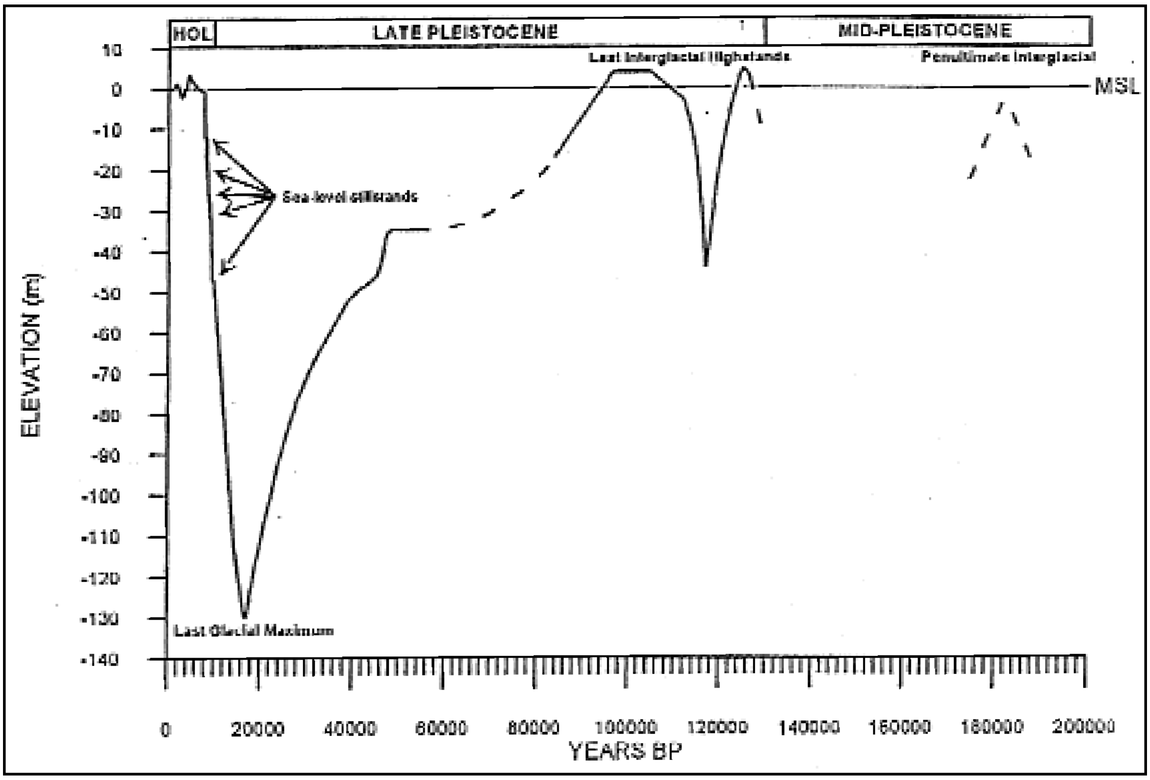


Fig. 4. Quaternary sea-level curve for southern Africa (Ramsay, 1997). Note that for the 4 small time periods, sea-level has been lower than present level, indicating the vast potential for offshore heavy mineral deposits.



GEOLOGICAL DEVELOPMENT AND MINERAL RESOURCES OF THE COASTAL BASIN OF TANZANIA

(cf page 209 and following)

Fig. 1. Pre-middle Jurassic plate reconstruction before the breakup of the Gondwana Supercontinent (modified from Shackleton, 1996 and Mpanda, 1997.)

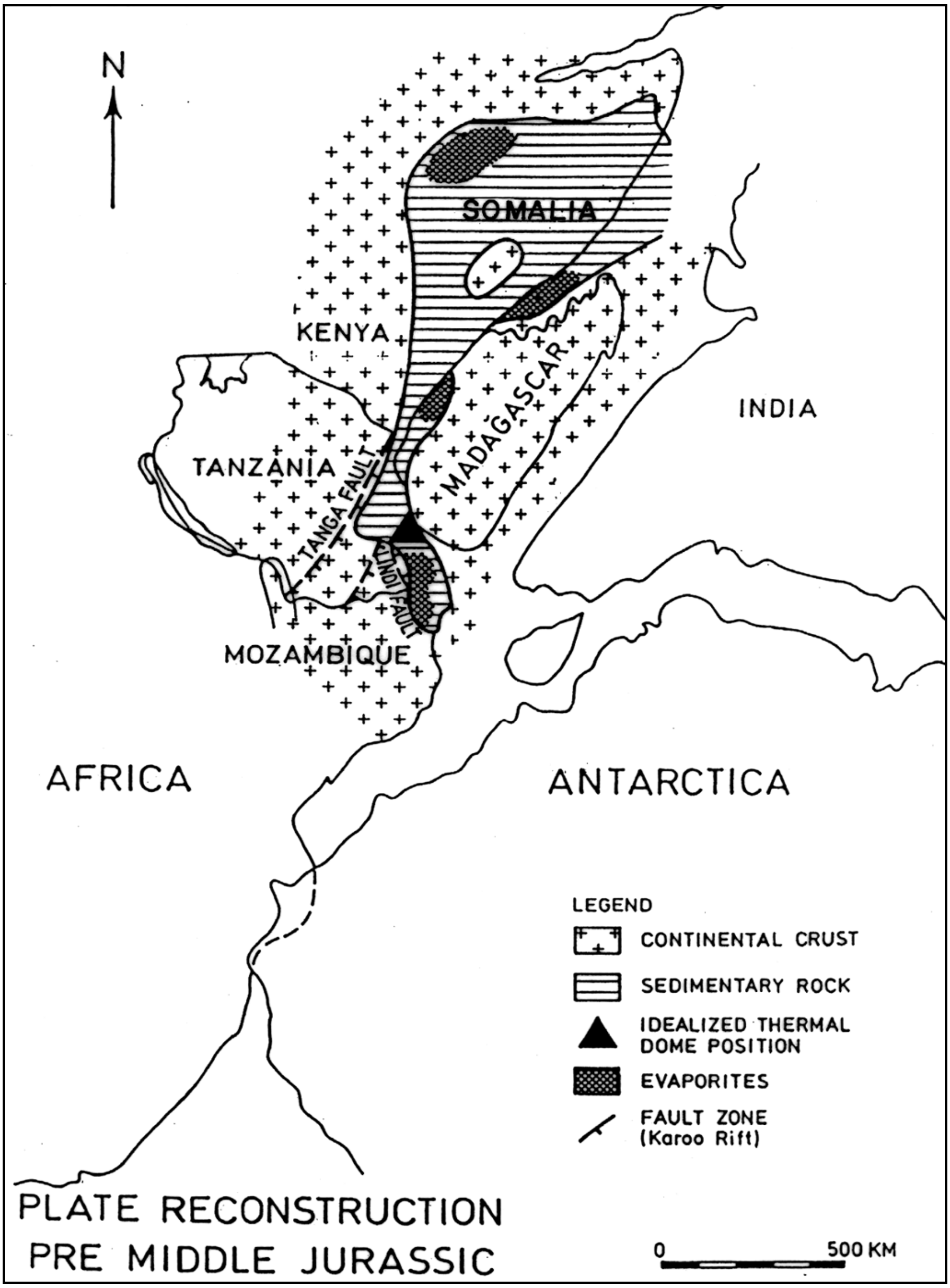


Fig. 2. Geological map of coastal Tanzania (modified from the Geological Survey of Tanzania, 1980 and TPDC, 1995).

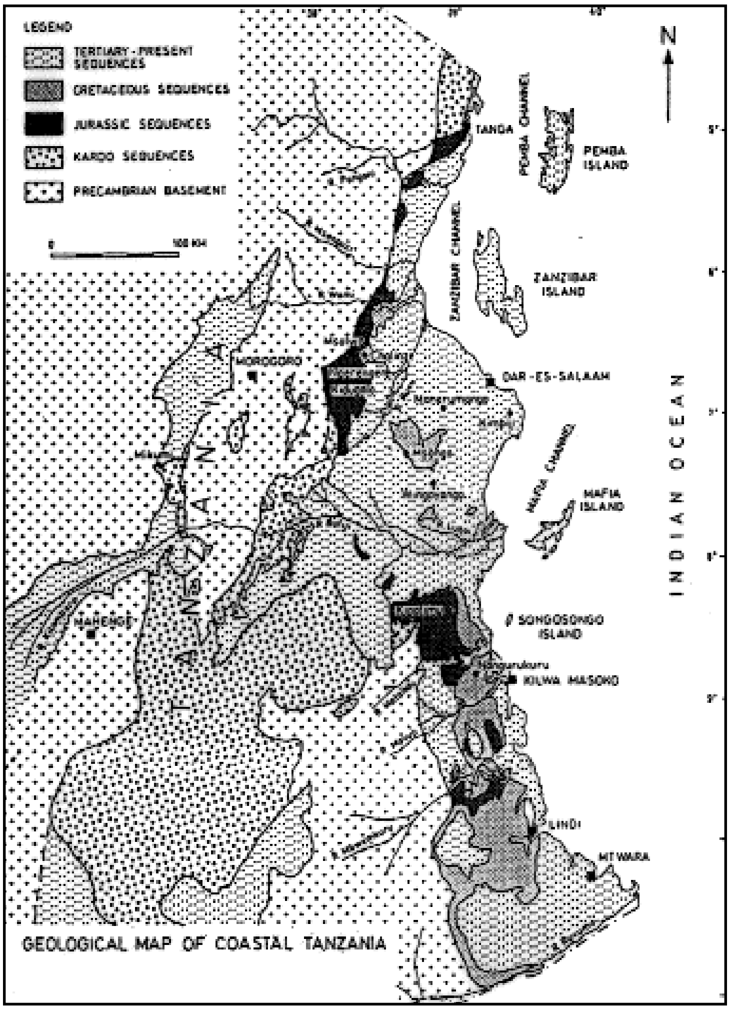


Fig. 3. Major structural features of the coastal Tanzania (modified from Kajato, 1982).

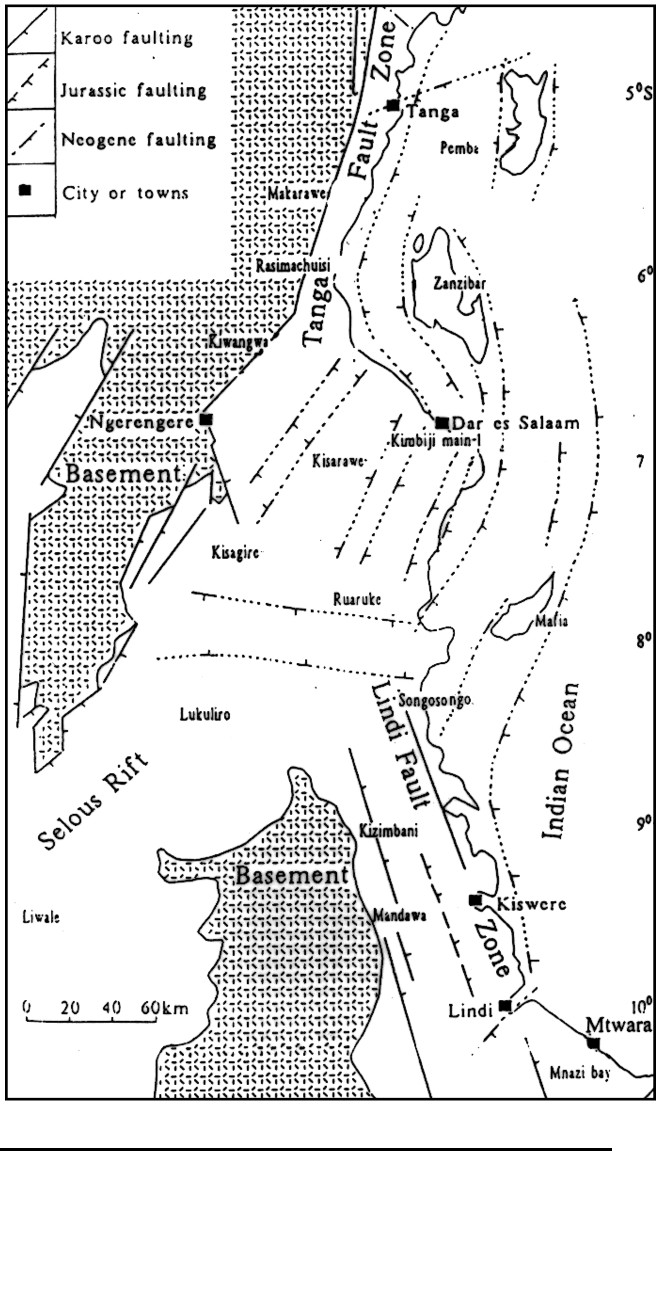


Fig. 4. Generalised stratigraphy of the coastal sedimentary basins of Tanzania (from Mpanda, 1997).

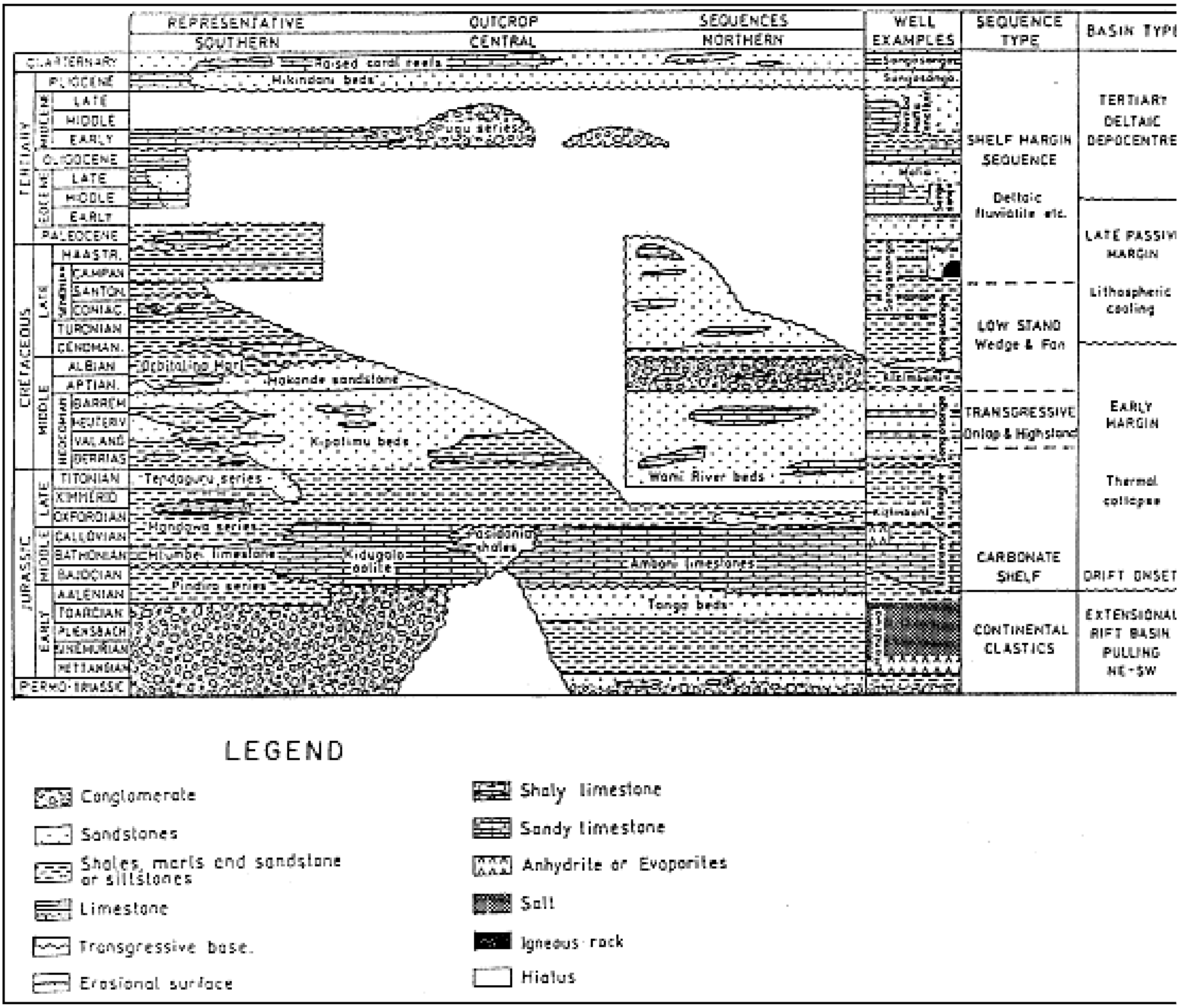
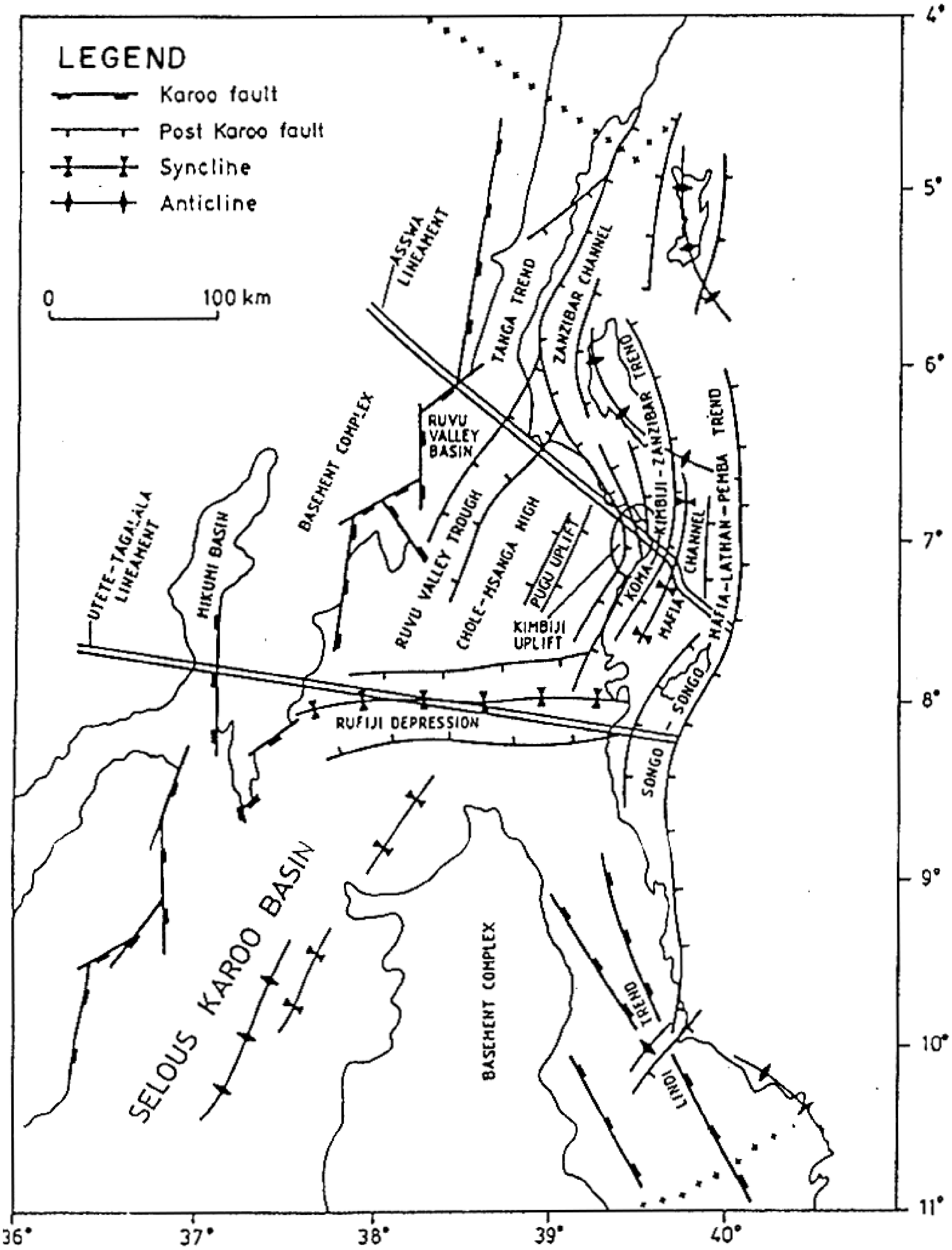


Fig. 5. Major synclines and anticlines of the coastal sedimentary basin of Tanzania (modified from Kajato, 1982).



KENYA: ENVIRONMENTAL ASPECTS OF PAST AND EXPECTED COASTAL MINING ACTIVITIES (cf page 217 and following)

Fig. 1. Map showing the general geology along the Kenyan coast, including major mineral deposits.

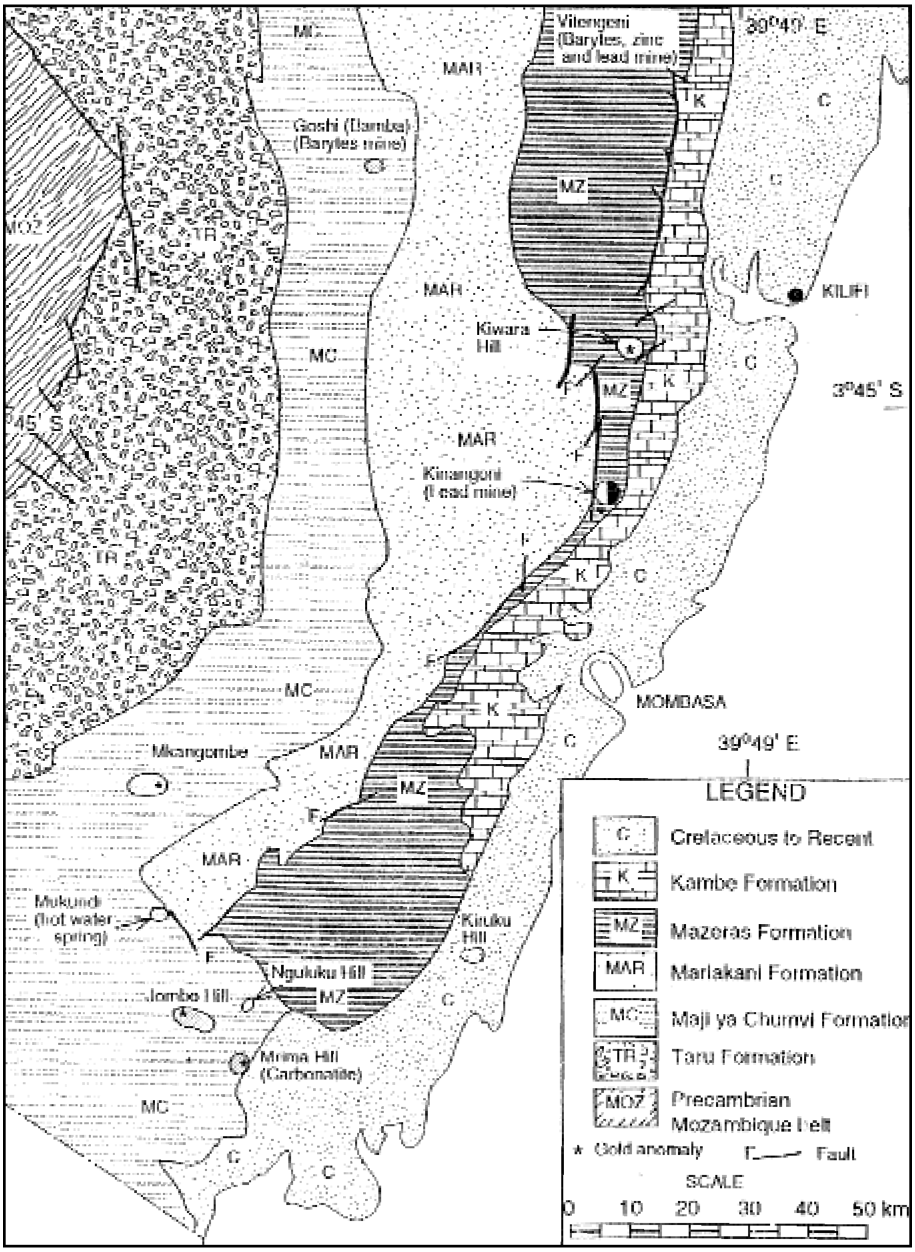
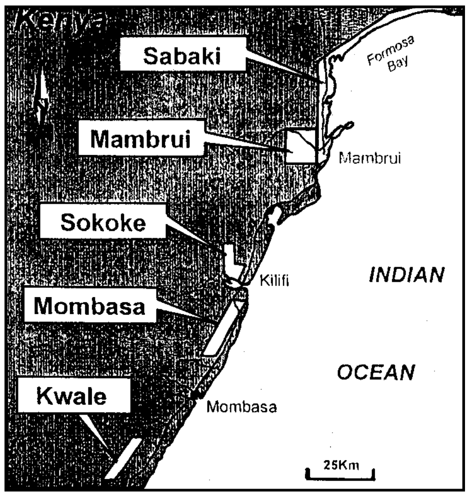


Fig. 2. Map showing the areas identified by TIOMIN as potential for heavy mineral deposits along the Kenyan coast.



POSSIBLE DESTRUCTIVE EFFECTS OF SEA-LEVEL RISE ON SMALL CORAL ISLANDS: MAZIWI ISLAND (NORTHERN TANZANIA (cf page 227 and following)

Fig. 1. Location map showing the bathymetry and barrier reef development in the vicinity of Maziwi Island.

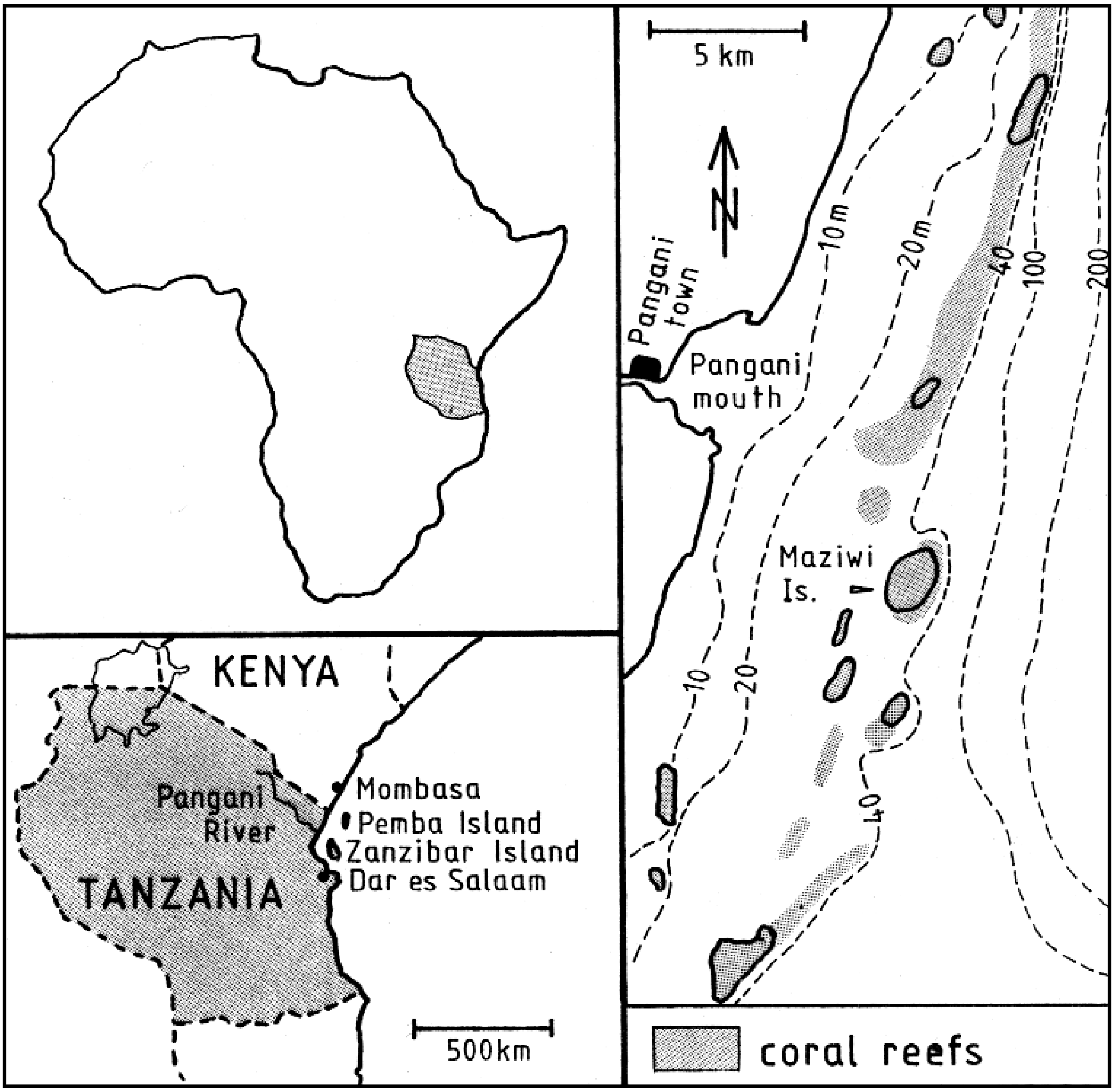
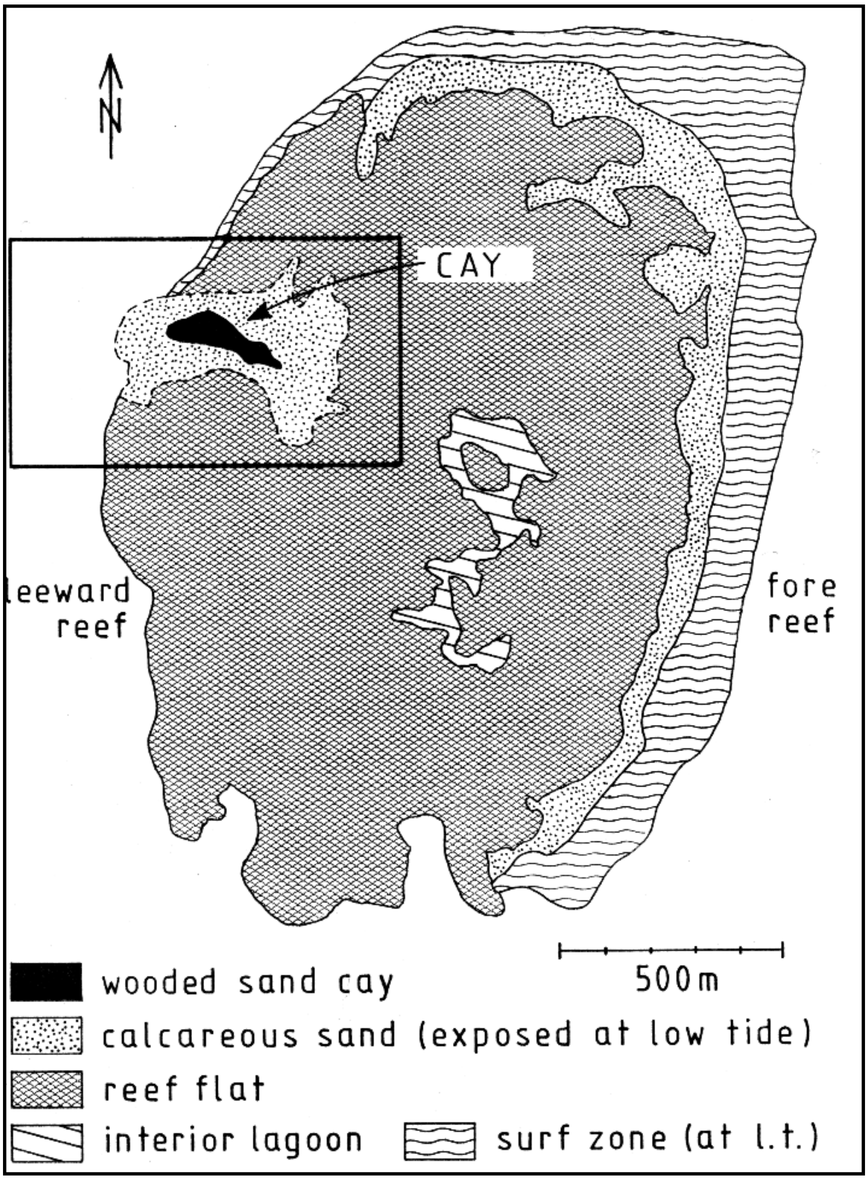


Fig. 2. Map of the Maziwi reef based on the 1975 aerial photograph.



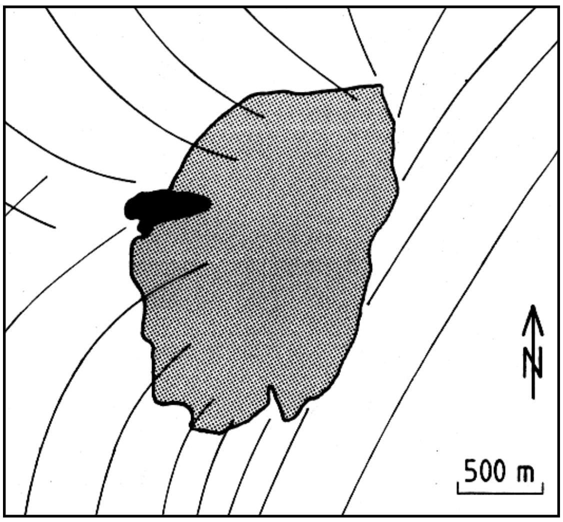


Fig. 3. Wave pattern around the Maziwi reef based on the 1982 air photographs and on the author's observations.

Fig. 4. Map of the Maziwi sand cay showing the destruction of the island and the successive growth of the fan. For cross sections C-D and A-D see figures 5 and 6.

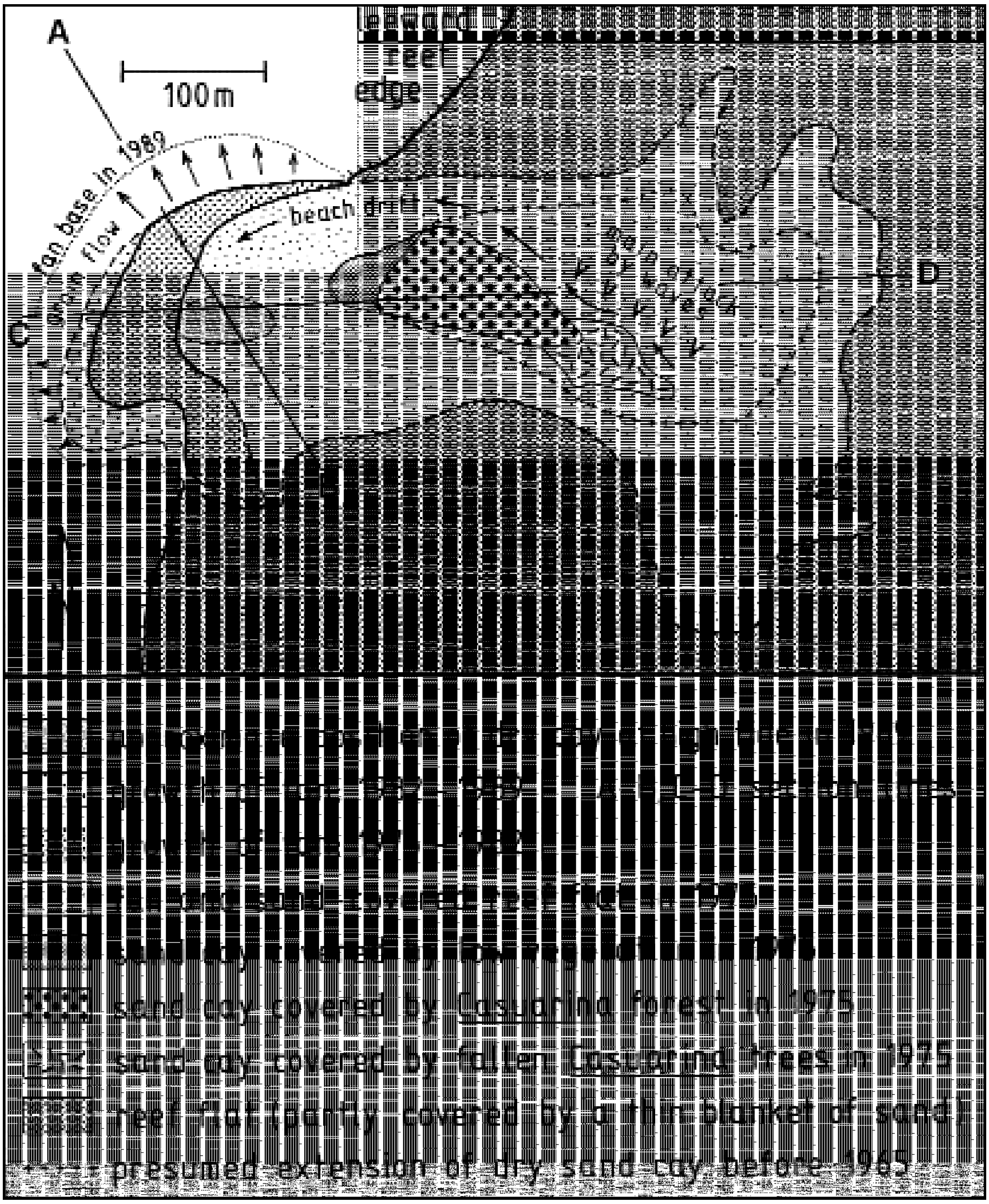


Fig. 5. Time series of cross sections showing the successive destruction of Maziwi Island. For position of section line see fig. 4.

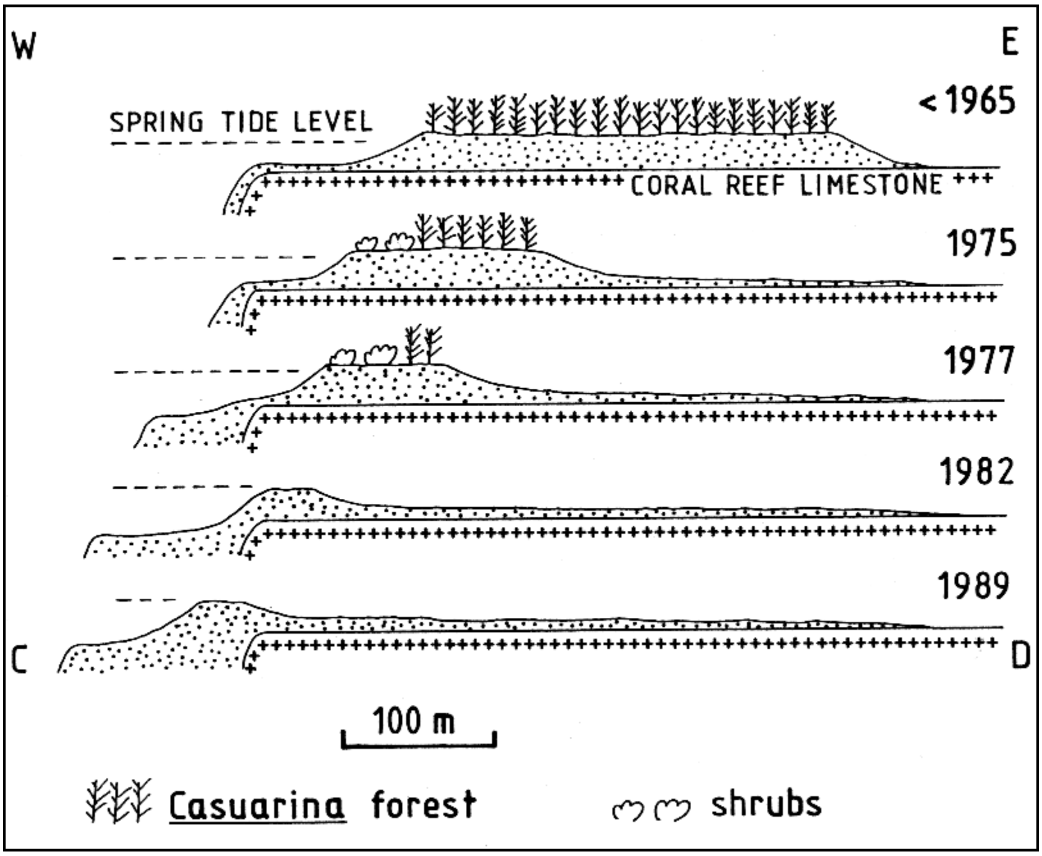
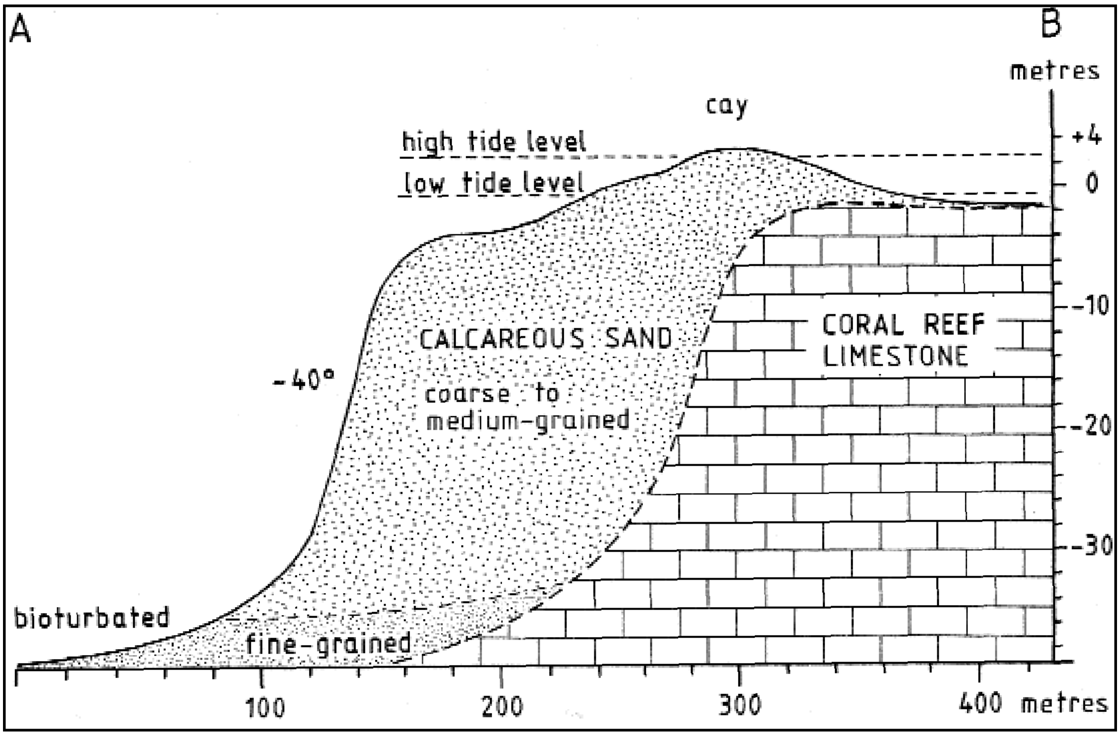
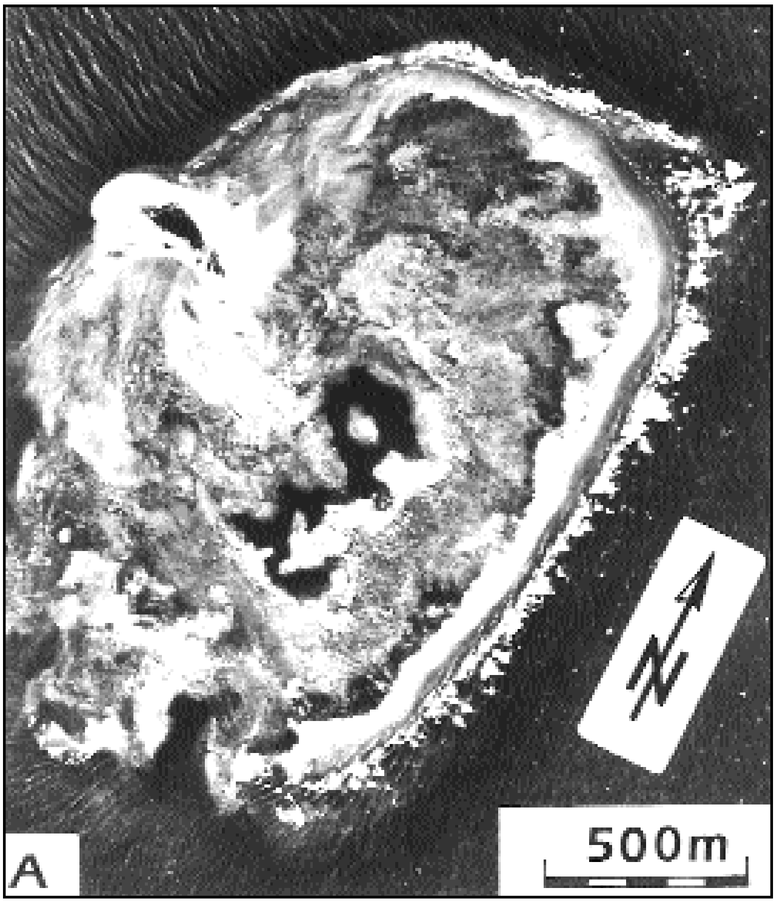


Fig. 6. Cross section through the Maziwi sand cay and fan (1989).

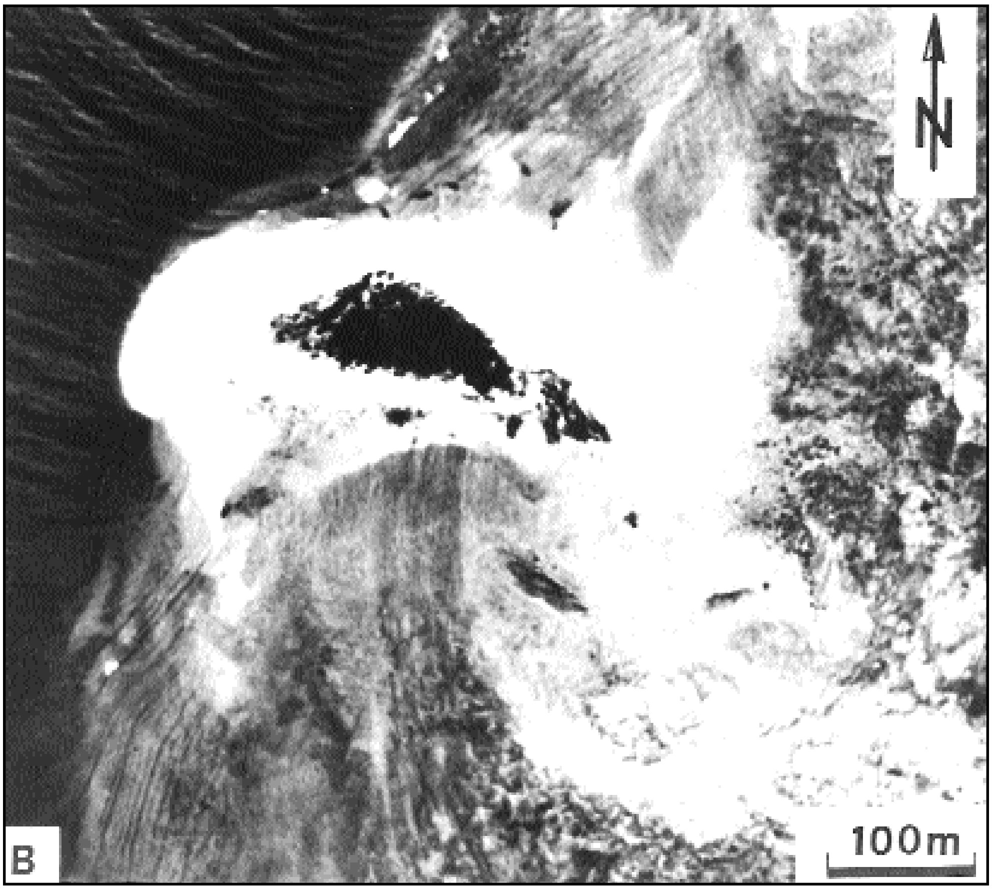


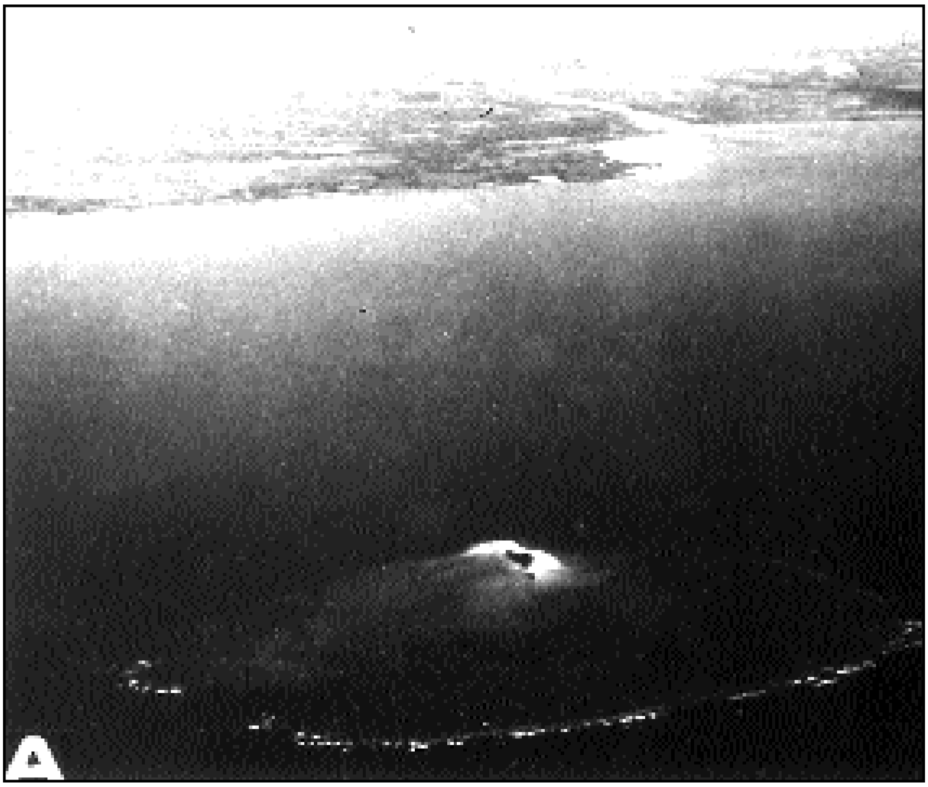
Photos 1:

A) Vertical aerial photograph showing the Maziwi coral reef in 1975. The wooded island (dark) was situated close to the western margin of the reef flat. For further explanation see text and fig. 2.



B) Maziwi Island in 1975. Areas covered by fallen trees (W), Casuarina forest (centre), and young, low vegetation (F) can clearly be distinguished. For further explanation see text and fig. 4.





Photos 2.
Oblique aerial photographs of the Maziwi reef. Photographs A and B were taken in 1978, C in 1981.
A) View towards NW showing the mainland coast and the Pangani River mouth in the background.

B) View towards SW; the dark spot on the sand cay is vegetation. Ample beaches have formed on the northern side of the island.

C) View towards W; virtually all vegetation has disappeared.

Photos 3.

A) Northern beach of Maziwi Island with destroyed Casuarina forest (1975).

B) Western part of the island in 1977. The youngest vegetation is seen in the foreground. The small group of trees behind the shrubs along the southern beach is the last remnant of the Casuarina forest.

C) The sand cay during low tide in November 1989. Westward view from the sandy tidal flat with oscillation ripples' crests striking N-W to the dry cay. The position of this cay is shown in fig. 6, p. 278.

ENVIRONMENTAL DEGRADATION DUE TO MINING ACTIVITIES: UGANDA CASE STUDY

(cf page 251 and following)

Fig. 1. Geological map of Kilembe.

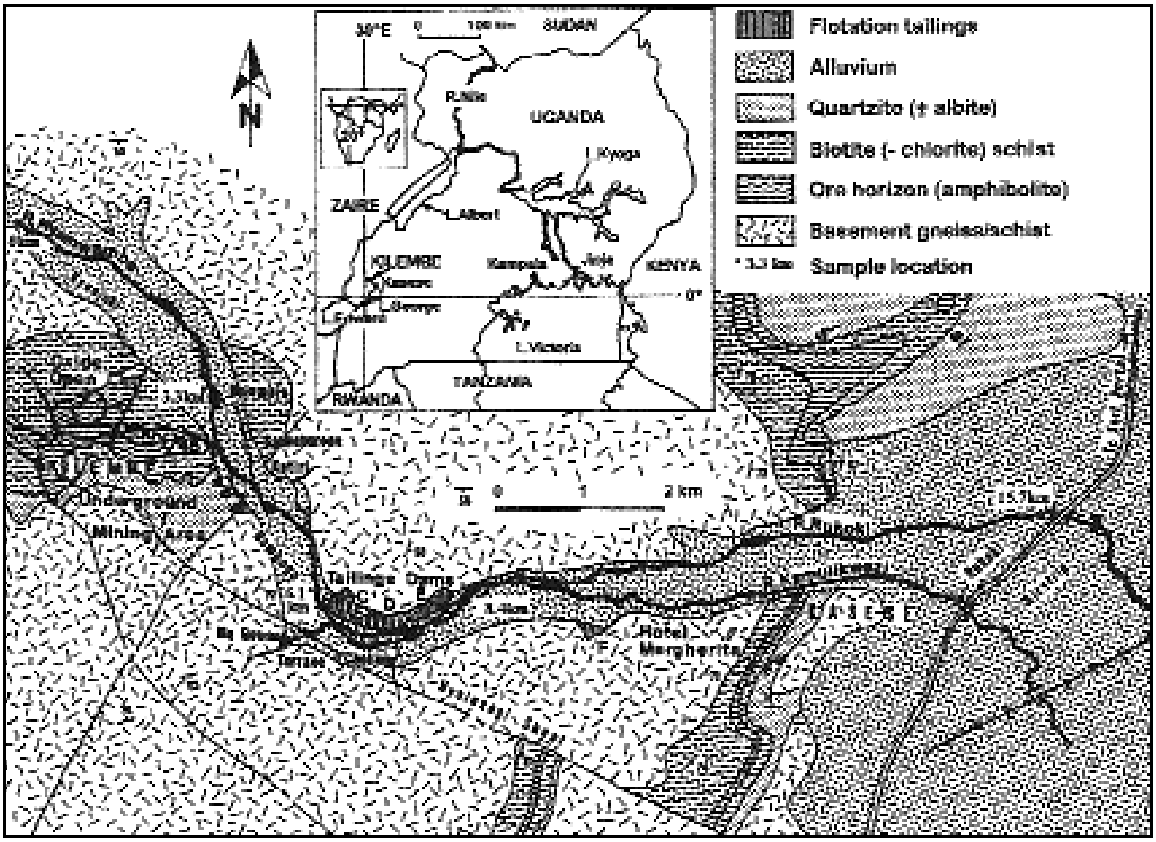


Fig. 2. Annual copper production in Kilembe (1956-1978). Data from KML records.

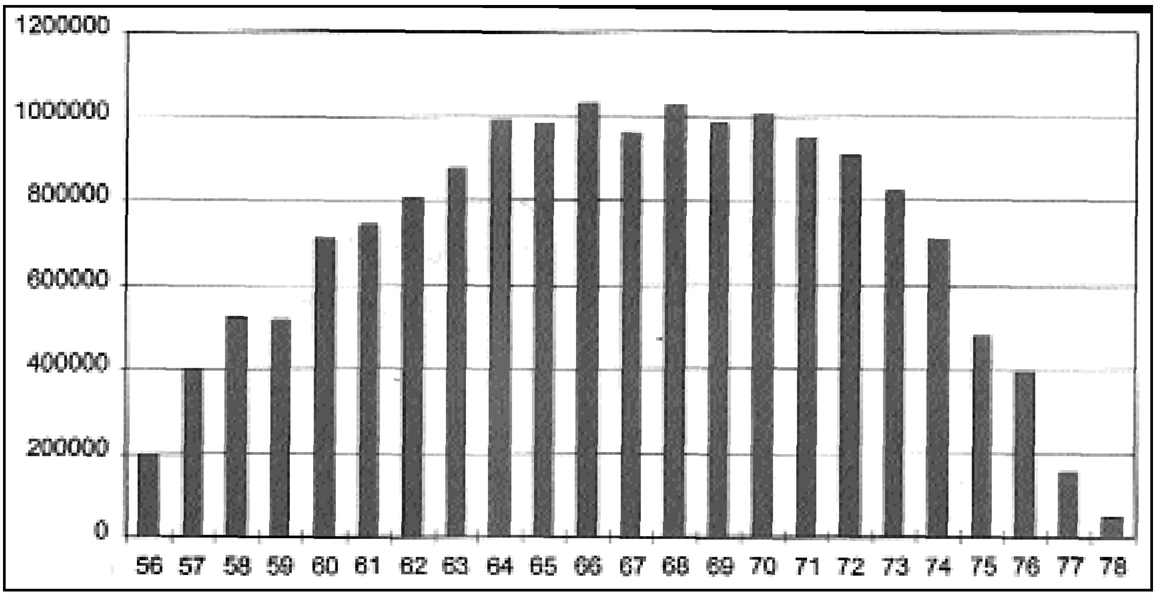


Fig. 3. Distribution of metals along the Nyamwamba River (sample locations are shown in Fig. 1).

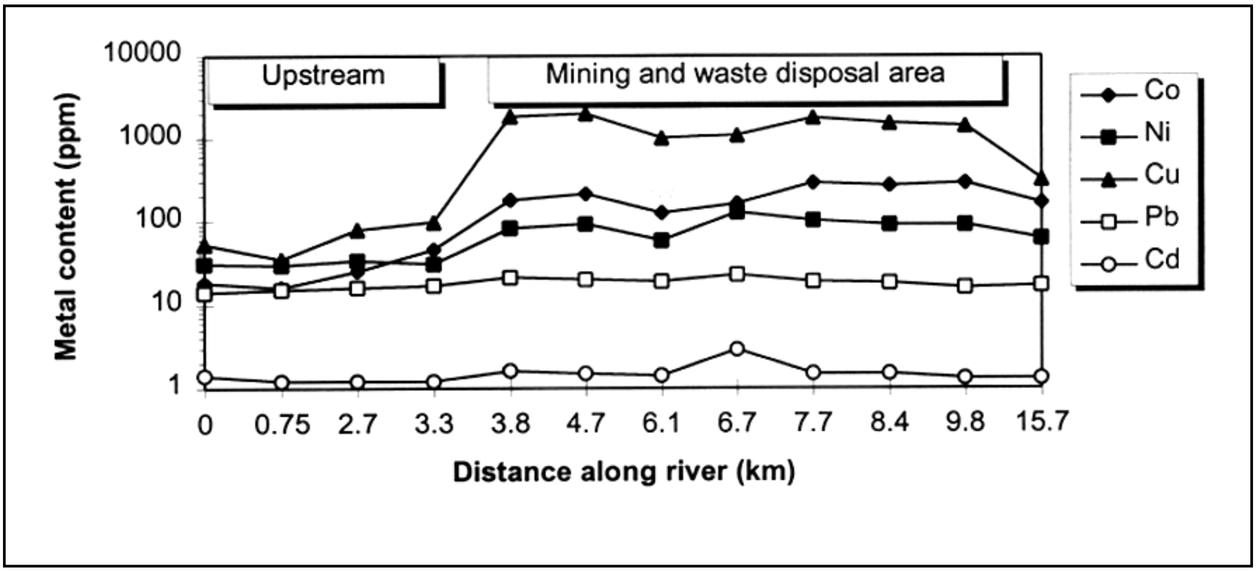


Fig. 4. Metal distribution in stream sediments from tributaries and tunnel drainage channels.

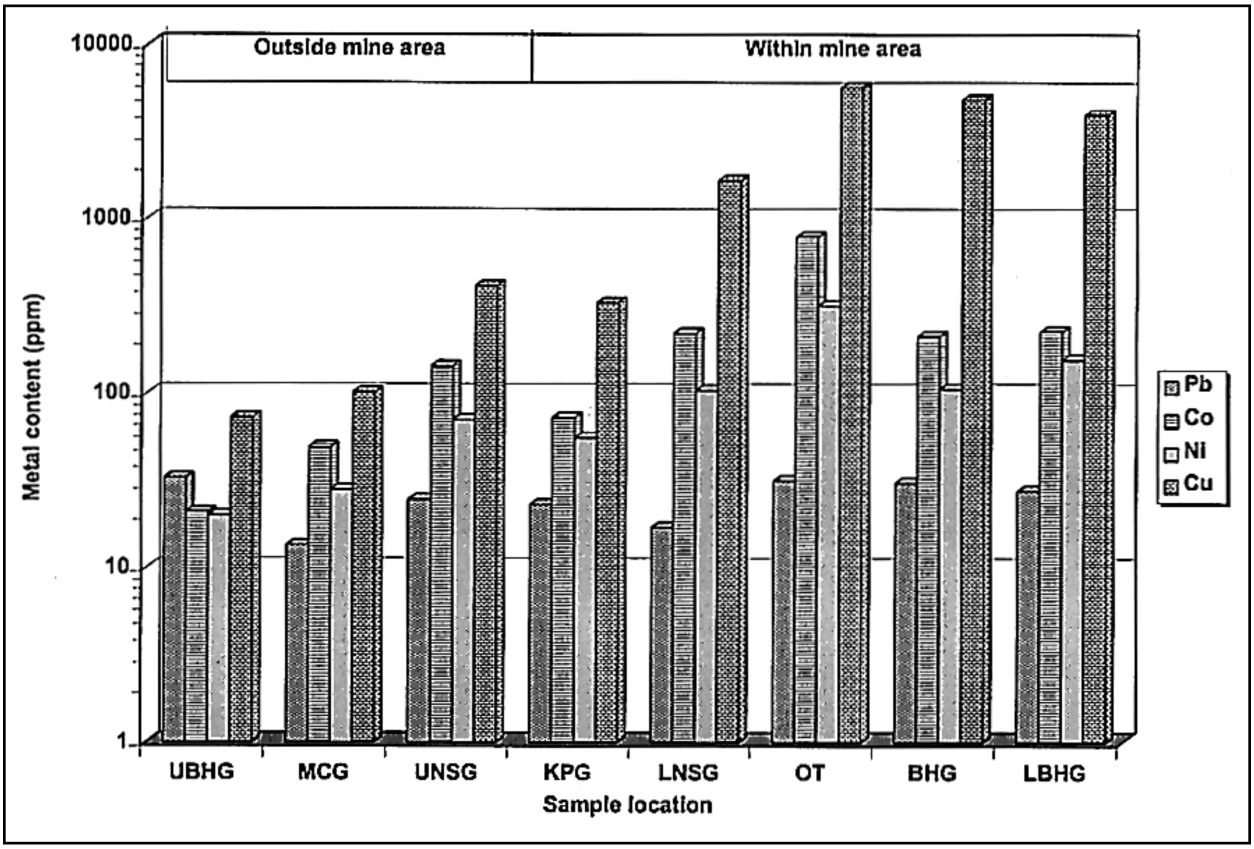


Fig. 5. Selected metal contents in soils compared to tolerable limits (Kloke, 1980).

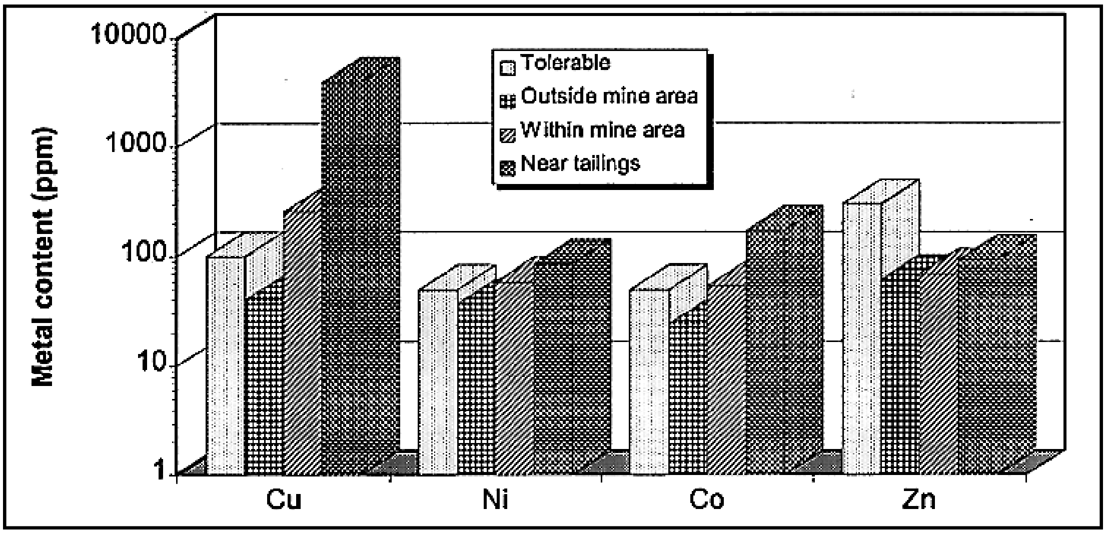


Fig. 6. Variation of metal contents in topsoil with distance from tailings dam F.

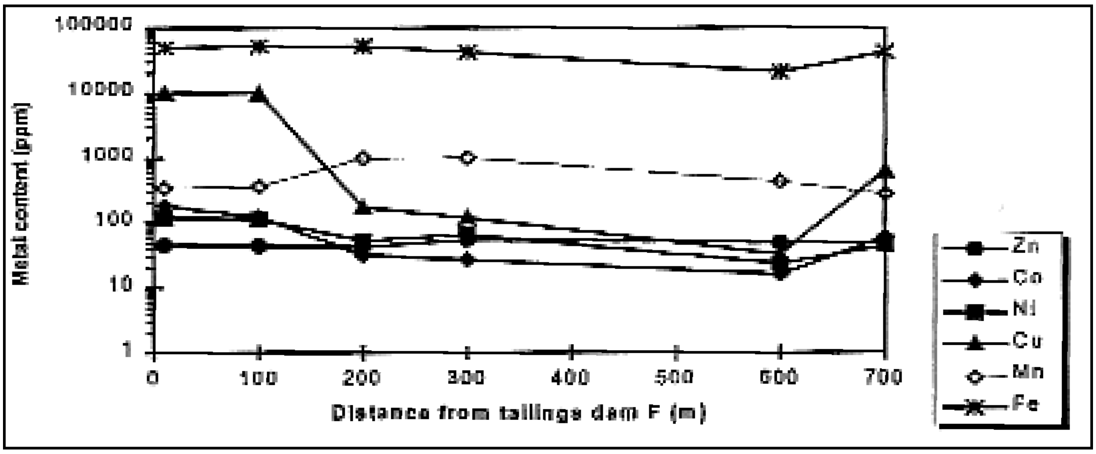
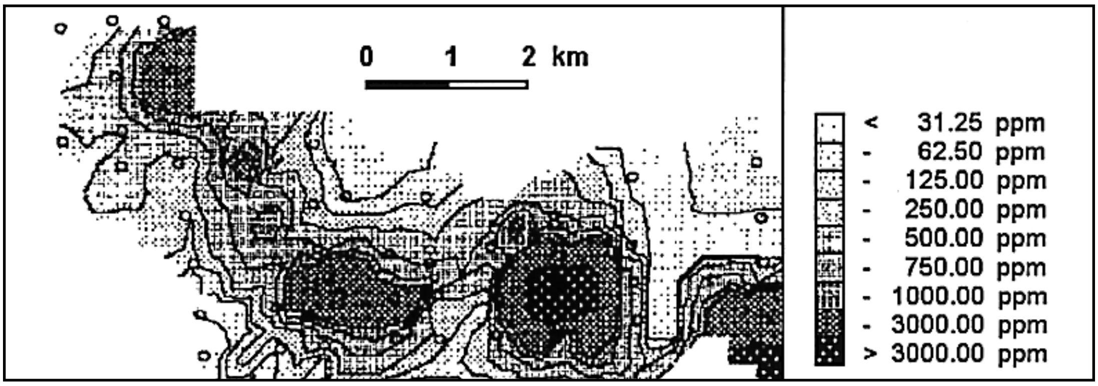


Fig. 7. Copper distribution in Kilembe's topsoils.



Workshop 4

WATER RESOURCES AND SICOM

WORKSHOP SUMMARY

Emmanuel Naah,
UNESCO Office, Nairobi, Kenya

Indeed there have been problems in Africa relating to water resources. They are due to the continent's drainage characterized by a substantial number of river basins that are international in nature. All sub-Saharan African countries share at least one and up to ten international river basins.

These problems are also due to the natural development process which was typical in the past but which is obviously inadequate to satisfy population growth needs of the modern world.

The development of African coastal areas should include strategies for rational water use, increasingly efficient water use and close supervision of water sharing among riparian countries. Lessons of experience suggest a new ecological concept based upon the management of drainage basin hydrology for the sustainable development of African coastal areas. In this approach, guidelines should include:

(i) preservation or improvement of the spontaneous functions fulfilled by a river basin and its coastal area,
(ii) conservation of the natural values of the river basin,
(iii) conservation of the river basin's entensive exploitation function (e.g., afforestation, floodplain protection),
(iv) development of sustainable intensive exploitation functions,
(v) improvement of the overall health situation in the basin and coastal area, and
(vi) working with the existing environment and human cultural systems.

The workshop aimed at laying the foundation for encouraging the development of sustainable water use in coastal areas through integrated coastal area river basin management; this can be accomplished by providing basic practical information for those engineers and scientists who are engaged in the physical development of the upstream portions of a river basin but who are not necessarily involved in coastal research.

The long-term objective here was to enhance the capacity of African countries to solve the huge environmental and development problems they face in the management of coastal areas and river basins, by interpreting the actions required in the instruments for capacity building, notably:

(i) education, training as well as research and development,
(ii) policy development, administrative policy, as well as legal and regulatory framework (the enabling environment) and
(iii) managerial and other structures at the operational level.

An excellent overview of problems was presented both by Professpr Harry Coccossis (University of the Aegean, Mitilini, Greece) who presented a keynote paper (see following contribution) on the drainage-basin approach to integrated water management for sustainable development of African coastal areas and, by Dr. Mahamadou Maïga (representing FAO), who focussed on human development and integration for the development of African coastal areas. Dr. Maïga discussed the current strategies and policies for integration.

This workshop was initiated by UNESCO's International Hydrological Programme (IHP), under its Humid Tropics Programme. Partnership was established with the Water Branch of UNEP and its programme entitled 'Integrated Coastal Area Management (ICAM)'.

ENHANCEMENT OF SICOM IN AFRICA THROUGH MANAGEMENT OF DRAINAGE BASIN HYDROLOGY

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INTRODUCTION

There are important functional relationships between river basins and coastal areas and one may influence the other. The two systems are linked through natural processes (water flow, sediment transport, energy) and human activities (urban development, rural activities, technical infrastructures, waste and pollution).

Coastal areas are extremely valuable as they concentrate a rich diversity of natural habitat areas and a large variety of natural resources. As the interface area between terrestrial and marine ecosystems, coastal areas are extremely important and fragile from an ecological perspective and should be carefully managed.

Coastal areas at the same time provide opportunities for development of a wide range of human activities, either exploiting coastal resources (i.e. fishing, recreation etc.) or taking advantage of favourable locations (i.e. mild climate, break of bulk transport and access to sea routes etc.). As a result there is an increasing concentration of economic activities and population in coastal areas.

River basins are also important areas from the point of view of natural ecosystems particularly on the basis of the presence of water and its support for the flora and fauna in the area. The riparian parts of the basin – around bodies of water – can be extremely valuable as areas of high ecological productivity. Some parts of the basin might be also valuable from a natural resource perspective, particularly the river and other water bodies but also the areas of replenishment and water exchange with groundwater resources.

River basins present advantages for the development of economic activities. The presence of water can support agriculture and animal husbandry but also fishing and industry as inputs to production processes. Water might be also used for transport of materials and trade, providing opportunities for the location of certain human activities which require access to such transport routes. In addition, water provides opportunities for recreation and tourism. As a result of these advantages human settlements often grow along rivers.

Coastal areas and river basins face increasing pressures for development:

- The problems of coastal areas relate mostly to the availability and intensive use of coastal resources, particularly land (for urbanization, tourism, industrial and port development) and marine resources (for fishing/aquaculture, tourism/recreation) and the quality of seawater (recreation, fishing). Relating to these are problems of ecosystem conservation, marine resource protection, beach erosion/accretion etc. In that sense integrated coastal zone management is essentially environmental planning.
- The problems of river basins relate mostly to the availability and use of water resources (for natural ecosystems, agriculture, fishing/aquaculture, energy production, mineral and construction material extraction, industrial processing, domestic use and effluent recipient). Relating to these are problems of ecosystem conservation, forest protection, soil conservation etc. In that sense river basin management is essentially resource management.

The coastal zone is an essential part of a river basin. The two areas are linked through a number of natural and socio-economic processes:

- The cycle of water which affects water quality and quantity and ultimately sea water

quality, affecting coastal ecosystems and human activities on the coastal zone (fishing/aquaculture and tourism/recreation opportunities);
- Sediment transport which affects soil and coastal dynamics ultimately having an impact on coastal ecosystems and human activities on the coastal zone (fishing/aquaculture, urban development, tourism etc.); and
- Human activities in the river basin might affect also coastal ecosystems and human activities in the coastal zone in a positive way – providing food, water and energy – or in a negative way through water retention for irrigation and other uses, waste effluents dumped in the river etc.

Both river basin and coastal problems require a multi-sectoral approach, although the emphasis changes as:
- River basin management is essentially multi-sectoral coordination with some elements of rural land use regulation; and
- Coastal zone management is essentially physical planning and resource management with a strong emphasis on land-use regulation and physical interventions (project planning).

Integrated management of coastal areas and river basins

Human action in coastal areas, as well as in rivers, dates back to the times when people needed access to the sea or river resources (fish, salt, sand etc.), facilities for transport, water (for drinking or irrigation) but also protection from natural forces and hazards (floods, wave action etc.). So early 'management' was basically related to satisfying economic and convenience/safety goals and consisted of highly localized physical interventions (piers, harbours, dams, flood channels etc.) in the spirit of 'taming nature' through technology. In some cases, however, human intervention was far more extensive in spatial terms, as in the case of irrigation schemes or navigational channels but still strongly physical/engineering types of interventions. For many centuries such interventions in general ignored the dynamic nature of both rivers and coasts.

The rise of environmental concerns at the forefront of public policy brought in a wider perspective which would include environmental concerns as priority issues along with socio-economic objectives. The emphasis on the protection of the environment shifted the objective focus from resource management to ecosystem management. This 'integrated' perspective considers rivers and coasts as dynamic systems consisting of interacting natural and human ecosystems which require rational management.

The *goals* of river basin management and coastal management fall within the scope of sustainable development where economic efficiency and social equity goals are linked to environmental conservation ones. The *general objectives* stem from the need to express such

The basic principles of integrated coastal zone management and river basin management, in the context of *sustainable development*, include:

- Respect for the integrity of the river basin or coastal ecosystem, accepting limits on the use of resources;
- Ensuring the strategic importance of renewable resources for socioeconomic development;
- Allowing for the multiple use of resources integrating complementary activities and regulating/separating conflicting ones;
- Ensuring multi-sectoral and multi-level integration in decision-making, linking broad scale management to local level interventions;
- Allowing for participation of all actors, particularly local population, in the planning process to assure effective management.

goals in terms of long-range considerations and medium- or short-range needs, allocating resources to various users ensuring at the same time the proper function of natural ecosystems.

As both coastal area management and river basin management fall within the scope of special area management, the process used in both cases for policy development follows the same basic steps:

- *Analysis of existing situation*
  This step involves essentially a reconnaissance survey of basic characteristics in terms of the structure and dynamics of natural and human ecosystems. Therefore it deals with the critical processes and factors, their extent and spatial distribution etc.
- *Identification of conflicts/opportunities*
  This step deals with the interaction between natural and human ecosystems, at present and anticipated in the future. It includes the analysis of needs and pressures of the basic actors which influence decision-making in development and environmental management.
- *Identification of goals and alternative courses for action*
  This step involves an analysis of basic management goals and objectives on the basis of critical factors and processes, conflicts and opportunities in the context of sustainable development principles.
- *Development of strategy*
  A selection is made, in the context of public policy making, among the alternative strategies identified above in order to specify the goals and objectives into targets and policy measures with the aim to develop a guidance system for environmental management. This step involves commitments in mobilization of resources and priorities in the form of a programme of action.
- *Implementation*
  This phase involves the actual implementation of the programme of action and is strongly linked to the next one.
- *Monitoring and evaluation*
  This provides for administrative procedures and mechanisms to periodically review the progress towards the achievement of goals and objectives through assessments of the state of the environment and policy implementation.

This process is cyclical in both cases allowing for periodic review, assessment and revision of goals, strategies and policy priorities and measures. The above steps are indicative and outline a typical process which has to be adjusted on the basis of the specific situation at stake.

The table on the next two pages summarizes the stages, elements and themes of river basin management and coastal management for comparative purposes as a first step towards the development of guidelines for integrated coastal and river basin management

References

The need and basic approach for Integrated Coastal Area and River Basin Management is presented in :

UNEP/MAP/PAP, 1999. Conceptual Framework and Planning Guidelines for Integrated Coastal Area and River Basin Management Split, Priority Actions Programme.

Integrated coastal area and river basin management			
STAGES	**ELEMENTS**	**THEMES**	
		COASTAL AREAS	**RIVER BASINS**
Problem Identification	Process	Coastal dynamics Water cycle Ecosystems dynamics Concentration of activities	Sediment transfer Water cycle Ecosystems dynamics
	Factors	Water quantity and quality Biodiversity Population growth Economic growth	Water quantity and quality Biodiversity Soil quality
	Critical issues/problems	Beach erosion/accretion Ecosystem degradation Sea pollution Water degradation Resource use conflicts Land use conflicts Human activity Concentration Urbanisation Waste disposal	River mouth shifts Ecosystems degradation River pollution Water degradation Soil degradation Deforestation Waste disposal
	Opportunities	Economic development Fishing/aquaculture Material extraction [Agriculture] Industry Tourism Transport Urban development	Resource development Fishing/aquaculture Material extraction Agriculture Animal husbandry Power generation [transport] Drinking water [recreation] Forestry
Plan formulation	Interest groups (actors)	Fishermen Industry Land developers Planning agencies Port authorities/military Utilities/sewage Tourists Environmental groups	(fishermen) Farmers Forestry/husbandry Industry/energy Utilities/sewage/water [tourists] regional/local authorities Environmental groups

(cont'd)

Integrated coastal area and river basin management			
STAGES	**ELEMENTS**	**THEMES**	
		COASTAL AREAS	**RIVER BASINS**
Implementation	Policy responses Scale/responsibility	Local/regional International	Regional/national
	Rationale	Spatial planning	Multisectoral coordination
	Instruments/tools	Physical planning and resource management plans	Resource management plans
	Legislation	Land development controls Emission standards Setback regulation EIA for projects	Water use Emission standards Agricultural practices control EIA for large scale projects
	Economic instruments	Land taxation Incentives	Incentives User charges
	Physical interventions	Infrastructure development ports beach protection wastewater treatment roads for access to coast	Infrastructure development power plants irrigation channels wastewater treatment water treatment

Strategies and policies for the sustainable development of coastal zones and integrated management of African river basins

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Acronyms used

ABN: Niger Water Basin Authority
ADB: African Development Bank
AFV: Volta River (Ghana) Authority
AFZ: Zambezi River Authority
CAB: After-Dam Commissariat (Senegal)
CBLT: Lake Tchad Basin Commission
CEDEAO: West African States Economic Community
CGIAR: Consultation Group on International Agricultural Research
EU: European Union
IMCMZ: Integrated Management of Coastal and Marine Zones
IMWB: Integrated Management of Water Basins
IUCN: International Union for the Conservation of Nature and Natural Resources
NGO: Non-Governmental Organization
NBI: Nile Basin Initiative
OBK: Kagera Water Basin Development Organization
OIDBA: Intergovernmental Organization for the Development of African Water Basins
OMVS: Senegal River Development Organization
OMVG: Gambian River Development Organization
PDRG: Master plan for the integrated development of the left bank of the Senegal river valley
SAED: Society for the development and exploitation of the Senegal river and the Faleme (Senegal) land
TECCONILE: Technical Cooperation Committee for the Development and Protection of the Nile Basin Environment
UNEP: United Nations Environment Programme
UNDP: United Nations Development Programme
UNCED: United Nations Conference on Environment and Development
WEF/GEF: World Environment Fund/Global Environment Facility
WHO: World Health Organization
WWF: World Wildlife Fund

Introduction

This paper has been prepared upon request by UNESCO which co-organized PACSICOM. It aims to achieve the objective of the conference: formulate a global sustainable integrated development strategy for coastal zones of the African continent while taking into consideration social and cultural dimensions.

In this paper, the importance of integrated management of coastal and marine zones (IMCMZ) in the development of the African continent with a sustainable development vision has been shown. This is following the 1992 United Nations Conference on Environment and Development (UNCED) recommendations in this field. It has also been shown that IMCMZ strategies and policies have often been applied to Africa independently of those of the integrated management of water basins (IMRB) which occupy several portions of territory and several coastal and marine zones in a number of African countries. This is probably because in the past, the two different categories of strategies and policies were conceived, developed and applied on the grounds of philosophies, concerns and practices which were all different. In order to guarantee the success of the sustainable development of coastal and marine zones, decision-makers and all others involved have been strongly recommended to integrate IMCMZ in the integrated management of water basins. Thus, in this paper, intergovernmental organizations for the development of African water basins (OIDBA) have been recommended to integrate IMCMZ in their policies and practices. In order to achieve this, reforms and technical and institutional reinforcement is required in OIDBA in Member States.

Finally, this paper also takes a glimpse at the problems and social conflicts that are present in the coastal and marine zones, the IMCMZ approach, the various stages of IMCMZ and the institutional, legal and financial dispositions to be taken for IMCMZ. The paper ends with proposals for global pre-investment and sectorial investment activities in IMCMZ in the context of IMWB.

The participants of the Conference are informed that this paper has as its only objective to present and submit concepts and practices of IMCMZ and IMRB in Africa, to contribute to discussions and debates towards the formulation of an IMCMZ global strategy for Africa. The author of the paper was a moderator and a resource person for the same Conference.

1. Integrated management of coastal and marine zones in sustainable development

1.1. In agenda 21 of the United Nations Conference on the Environment and Development (UNCED, held in Rio de Janeiro from 3 to 14 June 1992), chapter 17 dealing with the protection of oceans, seas (including enclosed and semi-enclosed seas), and coastal zones as well as the protection, rational utilization and the development of their living resources, it has been concluded that:

The marine environment, including seas, oceans and adjacent coastal zones, forms a whole which is an essential component of the global survival system and an asset which offers sustainable development opportunities. Since coastal zones accommodate diverse and productive habitats, important ecosystems for human populations, development and local subsistence, as well as the fact that more than half of the world population lives within 60 km of the coast, a population which will probably increase to three quarters by 2020, UNCED recommended that new integrated approaches be adopted at sub-regional, national and international levels for the management and development of coastal and marine zones.

1.2. At present it is commonly recognized that sectorial activities produce combined environmental impacts resulting from freshwater and marine pollution, air pollution, loss of marine and natural land resources, the degradation of land and the destruction of historical sites. Based on a sectorial approach, degradation reduction policies for coasts have failed and have transferred the problems to coastal and marine resources and products as well as support services (UNEP, 1995). It is for this reason that UNCED called for an integrated management of coastal and marine zones (IMCMZ) via a dynamic and flexible process that takes into account the total and integrated impact of coastal development on the resources.

1.3. The concept of sustainable development appeared for the first time in 1980 in the world conservation strategy that was apparently initiated by the International Union for the Conservation of Nature and Natural Resources (IUCN). This concept which was made official in the Brundtland Report of the World Commission for the Environment and Development (WCED), refers to development that meets the populations' needs without limiting its ability to meet the needs of future generations. It designates a process by which economic, fiscal, commercial, energy, agricultural, industrial and other policies are all conceived in view of setting up a development which is economically, socially and ecologically sustainable. According to the UNDP report on human development (1992), the basic conditions necessary to set up sustainable development are: the elimination of poverty, a decrease in population growth, a more equitable distribution of resources, a healthier, better educated and better informed population, a more participatory decentralized government, more equitable and more open exchange systems within and between countries and a better understanding of the diversity of ecosystems, solutions that are adapted to local ecological problems and a closer follow-up of the impact of development activities on the environment. Thus, this concept of sustainable development has penetrated that of IMCMZ notably since UNCED.

2. Link between IMCMZ and the integrated management of water basins

2.1. History shows that the development of water basins was based on a technical and sectorial development concept that would create multi-purpose water basins. This concept originated in the United States of America in 1879 with the discovery of the links that existed between navigation and defence against floods. Later, in 1888, the links between irrigation and defence against floods were discovered. In 1898, the relationships existing between the ground vegetation and the defence against floods on one hand, and between navigation and irrigation on the other, were perceived. In the beginning of the twentieth century, all these discoveries enabled the United States to elaborate the general assembling principles of the works for multiple purposes. It is for the first time in 1910 that the United States National Commission for Waterways expressed the necessity to study the various uses of water. For the first time as from 1928, the American federal government undertook major works for several purposes in Boulder Canyon: the main objective of the works concerned the production of hydroelectricity in vast quantities. The secondary objectives pertained to the defence against floods and sedimentation, navigation, irrigation and the supply of water to the populations in the south of the State of California. In 1933, the voting of the law for the creation of the Tennessee Valley Authority enabled the realization of 28 multi-purpose reservoirs in this gigantic valley. They served for navigation, defence against floods and the production of hydroelectricity. In the same way, the development of the Rhone Valley in France, for which the programme was adapted following a law in 1929, included navigation, irrigation and hydro-electricity production.

This technical and sectorial concept of the development of water basins has long since been privileged, for example by the Inter-State Committee for the development of the Senegal water basin (CIE) from 1963 to 1968, by the Riverside States Organization of Senegal (OERS) from 1968 to 1971 and by the Senegal River Development Organization (OMVS) since 1972. They founded the basis of a policy and strategies for the development of the river aiming at the development of irrigation, the production of hydro-electric energy and the development of fluvial transport.

2.2. It is after the major drought of 1968-1973 in Africa that the necessity to go beyond the vision of the development of water basins that was only technical and sectorial, towards a more human, social, economic and global environmental concept. Hence the relationships between hydrographic basins, control systems i.e. barriers, industries, wastewater treatment, land irrigation, water supply to households, hydraulic problems – floods, sediment transport, saline intrusion, pollution – and human utilization of land and water i.e. forests and mines, agriculture, land for husbandry, protected areas, habitat areas etc.

Thus the concept of integrated management of water basins (IMWB) was reached. Given that coastal zones and areas around river mouths represent an essential part of water basins, dynamic natural and social interactions exist between the former and the latter. Therefore the integrated management of coastal and marine zones should not be tackled without linking it to that of water basins that surround them.

3. OIDBA experiences in sustainable integrated management

3.1. OIBA experiences in the 70’s and 80’s

3.1.1. Since the independence of the 1960’s, the African governments have come to realize the necessity for developing large inter-African rivers and medium waterways, to develop their economies, especially when they were struck by repeated severe droughts, creeping desertification and recurrent floods caused by irregular and uncontrollable rainfall. Since the 1970's, the United Nations System has backed the governments in this development effort through several existing OIDBA having as immediate objectives to:

i) formulate guidelines for the development of water basins and lakes and carry out pre-investment activities,
ii) carry out a complete capacity management of the resources of the basins and lakes,
iii) gain complete control over water resources, and
iv) create the necessary conditions to promote technical and financial assistance by the money-lending community.

3.1.2. Up to 1986, towards the end of its third programme cycle, the UNDP had spent approximately 41 million dollars to help the OIDBA to carry out the immediate objectives mentioned above, and to trigger assistance from sponsors in a multi-donor and multi-disciplinary manner. Those concerned were essentially the OMVS, OMVG, ABN, CBLT, and OBK (see table 1, p. 309).

3.1.3**.** In the case of the OMVS, more than 600 million dollars were mobilized in 1987 to finance the necessary investments for the construction of the two dams of Manantali and of Diama to regulate the Senegal river flow, allowing irrigation, hydroelectricity production and navigation, and to prevent the backflow of seawater into the delta and the low valley of the river in order to continue agriculture. In 1986, UNDP had put aside 6 million dollars for the development of the Nile basin. The regional multi-sponsor and multi-sectorial approach of UNDP for the development of African water basins and lakes, was considered in the 1980s as the most effective thus far in ensuring the economic development of the countries concerned and also as an appropriate catalyst for attracting other sponsors.

3.14. But it seems that in the 1980s, the main preoccupation of governments, assisted by UNDP and other sponsors, pertained to the global integrated development of fluvial water and lake resources without any systematic or particular reference to the integrated management of coastal and marine zones of these waters. This was the case for the Delta and the Senegal River mouth. Their human and natural structures had been upset since 1986 by the construction of the anti-salt dam of Diama which had a negative impact on traditional husbandry and fishing activities and on the aquatic and marine fauna. Modern irrigation practices in these zones could not compensate for these negative effects.

3.2. OIDBA experience in the 1990s

3.2.1. *OMVS (Mali, Mauritania and Senegal)*

3.2.1.1. In the face of the advancing desertification in the basin, the delta and the Senegal river mouth in particular, and the difficulties of existence and development of agricultural systems, husbandry and fishing in this zone, the OMVS adopted an approach for the integration of agriculture, husbandry, fishing and forests for the after-dam period. But as this sub-regional approach hardly followed the OMVS practices, the governments of the three member countries seemed to be carrying out independent national policies for the protection of the environment and sustainable development. In June 1990 this is how the Senegalese government adopted a master plan for the integrated development of the left bank of the Senegal River Valley (PDRG) for the next 25 years. The aim of the plan is to improve the conditions of life of the populations via agricultural activities, husbandry, forestry and others while protecting the environment. The PDRG that englobes the Delta of the Senegal river does not seem to have followed with concrete actions. In the Delta it is rather an uncoordinated increase of individual actions, private or associated, that has been taking place since the State took over the management of pioneer zones in land zones. This gave an important role to the decentralized rural councils in the distribution of these lands.

3.2.1.2. In May 1995, the Senegalese government established an After-Dam Commissariat (CAB) responsible for the supervision of the coherence of PDRG programmes with those of the Cayor Canal, the re-watering of the fossil valleys of Ferlo and Sine Saloum, and of the green belt programme of all other programmes involving the use of the Senegal river resources. During the 45th meeting of the Ministerial Council of the OMVS held in Nouakchott on 20-23 February 1998, Mauritania and Senegal confronted each other over the use of the river waters for the Senegal fossil valley programme. To save the OMVS from the crisis that had developed between these two countries during the organization's 12th Heads of State Summit held on 25 April 1998 in Bamako, the Senegalese government decided to abandon the re-watering programme of the fossil valleys. The recent restructuring of the OMVS that resulted in a drastic reduction of posts (maintaining 7 professional posts per country to be discussed and confirmed), has confined it to the coordination of activities relating to the exploitation structures of the Diama and Manantali barriers and to the supervision of the equitable distribution of uses of the river waters. The purely productive activities in the river basin have been left to the Member States, the private sectors or group associations to be managed. What is left now is to invent and set up, in the years to come, an integrated management of coastal and marine zones of the Delta and the Senegal River mouth with the actors mentioned below in collaboration with the OMVS light structure and the After-Dam Commissariat of Senegal.

3.2.2. The ABN (set up by 9 countries in which the Niger water basin occupies 33.4% of Nigeria's territory, 25.3% of Mali, 22.2% of Niger, 6.7% of Guinea etc.).

3.2.2.1. Upon UNDP's advice, the Niger River Commission, which had functioned for 17 years until 1979, was transformed into the ABN in January 1980 in Conakry.

The ABN has carried out several technical studies and adopted development plans for the basin, and the distribution of hydraulic resources of the river between the Member States for agricultural and hydroelectric activities. The urgent actions to be launched concern:

i) the eradication of harmful aquatic plants (water hyacinth) which invade the waters,
ii) the identification of sand-generating and enlargement zones and the clarification of appropriate stabilization methods,
iii) the definition and setting up of an observatory for following potential pollution in the waters of the basin,
iv) the improvement of the computer environment of the Inter-State Centre and the national hydrological centres, and
v) the daily management and extension of the existing mathematical model to the whole water basin.

The implementation of all these actions depends on an institutional reinforcement of the ABN which has suffered a lot since its creation. Thus a reinforced ABN, with the assistance of development partners could:

i) define a re-launch programme for its activities and valorize the products in compliance with the resolution of the 16th ordinary session of its Ministerial Council (1997), and
ii) amongst these actions, assess the environmental situation of the basin and estimate the development potential of the latter and future perspectives (knowledge, handling and control of water resources; potential hydroagriculture and promotion of irrigation; potential hydroelectricity, water navigation, development of fisheries and pisciculture; main factors of environmental degradation and the solutions to reduce and stop it).

3.2.2.2. The ABN attaches a lot of importance to its environment observatory project in the basin which includes a geographical information system (GIS) of details and appropriate scales for the environmental follow-up on a collected, treated, formatted and simulated database. This observatory could also serve for the integrated management of coastal and marine zones of the water basin which, for the time being, seems to be the Nigerian government's only prerogative though the river is legally the property of 9 riverain countries through which it flows.

3.2.3. *The OMVG (Gambia, Guinea, Guinea-Bissau and Senegal)*
The joint commission for the Gambia water basin which was created in 1964 with FAO's assistance was later replaced by the Sene-Gambian Commission which was in turn assisted by the UNDP as from 1977. The OMVG was created in June 1978 between two countries which were joined in 1980 by Guinea and in 1983 by Guinea-Bissau. In 1980 the organization prepared a five-year action plan for the development of the basin based on the construction of infrastructures (multi-purpose dams of Kouya and of Kekreti) which does not seem to have been implemented in the 1990s, notably due to a lack of financing. Amongst the actions retained was the development of agriculture through the blocking of marine salt water intrusion (coming up to 526 km from the river mouth during the dry season) by the future Kekreti Dam (Senegal), and the consideration of socio-economic and environmental aspects in the development of the basin, notably in the coastal and marine zone of the latter.

3.2.4. *The OBK (Uganda, Tanzania, Rwanda and Burundi)*
The OBK of which the Kagera River constitutes the main source of water for Lake Victoria, was created in August 1974 with UNDP's assistance with as objective the development of the basin with integration of its resources (hydroelectricity, agriculture, husbandry, forests, land, fisheries etc.) while protecting the environment. In the 1980s the OBK adopted a programme of action for the development of the basin (including the environment) which does not seem to have been implemented in the 1990s due to a lack of financing. The prevalent political instability in the region of the Great Lakes since 1993 has marginalized the OBK.

3.2.5. *The Volta River Authority (AFV, Ghana)*
Created in 1965 by the government of Ghana, the AFV's mandate consists of managing the Akosombo Dam on this river while following the implementation of the research project on the Volta Lake responsible for studying the effects of the physical and social impacts of the dam on the lives of the populations. In 1997, affected by the lack of water in the flooding lake of the dam and by serious management difficulties, the AFV was not able to satisfy the needs in energy of Ghana (of Togo and Benin). In the beginning of 1998, as a result of the severe drought and the energy crisis, there was a debate in Ghana and Burkina Faso (source of the river). This concerned the need for cooperation to jointly manage the resources of the river, which had never really existed before, during the river swellings and the construction of the Akosombo Dam by Ghana. In March 1998 President Rawlings of Ghana proposed a delegation from Burkina Faso to create a joint management organization for the river waters which seemed to dwindle during the middle of the drought period.

This organization could be the instrument of reflection and action for the integrated development of the coastal and marine zones of the river in Ghana. There is also a national project of management and use of mangrove resources in the lower Volta in Ghana (which covers the climate, vegetation, fauna, the populations and economic activities etc.) with the long-term objective of finding solutions to problems of rational and integrated management of mangrove resources in the entire coast of Ghana (550 km). This project comes into the framework of the National Indicative Plan of Management of the Coastal Zone (PNIGZC).

3.2.6. The Zambezi River Authority (AFZ, Zambia and Zimbabwe)
3.2.6.1. The AFZ was created in October 1987 by these two countries, after its predecessor (the Central African Energy Company). Its objective is to jointly exploit the hydraulic resources of the river in general and in particular:

i) operate the Kariba Dam complex and follow the construction of other dams on the river,
ii) exploit hydrological and environmental data for all purposes and
iii) collaborate with national electricity companies.

The AFZ recently helped the SADC and other riverain countries of this river (Angola, Botswana, Malawi, Mozambique, Namibia and

Tanzania) to realize certain projects under the Zambezi Action Plan (PAZ). In the 1980's UNEP helped the AFZ and the riverain countries to launch this action plan for the integrated development of hydraulic resources of the basin in the framework of its Management Programme for interior waters with environment preservation. The Zambezi Action Plan (PAZ) comprises a series of projects including that of environmental management and education of which the implementation has been left to the SADC, given the absence of an organization grouping the eight riverain countries.

3.2.6.2. Negotiations are currently taking place between these countries for the creation of a Zambezi River Commission with an executive Secretariat which would be responsible for preparing and implementing a detailed master scheme for the integrated development of the hydraulic resources of the basin. It would be desirable for the future master scheme to comprise one component of integrated management of coastal and marine zones of the basin which correspond to the Indian Ocean coast of Mozambique (near Beira).

3.2.7. *The Nile Basin Initiative (IBN)*

3.2.7.1. The basin of the Nile, the world's longest river (6,500 to 7,000 km), covers an area of 3 million sq. km among 10 riverain countries, from the source of the white Nile in Burundi/Rwanda/ Republic of Congo, to the river mouth in Egypt, via Tanzania, Kenya, Uganda, Ethiopia, Eritrea and Sudan.

A Ministerial Council for Water (CMA) has been functioning since 1986 among these 9 riverain countries (which were joined by Eritrea in 1993) to promote cooperation among them and develop the resources of the basin. They meet annually and in 1992 launched the Nile Basin Initiative (IBN). Among these countries, in 1992 six of them set up the Technical Cooperation Committee for the Development and Environmental protection of the Nile basin Environment (TECCONILE), the headquarters of which is in Uganda. This committee functioned until March 1998, date on which the last Ministerial Council for Water meeting took place in Arusha, Tanzania. On this occasion they decided on the creation of a new inter-state Nile basin development organization which would group together the 10 riverain countries.

3.2.7.2. Upon the request of the Ministerial Council for Water in January 1998, the World Bank, in collaboration with UNDP and CIDA (Canada), prepared an Action Plan indicative of the integrated development of the basin which was discussed during the last Ministerial Council for Water meeting in Arusha. This document should also serve as a foundation for the next World Bank consultative group meeting on the Nile to support the Nile Basin Initiative.

The preparations are underway for this consultative group meeting.

3.2.8. *Conclusion*

This review of policies and strategies of development of water basins by the OIDBA in the past three decades has revealed that:

i) Governments and the OIDBA have moved from a technical and sectorial vision of development of these basins in the 1970s and 1980's, to an integrated social and economic vision that is concerned with the preservation of the environment in the 1990s,
ii) Even though the necessary relationship has been recognized between the integrated management of coastal and marine zones of river mouths on one hand, and that of water basins on the other, the OIDBA in general have not established these links in their field practices, often contenting themselves with strictly the management of hydraulic resources for various uses; and
iii) The integrated management of coastal and marine zones of these water basins is generally left to the individual governments of coastal countries without this necessarily resulting in cooperation with other riverain countries of the same rivers, or with the OIDBA that manage these rivers. Thus there is the necessity for the OIDBA to integrate the management of coastal and marine zones in their practices to guarantee a sustainable development of the latter, given that they are integral parts of water basins.

4. Integrated management of coastal and marine zones in the context of integrated management of water basins

4.1. Social problems and conflicts in coastal and marine zones

Since the UNCED in June 1992, several countries and organizations have tried IMCMZ policies, strategies and actions at the central government level; but in Africa it is observed that many of these central actions have been carried out in an *ad hoc* manner based on limited financial and technical support in time and space. They have therefore never come up with definite sustainable solutions to the local and regional problems. These problems are generally numerous and complex, entailing conflicts concerning the use and distribution of coastal and marine resources by populations that are growing faster than interior region populations. The problems of the Senegal River delta evoked in section 3.2.1.1. are of this order.

One of the main problems raised in the case of the Senegal River delta, is that of the legal status and of the occupation of irrigated and irrigable land. The Senegalese law of 1972 on the administrative and territorial decentralization of rural communities came into effect in the delta and the valley as from 1980. It was only as from 1986 that the control of the pioneer zones which were being managed by the SAED, was passed to the rural councils in the form of land zones, after which a state of disorder and laxism reigned in the distribution of land. This situation was aggravated by the fact that no plan of land allotment or occupation existed. In practice, rural communities lend land to farmers, who do not own any land or property, that can be seized at any moment — even when they improve the land. This generally does not incite users to invest substantially in granted land or maintain the existing infrastructures. It has been observed that large irrigable surfaces (up to 200 ha sometimes) granted by the rural communities in the delta can remain unexploited or hardly exploited over a period of several years. The holders adopt a strategy of occupation rather than one of development. Such behaviour in a situation where there is a great demand for land for numerous farmers should be eliminated by the State which has considered attributing long leases (from 18 to 99 years) to promote agricultural and rural development by eliminating the above-mentioned constraints. An IMCMZ approach could be one of the sustainable solutions to these problems and conflicts.

4.2. The IMCMZ approach

4.2.1. The IMCMZ actions, initiated in the beginning at the central level by governments, have had little success and impact. They should be given up in favour of actions initiated and implemented by the populations concerned who are better placed to identify their problems, analyze their conflicts and come up with sustainable solutions. Hence, the IMCMZ approach is not a substitute for macro-economic and sectorial policies of governments or state organizations, but rather a perception and a vision of the problems of inter-relations between natural, economic and social factors that condition the lives of populations, to find appropriate local and regional solutions. It is therefore a question of an approach that starts with the populations and the defence of their common interests and that has as priority the rational use, allocation and development of coastal and marine resources while preserving and protecting their productivity as well as the biological diversity of coastal ecosystems through the prevention of habitat destruction, pollution and over-exploitation.

4.2.2. The dynamics in the valley and the delta of the Senegal River, triggered by the peasant organizations, is a good illustration of the IMCMZ approach. The planned economy and technocratic approach of the framework that prevailed in the 1960s and 1970s led to the unease of the peasants whose life conditions had been aggravated by the diversification and drought phenomenons of the 1968-73 period which destroyed the vegetative cover and the harvests, impoverished the soil and decimated the livestock. As a result, due to the fall of the production systems of the delta and the valley, the peasant populations organized themselves in a relatively autonomous way in the 1980s and 90s thanks to three essential factors:

i) the gradual disengagement of the State and of the SAED from productive activities,
ii) the adoption of the 1984 law on Groups of Economic Interest (GIE) which enabled populations without any real legal status to be officially recognized and to have access to land resources and agricultural loans by grouping into GIE of 2 to 400 people each and
iii) the State-facilitated creation of all types of groups to develop production and human and natural resources while preserving the environment.

The organization of populations into GIE in the delta of the river is favourable for the integrated development of this coastal and marine zone. The advantages of this are as follows:

- The GIE relatively facilitates access to the irrigated perimeter of the land given that the rural and agricultural advisors are more open to the demands coming from GIE rather than individuals; and
- They enable easy access to agricultural loans without having to deposit social shares, and avoid the blockage of certain village sections of cooperatives that owe their countryside backwardness to the SAED and members of GIE who group together freely, based on reciprocal trust, and who are not subject to the strict regulations of cooperatives or old groups of producers.

The existing GIE in the Delta and the Valley are very diverse and have varied strategies: the GIE raised by national development structures are:

- family or inter-parent GIE,
- mixed GIE grouping peasants and professionals, the former come with their land and labour force, the latter with their know-how and capital, and
- the neo-rural GIE grouping civil servants, technicians, young unemployed graduates, those who have left regional organizations for rural development, retirees and civil servants who have left voluntarily.

As well as individual GIE, other forms of organizations and peasant groups exist in the region:

- village sections of cooperatives;
- feminine groups;
- children's homes;
- Northern Economic Groups Union (UGEN) which groups 600 GIE from Saint-Louis, Dagana and Podor;
- the Federation of Groups of Economic Interest of the Delta (FEGIED) which includes 170 GIE from the Ross Bethio, Rosso-Senegal and Gandon zones and
- the Union of GIE of the Delta (UGIED) spread over the whole Delta.

Hence the GIE have a tendency to group into unions or federations to be able to successfully defend their interests and become privileged partners of intervention structures and the bank system.

4.3. Stages of the IMCMZ approach

4.3.1. Theoretically they can be separated into successive stages of initiation, planning and implementation. The initiation stage allows the analysis of fundamental factors that may trigger the populations to realize the existing problems and conflicts and to come up with appropriate solutions. The planning stage permits the identification and formulation of policies and strategies based on general and particular objectives to be transformed into concrete actions in time and space. The implementation stage enables the realization of the above-mentioned actions through decision-taking by the populations collaborating at local and regional levels in political, administrative, technical, financial aspects etc.

4.4. Institutional, legal and financial dispositions for IMCMZ

The complexity of economic and social structures of environmentally fragile coastal and marine zones, militates in favour of the implementation of the dispositions mentioned below.

4.4.1. At the institutional level, there is a need to ensure a horizontal integration of sectorial institutions in the planning stage of the IMCMZ and a vertical integration in the implementation stage of the IMCMZ. For example, in the valley and the delta of the Senegal River, the Society for the development and exploitation of the Senegal River lands and of the Faleme (SAED), the After-Dam Commissariat (CAB) of Senegal and the Federation of Groups of Economic Interest of the Delta (FEGIED) (which consisted of 170 GIE of the Ross-Bethio, Rosso-Senegal, Gandon zones etc., in 1993) could play this role both at the horizontal and vertical levels.

But the great disparity that exists between the GIE of the Delta, their insufficient field organization and their lack of technical training in general should be compensated by outside assistance in the respective domains to enable them to play an active role in the initiation, planning and the implementation of IMCMZ actions.

4.4.2. There is also a need to involve the intergovernmental organizations for the development of water basins (OIDBA), namely the OMVS, in the initiation and planning of IMCMZ actions; as they are responsible for planning and following of the utilization and allocation of hydraulic resources of inter-African rivers, they are thus also concerned with coastal and marine zones. A meeting and negotiations between the FEGIED, the SAED, the CAB and the OMVS would be indispensable. This could take a legal form in the interest of the populations of these zones.

4.4.3. On the financial side, the realization of the IMCMZ would require funds from:

i) local, regional and national budgets for the financing of administrative structures;
ii) the utilizers for the infrastructures and the control of pollution, for example; and
iii) the private sector and its visiting utilizers/tourists for the conservation and preservation of parks, hunting reserves etc. All this should stem from legislation adapted to national, regional and especially local conditions of the populations concerned. The laws on decentralization in Senegal have envisaged such regional and local financial dispositions which should be applied in practice.

4.5. Necessary integration of IMCMZ in the OIDBA

4.5.1. In accordance with national, regional and local structures and the associations and groups of coastal and marine zone populations concerned, the OIDBA should integrate specific IMCMZ actions in their water basin integrated development actions which would be implemented in collaboration with them. The OIDBA should therefore participate in the process of:

i) identification of problems,
ii) planning and capacity reinforcement (definition of macro-economic and sectorial policies *vis-a-vis* natural and human resources of coastal and marine zones; technical capacity reinforcement of human resources and populations concerned in these zones; and the preparation and adoption of IMCMZ action plans), and
iii) the adoption and implementation of investment plans for IMCMZ (demographic aspects, settlement of populations and rural emigration; fisheries, agriculture; infrastrutures for supplying water to populations and agriculture, reduction or elimination of all types of pollution; protection and stabilization of river mouths and coastal and marine zones, notably against the effects of desertification and silting up; and conservation of marine biodiversity).

But to be able to fully participate in this IMCMZ implementation process, the OIDBA have to expand their mandate (which generally does not include IMCMZ) and consequently reinforce themselves technically, institutionally and financially.

4.5.2. The OMVS example could be considered in this respect. Despite the budgetary, financial and administrative obstacles, the OMVS has managed to set up an infrastructure of regularization for the Senegal River by constructing the Manantali Dam in the high basin of Mali in 1987 and the anti-salt dam of Diama in Senegal in 1986. With the realization of the complementary works in the Delta (embankment of the left side upstream from the dam and embankment of the right side), it is now possible to maintain the level of water at 2.50 in the dry season, which theoretically allows the development of irrigated agriculture during this season.

Until now, the OMVS has given priority to the planning and management of water resources of the river. Hence the creation of a permanent structure in 1975 called the Permanent Water Commission (CPE), composed of Member State representatives, and which is responsible for defining principles and modalities for the distribution of the river waters between the Member States on one hand, and between the utilization sectors (agriculture, industry, transport etc.) on the other, even though the role of this commission is limited to the definition of priorities. In the same way, the OMVS has set up a management agency in Rosso (Mauritania) for common works, the objectives of which consist of diffusing to utilizers' water management predictions from telecommunication networks in the basin that will be modernized, as well as a network of answering machines or Minitel. The purpose of this is to know the demands of the users and to follow and evaluate the consequences for the users after management regulations have been applied. There exists a regional committee for the planning, coordination and follow-up of development actions in the basin (CRP). It groups national planning committees and is responsible for advising the OMVS ministerial council on river resources development programmes and also for the follow-up; but this committee is generally restricted to general and technical water planning questions.

It is recommended that ministries of economic development, planning and of the economy (of Member States), that have an intersectorial vision of development, take over the OMVS responsibilities. The latter should then be responsible for the planning and coordination of actions for the development of water, land and human resources, for the follow-up of the implementation of plans, programmes and projects, and for the mobilization and utilization of funds to realize development actions as is currently the case for this last point. In the same way, a new unit for the planning of sub-regional development should be created within the High Commissariat of the OMVS, to tackle all tasks of multi-sectorial planning and economic integration based on hydraulic, land and human resources of the basin. This unit should be under the direct supervision of the High Commissioner who would make the unit his privileged instrument of advice in matters of planning and the concept of sub-regional development.

The most important responsibilities of this planning unit could be the following:

- propose more varied multi-sectorial development alternatives for the basin, from which the OMVS and the Member States would choose the one that most conforms to the objectives of the needs of the populations and of the integrated development of the basin and Member States; for this the unit would have to collaborate in a more systematic and sustained way with national directors of planning of member states;
- help to increase the know-how of OMVS professionals and those of Member States on the subject of planning, formulation, follow-up and evaluation of programmes and projects, and contribute to ensuring their training in the domains concerned;
- favourize the promotion of valuation by surveyors and private national and sub-regional organizations concerned, so that they can help the OMVS to have a vision of their own development of the basin;
- involve riverain populations and sub-regional and national development organizations and associations in the process of identification, planning, follow-up and evaluation of actions so that development alternatives proposed are as extensive as possible and discuss in depth the costs and advantages of the latter, as well as the apparent contradictory uses of water (navigation, hydroelectricity, irrigation, artificial swelling of rivers to sustain agriculture etc.);
- diversify to a maximum the bilateral and multilateral partners and donors interested in financing development actions of the basin, notably those of the Southern countries (Asia and Latin America) in the framework of economic and technical cooperation between third-world countries; and
- further involve African development and financing organizations and institutions in the perspective of the constitution of sub-regional groups such as the CEDEAO and the African Development Bank (ADB), which recently

pushed institutions and African states in the direction of integration and economic cooperation in Africa.

It is understood that all the above-mentioned proposals include the process of identification, formulation and implementation of IMCMZ in the zones of the delta (river mouth, coastal and marine zones) in Senegal and Mauritania, in collaboration with the central and regional authorities of these Member States, and the populations concerned at the local and village level of both countries.

5. IMCMZ financing in relation with IMWB

The following pre-investment and investment activities in IMCMZ will be considered as an integral part of those of the IMWB even if specificities exist in the two investment categories which should nevertheless be coordinated at national, regional and local level to ensure a sustainable integrated development of both coastal and marine zones, and international African water basins.

(Charts on following pages).

A. Preinvestment activites in IMCMZ		
Activity in relation to IMWB	Countries/coastal and marine zones of water basins	Financing organizations
Identification of problems, planning and capacity reinforcement.		
1. Technical aspects Evaluation of the effects of drought, desertification and the environmental situation; geographic information system (GIS); observatory for the socio-economic follow-up; participatory rural appreciation and rapid evaluation of the coastal situation.	River mouths and deltas of the Gambia, Zambia, Nile, Niger rivers etc. and the corresponding coastal zones.	National environmental action plans of riverain countries and OIDBA development plans should contain evaluations fo the state of river mouths and coastal zones of the rivers. They should be financed by the usual intervening organizations in the countries concerned: World Bank, International Development Bank, regional banks such as the ADB, World Environment Fund (WEF), trust funds and bilateral donors; United Nations organizations such as UNEP, UNDP etc.
2. Institutional aspects -Training of managers to follow the technical aspects below (natural resources and productive activities): - Support to various peasant and other organizations in following coastal and marine evolution. - Ensure links with the private and public sectors.		
3. Macro and sectorial policy aspects Support of diverse aspects of policies and for the adoption of guides in IMCMZ to direct donors'investments in coastal zones.	Coastal and delta zones of river.	
4. Public (state) administrators Central and regional intervening organizations. Progressive decentralization at the regional and local level for the promotion of activities in coastal zones.	Coastal and delta zones of river.	Consultation and dialogue with the population through training or state funds or NGOs.

B. Choice of investments in the development phase of IMCMZ.

Activity in relation to IMWB	Countries/coastal and marine zones of water basins	Financing bodies
I. Infrastructure, water supply and sanitary installations		
1. Water supply and sanitary installation (Water supply by surface or underground water). 2. Management of industrial effluents and solid waste.	Coastal zones and villages of water basins: Saint Louis, Lagos, Accra, Cairo etc. Ghana, Nigeria etc.	Financing via loans and bilateral subsidies or the United Nations (UNDP, Habitat etc.). Financing via international or regional loans.
II. Sustainable agriculture (chemical aspects and recycling of natural residues).	Coastal zones of rivers.	Loans in agricultural development assistance for agricultural research (CGIAR) and NGOs.
III. Management of fisheries resources 1. Industrial fishing sector. 2. Traditional fishing sector. 3. Pisciculture.	Senegal, Mauritania, Ghana, Nigeria etc. Coastal and marine zones of water basins. Coastal and marine zones of water basins. Coastal and marine zones of water basins.	Loans in the development of fisheries (EU, ADB etc.) and United Nations organizations (FAO). Multilateral and bilateral loans and the United Nations (FAO).
IV. Protection/conservation of marine biodiversity 1. Management of protected zones. 2. Habitat rehabilitation. 3. Marine biotechnology.	Coastal and marine zones of water basins.	Loans in the environment and education. IUCN; WWF; UNPD; UNID; FAO.; CGIAR.
V. Urban planning/coast protection 1. Biological or technical solutions for coastal erosion, sedimentation and the rising sea level. 2. Zoning for urban sites.	West Africa for coastal erosion and East Africa for sedimentation. Coastal villages.	Loans in infrastructure (bilateral) and multibilateral. Habitat (UN).
VI. Demographic tendencies in sensitive coastal zones 1. Acceleration of social and physical infrastructure development to reduce migrations. 2. Promotion of agrobusiness and other industries by attracting private investors, by creating free zones and increasing employment opportunities. 3. Diverse measures/methods to space births; family planning campaigns etc.	Coastal and delta zones of water basins.	Loans in infrastructure (bilateral and multilateral). Loans for infrastructure (bilateral and multilateral). Loans in human resources (bilateral and multilateral) and United Nations organizations: WHO, UNICEF.

(Cont'd)

Activity in relation to IMWB	Countries/coastal and marine zones of water basins.	Financing bodies.
VII. Tourism 1. Ecotourism. 2. Traditional tourism.	Specific zones of coasts and deltas of water basins. Riverain countries of the rivers.	GEF (conservation of biodiversity), IUCN, WWF, international tour operators. Loans in infrastructure.
VII. Alternative energy 1. Solar energy. 2. Biogas.	Riverain countries of rivers, coastal and delta zones where pluvial and irrigated agriculture is practiced.	Loans and subsidies of bilateral and multilateral institutions.

Table 1. Exterior financial assistance to OIDBA in 1986 (in millions of United States dollars).

Organization	UNDP contribution			Other donors
	Before 3rd cycle (1981)	3rd cycle (1982-86)	Total	
OMVS	10.0	3.3	13.3	812
OMVG	1.7	1.9	3.6	30
ABN	1.9	2.8	4.7	22
CBLT	12.3	2.0	14.3	2
OBK	3.0	2.3	5.3	2.2
Total	28.9	12.3	41.2	868.2

Source: PNUD, 1988

Table 2. Distributions of allocation of external sources of financing for the realization of great OMVS infrastructure works (March 1989).

Saudi funds for development	43.31
Kuwait funds for the economic development of Arab countries	31.21
Federal Republic of Germany	31.51
Abu Dhabi funds for the economic development of Arab countries	20.58
European Community Commission	26.49
France (Main treasury and FAC)	16.90
African Developmment Bank Group (ADB, FAD, NTF)	14.93
Italy	11.67
Canada	8.74
OPEP funds for international development	6.32
Islamic Development Bank	7.43
USAID	5.80
UNDP	3.16
Total (billions CFA)	**228.08**

Source: *OMVS Magazine*, May, 1990

Table 3. OMVS – Costs of Diama's and Manantali's dams (in FCFA) in 1989.

Diama Dam	
Actual dam:	
- Civil engineering	30 320 552 329
- Electromagnetic equipment	3 076 814 979
Total	**33 397 367 308**
Aftout-es-Sahel works	
- Civil engineering	700 911 424
- Electromagnetic equipment	73 883 010
Total	774 794 434
Supervision	1 812 328 829
General total *	**35 984 688 829**
Manantali Dam (forecasts)	
- Civil engineering	129 988 530 789
- Electromagnetic equipment	12 272 899 288
- Supervision	5 609 153 793
- Lateral access route	2 791 465 938
- Rehousing of populations	5 786 002 500
- Deforestation	3 388 620 000
General total	**159 836 672 308**

* To these sums should be added the sums needed for the reparation of the Faidherbe Bridge in Saint Louis, and for the supplies of the construction site. (US$: 16,406,800, that is F CFA : 51,847,200 upon UNDP's subsidies.

Source: *OMVS Magazine*, No 1, May 1990

ANNEXES

Halifa Drammeh

Representative of the United Nations Environment Programme

Let me begin by paying tribute to the honourable Minister of Environment who, by example and total commiment, contributed to the shaping and realisation of PACSICOM and the process it has ushered in. UNEP also wishes to express its gratitude to the other partner co-sponsors of PACSICOM (Mozambique, Finland, and UNESCO) for the collaboration.

This unique Pan-African conference has the mandate to look beyond the obvious and immediate. Indeed our obligation to act is a particularly special and important one. Having been designated a special event in the International Year of the Ocean, PACSICOM provides a special opportunity to discern trends, as well as to detect signals warning us of the emerging problems of Africa's coastal and marine environment, to think seriously and critically of alternative solutions and to recommend strategies for achieving solutions.

Eight years ago, in 1990 to be more precise, UNEP and its sister agencies (UNESCO, FAO, IMO, WMO, WHO, IAEA), drew attention to the rapid deterioration of the coastal areas which threatened to cause significant harm to the marine environment unless coordinated regional as well as international action is taken. In order to bring the coastal crisis to the widest possible audience, UNEP's Regional Seas Programme continues serving as a catalyst in encouraging scientific work as well as regional and international cooperation. In doing so, we continue to provide early warnings and to get governments, which share a common sea, to deal collectively with their coastal and marine environmental problems.

The PACSICOM technical workshop component constitutes an assembly of African's scientific and technical strength on matters relating to the marine and coastal environment. It is therefore our hope that your deliberations will bring about better understanding of: i) the pressures which have triggered widespread coastal resource degradation in Africa and ii) the imperative need to apply ecological approaches in understanding the linkages between the diverse issues of the marine environment. Most importantly, this PACSICOM workshop should lead to a better appreciation of the fact that almost all the problems of the marine environment are problems at the new interfaces or that take place because of lack of integration between related forces – economic, environmental and social.

Thank you for your attention and best wishes.

H. E. Mr. Jarmo Kuutila

Representative of the Government of Finland

Finland is a country with a long shoreline in the Baltic Sea where the conditions are in many ways totally different from the African coastline. But despite these differences, there is one similarity in both ecosystems: the sea does not recognise national borders. Actions taken in one country will inevitably affect other countries. Even if principles of sustainable development are adopted in one country, its results can well be destroyed if neighbouring countries take adverse measures. Therefore, coherence in environmental research, monitoring and decision-making is of greatest importance.

The need for unified and co-ordinated cooperation was the underlying motivation for Finland to initiate a process in the Baltic Sea which was later used as a model for international cooperation in marine and coastal zone sustainability elsewhere in the world. The Helsinki Commission, as the convention is called, unites all countries of the Baltic Sea in an effort to direct the results of the marine environment research into environmental decisions. This is, in our opinion, the essence of environmental management.

Thus, we are very happy to offer our support and experience to the Mozambican Government, as it initiates today a process, which, as a concept, strongly resembles what Finland initiated in the Baltic Sea. The PACSICOM process we are today inaugurating not only aims at the development of a coherent, sustainable strategy for the African coastal zone, but it also includes a sound long-term educational component being the capacity building component, one of the major themes in the process. This is very much in line with Finland's views. We avoid subjecting others to ready-made solutions, but instead prefer to emphasise learning and scientific education as a tool, first to identify problems, and then to find their solutions. We gladly support this approach to strengthen the capacity of environmental research and education as being part of the PACSICOM process.

Excel1encies, representatives of UN, ladies and gentlemen, this moment is historical since it is the first truly continent-wide, pan-African conference aiming to explore one of the key issues of human life. Bearing in mind that about 70% of the world population lives in the coastal zone makes this event, for which we are all gathered here, extremely important, not only from any one country's point of view, but globally. Finland also highly appreciates the good cooperation between UNESCO and UNEP, both giving their best expertise to support this Mozambican initiative. To finalise, I would like to thank you all for participating in this extremely important event which shows well your concern for a sustainable and integrated coastal and ocean management and I wish the very best success for PACSICOM.

H. E. Mr. Bernardo Ferraz

Minister for Coordination of Environmental Affairs, Mozambique

His Excellency, the embassador of Finland,
the Assistant Directors-General of UNESCO,
the UNEP Representative,
the Representative of the United States in Mozambique,
Ladies and gentlemen,

On behalf of Mozambique, I would first like to extand a warm welcome to all participants. I'm grateful for this opportunity to share with you some thoughts on sustainable coastal management for this country as well as for the rest of Africa.

Thanks to its geographical situation, Mozambique is among the most privileged countries in the world. It benefits from a wealth of natural resources: vast stretches of fertile land, a rich fauna, important hydrological sites and mineral deposits as well as an extended seashore with great economic and environmental potential. Yet, paradoxically, Mozambique lives in deep poverty. By "poverty" we understand, of course, the *actual* per capita income, rather than the *potential wealth* of the country.

Going back to our subject, integrated coastal management, I would like to add a few preliminary remarks. Our country's coast – 2,700 kilometers long and composed of a diversity of habitats such as beaches, coral reefs, estuaries, bays, mangroves, marine flats etc. – is Mozambique's most precious resource. Fishing, agriculture, tourism and forestry make up for a large share of our GNP and contribute to the social and economic well-being of a significant percentage of the population. These resources, however, are also Mozambique's most vulnerable ones.

Well aware of the importance and of the fragility of the coastal environment, the Mozambique Government has placed the integrated coastal management at the top of its priorities. It is within this framework that we are currently setting up the National Programme for Coastal Management. This programme, based on inter-sectoral coordination, aims at establishing the groundwork for sustainable coastal development. This strategy will include different subjets such as: (i) fishing, (ii) coastal and marine ecosystem management, (iii) coastal preservation, (iv) marine parks and (v) tourism. A few initiatives have already been implemented while the remaining ones are currently being developed.

This strategy aims primarily at establishing a policy and at optimizing the use and management of our coastal resources so as to maximize the benefits and reduce damage to our coast. I believe that this concern is shared equally among all African countries present here today.

I would like now to share with you some considerations on the regional dimension of integrated coastal management.

If I were to be asked whether the Mozambican people have a clear understanding of the different phenomena which influence the coastal system, my answer would be, without a second of hesitation, "*No*". But I believe that the people from Mozambique are not unique in that respect; the answer would certainly be quite similar in your own countries. I hope therefore that this conference will succeed in making our people aware of the benefits brought about by an integrated coastal management.

There is an African proverb that says that "where the Creator strives for happiness, the Devil and sorrow will bloom...": Indeed, abundant natural resources do not necessarily bring prosperity. Furthermore, the present human suffering and the dismal economic situation with which we are faced today are detrimental to the wise management of our natural resources. Over-fishing and over-exploitation of the mangrove areas, coral destruction and of the interdependent ecosystems, coastal erosion etc. are but a few examples of the dangers facing our coasts.

A lot has been said already about coastal erosion and deforestation. But I would like to briefly remind you of the negative effects of deforestation, and particularly those of the deadly flashfloods which take a severe toll on human lives and properties and greatly contribute to soil erosion.

I would also like to make a few comments about pollution. We often think that it is the only threat to our environment. We also often believe that our region, to a large extent, is preserved. While it is true that some areas are quite resistant to pollution, this resistance, though, has its limits. When floods occur, the pesticides and herbicides used in agriculture can cause irreversible damage to coastal ecosystems.

Damage to coastal resources due to the lack of coastal management, the uncontrolled development of the tourist industry and negligence in the conservation of biodiversity are but a few of the many other challenges facing our coastal systems today. Furthermore we must be aware that these threats go beyond any country's borders. Consequently, establishing a coastal management policy at the regional level is of the utmost importance. Today's worldwide economy, combined with the fragility of most African countries' own economies, have made this cooperation an absolute necessity. And it is the only way that wise coastal management practices can co-exist with the maintenance of our populations' minimum standard of living.

I have no doubt that we all share the common ambition to come to terms with those problems. I hope, ladies and gentlemen, that the subject matters studied in the next few days will generate further discussions once this PACSICOM conference is over.

The African continent is in jeopardy. Its fauna and its ecosystems are threatened with extinction. It is our duty to make significant diplomatic efforts to facilitate the UN's work and help organize and execute the PACSICOM programme.

On a more optimistic note, I would like to point out that there is still hope for our continent, and that this hope lies in our coasts and seas. If we want to save Africa, it is crucial that our coasts be managed with care and wisdom.

This is true, of course, for countries with access to the sea. But it is also true for landlocked countries, for they depend just as much on the sea as the coastal countries do. Indeed, it is up to these inland countries to negotiate, push and encourage coastal countries to take coastal management into serious consideration.

But coastal and sea management and protection is also the developed countries' responsibility, for they are the ones who own and control the sophisticated equipment and satellites capable of detecting the ships cruising in our oceans. Our coasts, our seas are also *your* coasts and *your* seas: Where do you fish? In which seas do your supertankers navigate?

As many of you here today know, this PACSICOM conference is a first phase. Within the next six months, another conference will take place in Capetown. This conference will focus on Africa's difficulties and tardiness in implementing an integrated coastal management programme.

Implementing a programme requires three types of resources: technical resources, time – without sufficient time no programme could ever be implemented – and, finally, financial resources.

The third conference, which will take place in mid-1999 somewhere in Africa, will gather various banking and financial institutions as well as investors from the private sector, all wanting to participate in the establishment of a coastal management fund for the next five, ten or fifteen years. It is important to remember that in order for PACSICOM to become a reality, we must make great efforts to gather not only the financial and technical means but also, and most importantly, the *political* will.

What's at stake here today is our survival. This is true not only for us, Africans, but also for the non-Africans who utilize the resources from Africa just as we, Africans, utilize resources from Europe, America and Asia.

PACSCICOM will force us to think, to discuss, and possibly to argue over subjects. Yet it is imperative that we reach an agreement on African coastal and marine management. We must convince our politicians and our citizens. We must convince you, the possessors of the financial and technical means and know-how, to help us save Africa.

Many say that Africa is the cradle of humanity. Let us make sure that it doesn't become its grave.

Maurizio Iaccarino

Assistant Director-General for Natural Sciences, UNESCO

Honourable Ministers, Distinguished Delegates, Ladies and Gentlemen,

Let me first of all say how happy I am to be here in Maputo, the heart of Mozambique, with its serene and beautiful surroundings. Before saying anything on the topic of the Conference, it is my pleasant duty to welcome and thank you all on behalf of the Director-General of UNESCO, Mr. Federico Mayor, for, having come from all parts of Africa to this important meeting. Your presence here, distinguished delegates, bears ample testimony to the importance which your Governments attach to this Pan-African Conference on Sustainable Integrated Coastal Management and, beyond this, to the international cooperation in the framework provided by UNESCO and its sister organizations in the UN System.

The origin of the idea of PACSICOM is actually rooted in the initiative taken by the Member States of Africa starting with a series of national efforts which culminated in 1989 with the adoption of the United Nations New Agenda for the Development of Africa (UN-NADAF). This was followed by the historic Treaty on the African Economic Community (AEC) adopted by the heads of Governments at the Intergovernmental Conference held in Abuja in Nigeria in 1991. The Abuja Treaty was a turning point in the history of the continent towards "self development" in all spheres of human activities. The treaty, while adopting a comprehensive programme of action, stresses, among other things, the need to undertake, and I quote, "the necessary measures to accelerate the reforms and innovative process leading to ecologically rational and economically sound and socially acceptable development policies and programmes", at the national, regional and continental levels. To put it in another way, integration of the environment into all development processes was upheld from the very beginning in the Abuja Treaty in order to achieve sustainable economic development, as well as social goals.

UNESCO, as you are aware, is responsible for development of human resources and capacity building in the field of education, science, culture and communication. The commitment of UNESCO to the development of Africa is best reflected in the statement of our Director-General Mr. Federico Mayor at the high level segment of ECOSOC held in 1995 in Geneva in his role as Chair of the working group on Social and Human Development and through his active participation in other working groups. Within the context of the coastal and marine regime, the mandatory functions of UNESCO have evolved over the years to keep pace with contemporary developments. As a consequence, UNESCO houses several intergovernmental programmes, such as the Intergovernmental Oceanographic Commission, the International Coordination Council of the Man and Biosphere Programme, the International Geological Correlation Programme, the International Hydrological Programme and the International Council for the Programme on Management of Social Transformations. The UNESCO Sectors of Culture, Communication and Education have played key roles in all these areas. It was at the initiative of the African Member States that the General Conference of UNESCO recently committed the Organization to draw-up a comprehensive strategy for the sustainable development of the coastal environment, in particular by convening the Pan-African Conference on Sustainable Integrated Coastal Management.

The theme of integrated coastal zone management was chosen because it is of widespread importance and hence a conference dealing with this matter was long overdue. As you certainly are aware, of the total 53 states of Africa, no less than 38 are maritime nations, whose economy is linked to coastal and marine resources and the environment. In fact, of the total population of 750 millions recorded in 1995 for the whole of Africa, about 570 million inhabit the coastal and island states. This represents about 77% of the total population. Many of the capital cities and urbanized centres are located in the coastal areas; moreover, migration towards the coast is an active process. This is driven by population density leading to soil exhaustion. Under- and unemployment are major factors affecting the decisions of Africans to emigrate within and across national frontiers in search of a livelihood.

The tendency for populations to concentrate in coastal areas places increasing demands for space and, as a consequence, results in pressure on the scarce and fragile resources of the coastal regions. The total population in coastal urban centers, which excludes the majority of the population still living in coastal rural areas, account for more than 110 million; this figure will increase in the future since the projected population for the whole of Africa for 2025 is estimated to become over 1.5 billion.

Let me now say a word about integrated coastal zone management.

The coastal zones, as we all know, are an important national asset of great economic value to a country. Unlike the terrestrial systems, the coastal zones represent a highly dynamic environment, and are often endowed with some of the most important resources having great marginal benefits, such as beaches suitable for recreation, marine parks, and a variety of natural resources that are fragile and sensitive. For example, the beautiful coral reefs living in pristine environment are economically important from the viewpoint of both fisheries and the tourist industry. This is true also for the coastal vegetation, which acts as a defense against the forces of the sea, where it is in dynamic equilibrium with the constantly interacting physical forces. Further, what happens in the hinterland as a result of increasing human activities encompassing agriculture, deforestation, industrial and domestic operations, is bound to affect the coastal areas and their valuable environment.

There are yet other aspects that we need to consider, and these include the cultural dimensions of integrated coastal zone development and the preservation of social values involved with the great ethnic diversity in Africa along with the question of maintaining continuity within change. Though poverty and the necessity of life within a subsistence economy is a major cause of environmental degradation in Africa, we must keep in mind that economic criteria alone cannot provide any guarantee for human dignity and values. Thus, there is obviously the need for balance in the use of the coastal environment and its resources on one hand, and respect for the closely interwoven social, economic, and cultural aspects on the other. Finally, there is also the question of facing the task of ensuring the rights of future generations with equity and justice. It is our ethical duty that the unborn should not be deprived of the Earth’s resources.

It is therefore necessary that all development programmes adopt a holistic approach in order to achieve sustainable development. We are now learning about the new trends and are trying to balance the multifaceted aspects of complex coastal issues involving the interests of many sectors. One thing is becoming crystal clear from experiments undertaken in the developed world: it is that the traditional sectoral and fragmentary approach is no longer considered valid today. A new paradigm is emerging to reconcile different interests. In my view the greatest challenge facing this conference, is how to propose a formula that would allow a balanced use of the coastal zones, and at the some time minimize conflicts amongst the stakeholders.

Distinguished Delegates, I am not going to indulge myself in the question of environmental, cultural, social and economic connections, and how they are irretrievably linked to each other. I have no doubt that our distinguished participants will define these links in a very candid manner and in a way that is most appropriate for Africa. One thing, however, I wish to dwell upon, since it concerns what I call the fundamental problem facing most developing countries today and

African states in particular. I refer to the importance of information in all domains of national policy. We cannot have sustainable development unless all concerned people are fully involved. This is related to what we already know about “policy”. Policies, whether relating to the environment, industry, or resources, are developed and followed by governments in response to a set of perceived problems. Implementation is actually the process of transferring policy decisions into action. Management, however, is the actual control exerted over people, activities and resources. The main cause of policy failures that we see in many developing countries is due to information failure. The strength of a policy to my mind lies in the availability of accurate, authentic and valid scientific and socio-economic information and data about the issues that are under consideration.

For development to be sustainable there is an immediate need to enhance capacity building in all areas relevant to sustainable integrated coastal zone management. “Capacity Building” is a catchword used to help describe requirements for executing projected activities. It encompasses three important components:

(i) human resources development;
(ii) institutional infrastructure and
(iii) policy instruments.

Policy instruments should be developed at the highest governmental level in response to a set of perceived objectives to guide all operations toward achievement of the stated goal. However, if we remove human resources development and infrastructure from the context of “capacity building”, then the whole fabric of national planning is bound to collapse sooner or later. Environmental considerations are also important since, as observed in many OECD Member Countries, in order that integrated coastal zone management can be realised, interdisciplinary information is fundamental. This includes information required for identification of problems and possible solutions.

Improving scientific understanding of the interactions between natural systems and coastal processes is essential for conservation and for ameliorating effects. Inadequate information and scientific understanding can result in serious environmental degradation. Ecological data will be needed in making decisions concerning resource allocation, including baseline information and data about the coastal processes, the nature of the resources and the size and physical limits of those resources. Information is also needed to solve disputes amongst the stakeholders. Ecological and interdisciplinary scientific research needs to be oriented towards new findings about the economic and judicial use of resources. This will include identification and estimation of the economic potential of resources, as well as formulation of management priorities for developing strategies.

Let me now say how UNESCO has organized its activities to address coastal issues in all its many dimensions through its various programmes.

UNESCO has developed during the World Decade for Cultural Development and within its programme on Coastal Zones and Small Islands, methods and tools for integrating cultural considerations in development planning and coastal management. One important aspect of interest to coastal states of Africa is “tourism” which, in the coming century is going to be among the most important of leisure activities and a source of revenues to many coastal and island states. But there are many issues associated with this form of development, especially inappropriate development and social disruption. If required, UNESCO will be ready to put this knowledge at the disposal of all Member States and institutions wishing to ensure that development efforts create conditions for sustainable development rooted in the realities and aspirations of the people.

Within the Sector of Social and Human Sciences, and through its MOST programme, UNESCO has been involved in many activities, including multiculturalism, urban development, poverty eradication and youth-centred planning. UNESCO also established a Chair on “Man and Environment” as part of the UNITWIN-Southern African network at the Eduardo Mondlane University in Maputo and another one on “Forced Migration” at Moi University, Eldoref, in Kenya. As part of this programme three additional chairs are now being considered for other parts of Africa, two on Inter-cultural Sciences at Legon University in Ghana and at the Université d'Abidjan in Côte d'Ivoire and a third on Transport and Development at the University of Dakar, in Senegal. A further Chair in marine sciences is also planned for the Eduardo Mondlane University in Maputo under the sponsorship of the Intergovernmental Oceanographic Commission of UNESCO.

In the Education Sector, UNESCO has been requested to help developing countries with modern curricula in "environmental education " as well as in marine sciences at the school and higher levels. The Communication Sector has been involved in developing curricula and training programmes in communication media that can be launched in addition to the production and dissemination of media programmes as part of integrated coastal management.

The coastal and island states of Africa are actively involved in the intergovernmental and international programmes in the Science Sector of UNESCO including those on coastal oceanography, geology, water resources and Man and Biosphere. The programmes of the Intergovernmental Oceanographic Commission are based on priority needs of coastal states and are executed through its regional committees (IOCINCWIO and IOCEA) in the East Africa and West African Sub-regions.

Apart from establishment of a regional information network in the East African Sub-region, RECOSCIX, with the support of Belgium and SAREC of Sweden, the Intergovernmental Oceanographic Commission has long been involved in training and educational activities. Of interest to coastal states are the programmes on the monitoring of marine pollution, on marine sciences, observations for integrated coastal area management, ocean science in relation to living and non-living resources, the Global Ocean Observing System (GOOS) and oceanographic information and data exchange. The Unit on Coastal Zones and Small Islands is involved in several pilot projects in Africa.

The International Geological Correlation Programme is executing 8 projects in coastal States in Africa. The International Hydrological Programme carries out activities on river flow regimes as part of the FRIENDS programme, the hydrology of the Humid Tropics Programme in Western and Eastern Africa, together with the Wadi Hydrology Programme in North Africa. Regional post-graduate courses in hydrology have recently been held in Burkina Faso, Dar-es-Salaam and Cairo. The African Association of Hydrologists based in Benin, has been established.

The Man and Biosphere Programme established 39 Biosphere Reserves in 19 coastal states of Africa. In addition, 7 projects are being implemented with the support of donor countries, such as Germany, Norway and the Netherlands in different countries in Africa.

I know that many governments have already embarked on coastal area planning and have promulgated regulatory acts and measures to deal with environmental issues. This indeed is very encouraging. You will agree with me that all the above-mentioned programmes and activities undertaken by UNESCO are fundamentally important in order to lay the foundation for production of accurate information and data relating to the problems of integrated coastal zone management. These actions are undertaken both on land and sea, thereby assisting the national decision-making process in choosing amongst available resources, as well as in addressing various aspects of coastal problems and issues. The programmes also assist in reformulation and harmonization of policies, legislation and other related matters for sustainable development of coastal Africa in the letter and spirit of the Ajuba Treaty.

Role of UNESCO sectors and IOC in strengthening capacity support of integrated coastal management in Africa

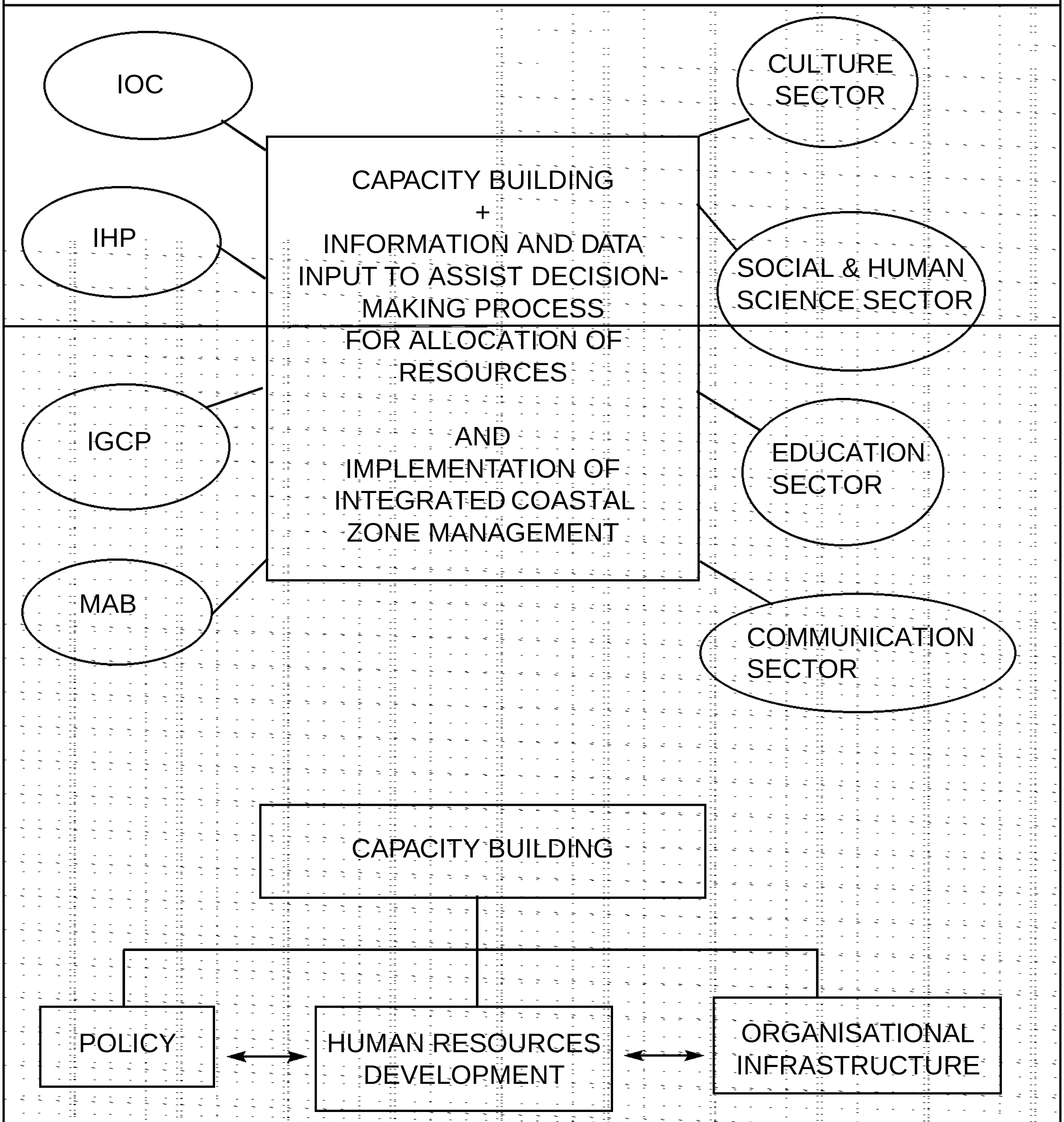

FIG. COMPONENTS OF CAPACITY BUILDING

H. E. Mr. Andiba Toivo Ya Toivo

Minister of Mines and Energy, Republic of Namibia

Honourable Minister, Distinguished representatives of the United Nations Educational, Scientific and Cultural Organization, Dear Delegates, Ladies and Gentlemen:

It is a great honour for me to have been invited to address you on issues related to sustainable integrated coastal management and the input that geological sciences can make in sustainable development and environmental protection. The earth sciences are key ingredients in such sustainable development and environmental protection, and must be an integral part of any planning.

Geological conditions influence to a great degree every aspect of the environment on the surface of the earth, including the oceans, land degradation,desertification, natural background levels of elements and the transportation and transformation of pollutants in the ground are only a few examples. In the light of sustainable development, knowledge from the earth sciences must therefore be integrated into all technological planning to avoid environmental and economic disasters. In particular in the use of natural resources, new and improved technologies with reduced negative environmental impacts are required. The increasing world population, coupled with the ever-growing demand for better quality of life for all people, put an enormous strain on our limited resources. There must be a vast development of the Earth's resources of all types, if there are to be hope and prospects for future generations. On the other hand, development that cannot be sustained in the long run, such as the uncontrolled use of finite resources, cannot be tolerated. Sustainable development and environmental protection for our sphere of life, which is so far limited to this planet, has therefore become an absolute must.

Life on Earth has existed for millions of years, and, although natural catastrophes occurred frequently throughout Earth's history, life never became totally extinct. Those species that survived, adapted to the fluctuations in the ecosystem and advanced. This includes our own species *Homo Sapiens.* Nevertheless, the changes that have occurred in the last 100 years, and which are set to continue well into the next millennium, have never before been faced by human society on such a large scale. We have developed numerous systems to support human life on Earth; however, many of them are not sustainable, and some even have the potential to destroy ourselves and others. In the geological past, changes in ecosystems were dominated by the Earth's own dynamics. Today such changes are brought about and dominated by human activity, with all its positive and negative impacts. It is therefore clear that never before in human history has the wise use of resources, such as land, energy, water, soils and minerals, been so important at the centre of planning processes. We must also learn to reduce, use and manage our waste products more carefully.

The oceans and the coastal zone play a prominent role in the development of nations and national economies and have a growing importance for the future survival of mankind. While the historic importance is in the linking of different cultures using the oceans as a means of transport and trade, the future importance lies in the sustainable harvesting of the rich marine resources. As a consequence, a large proportion of the world's population already lives in coastal areas, thereby creating a strain on coastal ecosystems. All this has been recognized by the fact that the United Nations declared 1998 the "International Year of the Ocean" and it is also reflected in the theme of the world exposition in Lisbon, Portugal, which is "The Oceans: Our Heritage for the Future".

Let me now come to Namibia. Namibia's economy rests on four pillars, namely mining, fisheries, tourism and agriculture. These four sectors, as you can imagine, do not always co-exist happily, but are in competition. To complicate matters further, Namibia has a fragile ecology, derived from her extremely arid climatic condition, and this makes each and every participant in the ecosystem compete for resources. The Namibian coastal zone, which straddles the South Atlantic Ocean for almost 1,500 kilometers, is entirely made up of the Namib Desert. Nevertheless, it is home to many people and to a number of economic activities. On land, we have, from north to south, the towns of Swakopmund, Walvis Bay, Lüderitz and Oranjemund. Swakopmund is one of the centres of tourism, while Walvis Bay is our major port and the centre of the fishing industry. Lüderitz plays a role as a harbour and for the fishing industry, it is also the centre of the Namibian lobster industry. Lüderitz furthermore is significant for the marine diamond industry. Oranjemund is the big centre of the Namibian diamond industry. Large parts of the entire coastal area are used for diamond mining and salt production. Deposits of other minerals are known, but are currently not exploited or only exploited on a small scale. Walvis Bay, located in the central part of the coast and strategically well linked to the interior, is a major centre for growth and development of industry, which has been recognized by the Namibian Government when an export-processing zone was proclaimed here. However, the coastal area with its untold natural beauty derived from the incredible contrast of a landscape, where a desert meets the sea, is also a major attraction for the tourist industry and local recreation alike. The Atlantic Ocean off the Namibian coast hosts the richest diamond deposits identified on the seabed so far. It is also host to one of the richest fishing grounds in the world, based on the nutrient-rich Benguela Current. The offshore geology is promising as far as the potential for hydrocarbon exploration is concerned, and a rich gas field, the Kudu field, has been discovered.

The marine diamond operations which take place in Namibian waters are unique, and methods employed are currently not applied anywhere else in the world to such an extent as in Namibia. As early as during the German colonial period, the potential for diamonds on the sea floor was recognized. Mining rights were then given to a colonial company, but due to the technical difficulties, nobody even attempted to recover any stones from below the sea. In 1961, mining of shallow marine deposits was initiated. A fleet of four barges and support craft worked for several years, before the aging fleet was replaced by a more modern mining barge and a sampling vessel. Nevertheless, mining efforts ceased in 1971, due to the depletion of reserves. Mining interests thereafter concentrated on the deeper waters. Between 1970 and 1983 marine exploration and prospecting established a low-grade but large diamond deposit on the continental shelf off Namibia. Since the water depths, in which this deposit was found, were much greater than was hitherto experienced, the techniques used in the shallow water were totally inappropriate and new methods and equipment had to be developed. This was pioneered by the company of Debeers Marine, who began producing significant quantities of diamonds from the deeper water deposits at about 1991.

Today, offshore mining is carried out by a number of companies, with Debeers Marine still playing a very significant role. Let me therefore explain their operations as an example. Debeers Marine carries out a deep water exploration programme, which aims at understanding the geology of seabed deposits. The technical information is collected by means of side-scan sonar, seismics, coring and grab sampling. A vessel has been especially equipped for that purpose. Maps of the seabed are produced and analyzed to select areas for sampling, which is conducted by another vessel. This vessel takes precisely located samples, using two airlift drill devices, on a very wide grid. Established areas of interest are then followed up with more detailed mapping and sampling. Samples are processed aboard the vessel, concentrated, and sent to a geological laboratory. Vessel positions are accurately recorded using a global positioning system. The collected data are processed, analyzed and evaluated to establish estimates of ore reserves in order to produce geological maps upon which mining operations can be planned. Subsequently, two mining methods are employed for the production stage, namely the horizontal and vertical techniques. The horizontal technique involves a seabed crawler operated from a vessel. It achieves precise coverage of the area to be mined and utilizes an airlift suction box as the mining tool. The crawler unit is powered by an umbilical cable and delivers diamond-bearing gravel to the vessel through flexible hoses. The vertical technique uses a large diameter drill head mounted on a steel pipe drill string, which recovers diamonds from the seabed in a systematic pattern over a mining block. Material loosened by the drill head is lifted to the surface via a steel pipe onto the vessel. Each vessel is equipped with a conventional diamond treatment and recovery plant. A final concentrate is automatically sealed and flown for final hand-sorting to a sorthouse on shore. Currently, some 30% of the total Namibian diamond production is derived from marine operations, a figure which is definitely going to increase in the future.

As explained before, diamond mining, although of extreme importance to the Namibian economy, is not at all the only economic activity that takes place in the coastal zone. Since we are talking about sustainable development and management, the sectors of fishing and tourism become important, since mining – by definition – is not sustainable in the sustainable development, even if it is strategically used to kick-start other developments. Geological sciences are therefore required in our development strategies to assure first of all the reasonable exploitation of marine and coastal mineral deposits so that the maximum life of a mine is assured without any overmining taking place. A maximum benefit from the exploitation of mineral resources is thereby assured for all stakeholders, including the state and its receiver of revenue. Geological sciences are also required to create a sustainable co-existence of sectors, such as for example Namibia's marine diamond industry and Namibia's fishing industry. While these two sectors do not compete for the same resource, the area of activity is the same and the respective activities the resources which the competitors exploit. Only an integrated management approach can be used to find a solution in such a situation. Last, but not least, geological sciences are indispensable for minimizing the environmental impacts of our economic activities and are instrumental for developing remedies for damages that have already occurred or are unavoidable. UNESCO has realized this important role of geological sciences and therefore has organized this workshop. I hope that my deliberations, including the unique example of marine diamond mining from my own country Namibia, have been stimulating and set.

JOINT REPORT OF THE TECHNICAL WORKSHOPS

1. INTRODUCTION

1. The first segment of the Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM) was a set of four workshops, held from 18 to 20 July. All of the workshops addressed the master theme of Sustainable Integrated Coastal Management (SICOM). Specially, the workshops dealt with the following subthemes:

- *Subtheme 1:* Data for SICOM and Global Ocean Observing System for SICOM in Africa (GOOS Africa) (Workshop 1)
- *Subtheme 2*: Water Resources and SICOM and Enhancement of SICOM in Africa through Management of Drainage Basin Hydrology (Workshop 2)
- *Subtheme 3:* Capacity Building for SICOM: Communication, Education and Public Awareness:
  - Capacity Building for SICOM in Africa: National and Regional Capacities (Workshop 3)
  - Capacity Building for SICOM: The Role of Education and Communication for SICOM (Workshop 3)
  - Policy and Planning for Integrated Coastal Area Management (FAO, with Workshop 3)
- *Subtheme 4:* Earth Resources and SICOM: Geological Background for SICOM (Workshop 4)

2. Following is a joint report of the four workshops. It was produced by first combining the separate reports of the individual workshops. The resulting document was then tabled for discussion at a joint session of all workshops to produce this report. It is intended for consideration by the Cross-Cutting Workshop as a working document for the second segment of PACSICOM, the Ministerial Conference.

2. SUBTHEME 1: DATA FOR SICOM

Global Ocean Observing System for SICOM in Africa (GOOS-AFRICA)

A. Introduction

3. The sustainable management of the marine environment in coastal seas everywhere requires information based on data obtained by national operational oceanographic and marine meteorological observing systems. The demand for this information has increased recently because of the increase in national jurisdiction over resources in Exclusive Economic Zones, and because of the pressures placed on coastal seas by growing populations and increased pollution from land. This is particularly important to Africa, bounded as it is by the Atlantic and Indian Oceans and the Mediterranean and Red Seas.

B. The Global Ocean Observing System (GOOS)

4. GOOS was called for by Agenda 21 to aid in sustainable management of seas and oceans. It provides a unified global network to systematically acquire, integrate and distribute ocean observations, and to generate analyses, forecasts and other useful products designed for the benefit of a wide user community. It is analogous to the World Weather Watch that underpins all weather forecasts, in relying on cooperation between neighboring countries in the collection and exchange of pertinent data. The Tropical Atmosphere Ocean array of buoys in the equatorial Pacific, which is used to collect the data underpinning forecasts of El Niño events, is an example of an operational ocean observing system that is part of GOOS. GOOS facilitates: data collection; data and information management; data analysis, preparation and dissemination of products; numerical modeling

and forecasting; and the training, technical assistance and technology transfer needed to build the capacity of all countries to both contribute to and benefit from GOOS. Benefits include improvements in: (i) warnings of storms, high waves, and surges; (ii) management of ports and harbors; (iii) offshore design and operations; (iv) ship routing; (v) safety and health in marine recreation; (vi) detection of poor water quality; (vii) managing fisheries and mariculture; (viii) warnings of droughts and floods; and (ix) preparedness for disease outbreaks. Each of these will contribute to effective and sustainable management in the coastal zone.

5. The operational oceanographic and marine meteorological measurements made in GOOS should be systematic, routine, sustained for the long term, relevant to users'needs, high quality, cost-effective, and available in a timely manner. They are designed so as to provide: (i) accurate descriptions of the present state of the sea and its contents, including contaminants and living resources; (ii) continuous forecasts of the future condition of the sea and its contents for as far ahead as possible; and (iii) long term data sets showing trends and changes including the effect of the ocean on climate and of climate change on coastal seas.

C. Information needs in Africa

6. For African countries to contribute to and benefit from GOOS requires developing national knowledge, understanding and prediction. Knowledge comes from observing oceanographic and marine meteorological phenomena, and implies the need for data acquisition systems. Understanding comes from studying the processes that cause these phenomena, and implies the existence of a skilled workforce. Prediction comes about by using knowledge and understanding to forecast outcomes, and implies access to appropriate computing and communication facilities and an appropriate skills base.

7. The ocean knows no political boundaries. Single ocean current ecosystems, like those of the Benguela Current of South Africa, Namibia and Angola, crosses several borders. Recognizing the temporal and spatial scale of these connections leads to the recognition that regional programmes and networks of data collection and exchange are required; the whole is greater than the sum of its parts.

There is also a land connection. Runoff from major rivers carries excess nutrients from farms in the hinterland, disturbing coastal ecosystems.

D. Recommendations

8. For GOOS to meet coastal needs in Africa requires as a first step organizing national GOOS coordinating committees to improve the effectiveness of the national institutional infrastructure in support of operational oceanography and marine meteorology. The national committees would be expected to:

i) Determine user needs and specify the data and products required to satisfy those needs;
ii) Identify and work to improve existing national capabilities, including human skills and available technology;
iii) Identify gaps in those capabilities, including inadequacies in present observing and data management systems, and work to correct them, focussing (a) on training and practical assistance related to meeting users' needs in the coastal zone, and (b) on formulating plans to fill gaps;
iv) Pay special attention to exploiting the opportunities offered by the increasing number and variety of observations of the coastal zone from space satellites;
v) Promote communication between marine scientists and coastal managers through the development of national, regional and global electronic networking;
vi) Promote the design and implementation of regionally coordinated strategies for data acquisition, integration, synthesis and dissemination of products to improve coastal zone assessment, and the forecasting and prediction of environmental change;

vii) Develop regional pilot projects to demonstrate the usefulness of the GOOS system in the coastal zones of Africa, and encourage African participation in ongoing GOOS pilot projects;
viii) Evaluate costs and benefits as the basis for persuading governments, donor agencies and the private sector to support a data acquisition programme and associated capacity building;

9. The second urgent step requires investment in the following top priority activities to support sustainable integrated coastal management:

i) To form an Africa-wide network of National Ocean Data Centres that are properly equipped and staffed by trained personnel, whose first responsibility will be to resave in digital form the presently widely scattered and more or less unavailable observational data on African coastal seas, so as to provide a sound information base for local and regional coastal planning;
ii) To upgrade and expand the present African network of sea level stations for the measurement of tides and changing sea levels, and to train the technical professionals manning those stations in the analysis and interpretation of the data, so as to enable the production of advice for decision makers on potentially hazardous and costly changes in the local marine environment such as sea level rise;
iii) To encourage the formation of a network of specialists trained in the use of remotely sensed ocean data from space satellites, and to ensure increased access to regional satellite receiving stations in Africa, so as to ensure that coastal managers have ready access to the rapidly increasing wealth of spatial data on the coastal environment;
iv) To facilitate the further implementation of modern electronic communication systems such as Internet connections and data transfer mechanisms, so as to promote effective communication and to make data and information more readily available for planning.

3. Subtheme 2: Water resources and SICOM

Enhancement of SICOM in Africa through Management of Drainage Basin Hydrology

A. Introduction

10. There are important functional relationships between river basins and coastal areas and one may influence the other. They are linked through natural processes (water flow, sediment transport, energy) and human activities (urban development, rural activities, technical infrastructures, waste and pollution). At a macro-level, all coastal areas can be considered from a physical geographic point of view as parts of large river basins, as eventually most rivers end at the sea. At a meso-scale (region), some river basins may be considered as linked with their coastal areas. At a micro-scale (local), there are a variety of situations where a coastal area may be directly or indirectly related to its river basin, particularly in relation to river estuary, river delta, wetland and coastal waters.

11. The workshop participants considered rivers and coasts as dynamic systems consisting of interacting and overlapping natural and human ecosystems and require rational management in a strategy to enhance sustainable integrated coastal management (SICOM) in Africa. For the rationale and benefits of linking the management of river basins to the management of coastal areas, the following issues emerged from the discussion:

B. Problem analysis

12. The basic processes, which are important from a river basin management perspective, are water flow and transport of sediment as well as energy potential from water flow in some cases. In coastal areas, the basic processes deal with coastline dynamics (erosion and accretion), seawater pollution, seawater intrusion in coastal aquifers, urbanization of the coast as a result of the concentration of population and economic activities in the coastal zone.

13. These processes are common and/or interacting, suggesting that river basin management concerns should be part of coastal management

issues and vice versa. In this context, the following problems and constraints were brought forward.

i) Deterioration of natural resources: Continued erosion and nutrient depletion as well as excessive water mining, overgrazing, logging of forests, the conversion of wetland and pastures into agricultural land, in relation to natural constraints such as droughts, flash floods etc.

ii) Political and institutional constraints on development: Lack and weakness of cross-sectoral and integrated approaches at the conceptual and policy level, especially at the implementation stage (inadequate political priority is given to water as a unifying and vital resource, discontinuities in policy and policy implementation), conflicts over the use of marine resources and the loss of areas of high ecological value, pollution of the sea and conflicts over the use of coastal land.

iii) Technical constraints: Lack of adequate data, poor pollution control, inappropriate technologies for local African conditions etc.

C. Needs and solutions

14. River basin management focuses essentially on resource management plans, in most cases strongly water resource-related. They include: the effciency of water use through water demand management, land-use and agricultural practices, re-use of wastewater, reduction of pollution, rehabilitation of polluted areas, erosion control through reforestation, finding alternatives for fuelwood through fuelwood farming, restoration of vegetation cover etc.

15. Coastal zone management relies on integrated coastal area management plans focussing on land-use and other land development controls, infrastructure development, marine resource management, environmental protection measures including wetland and dune conservation etc.

16. To address the above issues in an integrated way, it is essential to develop appropriate policies, strategies and actions to tackle primarily political, institutional and technical constraints. This should include the regulatory measures, mechanisms for institutional coordination at local, national and sub-regional level and across sectors providing also for awareness building and incorporating local knowledge.

17. There is an important task for research and technology to come to a better understanding of the processes involved in changes due to human interference with natural systems. Baseline and monitoring information, is the basis of any sound decision-making process. Major efforts are required to design and to set up adequate monitoring networks that supply efficient management information based on the requirements of decision support models. The technical solutions have clear capacity-building implications. They require research capacity and institutions that deliver the related goods and services .

D. Recommendations

18. The workshop made the following recommendations:

i) Both river basin management and coastal area management should be closely integrated, as appropriate. At the planning level, proper coordination and linkages should be established between water resource plans and land-use/urban development plans, natural resource management, environmental protection etc;

ii) Appropriate legal and regulatory framework and appropriate institutional structure should be developed at the local, national and sub-regional levels;

iii) Policies and demand management should be enhanced, based on principles that water be treated as an economic and social good (or scarce resource) respecting the user-polluter-payer principle while meeting economic growth, environmental and equity concerns;

iv) A participatory and consultative approach that involves all actors and interests (women, communities, NGOs, the public and private sectors) should be adopted;

v) Economic growth, food security and poverty reduction should be priority concerns in river basin and coastal area management;

vi) Management of international water (through local and national actions and regional cooperation), including their protection and development, and streamlining, strengthening and/or merging of international river basin organizations should be encouraged;

vii) Set up pilot projects to gain experience and for demonstration. Project formulation should take in account:
- problems already occuring or foreseen in the near future;
- all relevant aspects such as hydrology, socio-economics, land-use, urban planning, environmental aspects, legislation and its administration, monitoring and enforcement (permits and fines), education and training and communities'participation;

viii) Pilot projects should be seen as a platform to provide technical training to professionals and technicians;

ix) In order to improve policy decisions and create a wider knowledge base through education and research, a new intensive relationship between policy making and the scientific community should be established and strengthened. Regional cooperation and networking between universities, research centres, governments and other partners should be encouraged.

E. Priority and action plan

19. The Workshop identified the following as priority areas for action:

i) At national level: Review institutional policies to reflect the need to integrate coastal management and river basin management, and develop appropriate action programmes.

ii) At the sub-regional level: create a Centre for Humid Tropics Hydrology and Water Management whose tasks would be to enhance the implementation of multi-disciplinary water resources management strategies in the region and develop an appropriate mechanism and tools for enhancing the integration of efforts between scientists and policy makers, and cooperation with the other Centres for Humid Tropics Hydrology.

iii) A series of pilot projects should be launched in the region to test in practice the concepts of integration of both river basin and coastal area management. Possible authorities are:
- coastal biodiversity areas
- polluted rivers
- areas of coastal erosion
- coastal areas threatened by drought and desertification.

4. Subtheme 3: Capacity building for SICOM

3.1. National and regional capacities

A. Introduction

20. Workshop participants generally agreed that Sustainable Integrated Coastal Management (SICOM) is a relatively new and desirable concept in the African setting. Traditional development plans and efforts based on the sectoral and fragmented approach have failed to resolve resource use conflicts and address issues of degradation, capacity building and sustainable development.

21. Coastal area management, which is a multidisciplinary process, should not be a substitute for marine science which is fundamental to the provision of a reliable data base for sustainable utilization of coastal resources. It is the responsibility of governments to foster sustainable coastal management and ensure a conducive and stable environment crucial to the success of the process.

B. Indentification of problems

The Workshop identified the following problems:

22. Twenty-five years of exposure to lessons and experiences in the developed countries have not produced significant impact on the developmental processes of the relatively less developed coastal areas of Africa. Pitfalls have not been avoided. SICOM implementation is beset with the following problems:

i) Lack of coordination in planning and management at district, national, subregional and regional levels;

ii) Absence of institutional framework;

iii) Lack of awareness in both public and private sectors;
iv) Inadequacy of infrastructure;
vi) Inadequacy of human resource base;
vii) Inadequacy of mechanisms for sustainable financing.

C. Recommendations

23. The Workshop made the following recommendations:

a) General aspects

i) Integration of coastal management into national development plans or as well as national environmental plans;
ii) Alleviation of poverty which is a major cause of degradation of coastal resources and a constraint to sustainable coastal management.

b) National capacity building

i) Creating an institutional framework for effective cross-sectoral collaboration and integrated coastal zone management;
ii) Training and education in marine sciences and coastal zone management;
iii) Institution of policies for attracting and retaining human resources and more efficient use of developed expertise;
iv) Involvement of local communities at all levels in the development of the coastal management process;
v) Use of modern technology to enhance communication, exchange of information, networking and data base development;
vi) Greater involvement of private sector;
vii) Harmonization of national legislations relevant to the coastal zone.

c) Regional capacity building

i) Need for sub-regional model projects and centres of excellence. Building of sub-regional technical teams as part of technology transfer. Initiatives towards regional technology development;
ii) Sub-regional programmes should be encouraged, shared development;
iii) Contribution of sub-regional and regional bodies as well as institutions must be enhanced.

d) Funding

i) Development of national and sub-regional sustainable funding mechanisms;
ii) Increased funding from international and bilateral organizations;
iii) Avoidance of duplication of international and bilateral initiatives.

D. Follow-up

24. The Workshop suggested the ensuing follow-up actions:

i) Development of sub-regional pilot projects that can serve as a learning mechanism and catalyst for Member States, training and exchange of experience;
ii) Establishment of national focal points and networking at the sub-regional level;
iii) Encourage the development of a formal university course in advanced marine and coastal zone management for professionals to enhance understanding among them;
iv) Initiate action to identify and upgrade potential centres of excellence in Africa.

3.2. The role of education and communication

A. Situation

25. The working group on capacity-building for SICOM: The Role of Communication and Education, after deliberations, identified various factors and concerns, based on the view that the global ecosystem comprises the atmosphere, lithosphere, hydrosphere and biosphere which are inseparable components and interact with social, economic, cultural and gender factors.

26. A summary of the proceedings is presented below as a representation of the emerging issues.

27. The different elements of SICOM need to be defined in a way agreed upon by all.

1. Integrated coastal management

28. The primary goal is the preservation of physical features of coasts and the conservation of biodiversity, using local knowledge, for the benefit and well-being of coastal inhabitants. Local communities have been found to be central to "best practices" for coastal management. Existing

experiences clearly indicate that a multidisciplinary approach is necessary for improving communication and management of SICOM programmes and activities.

29. Elements that have proved to be successful in integrated coastal management have been: participation of stakeholders in the identification of issues and strategy development, the use of sustainable approach (like those involving local communities in the coastal management) and a management committee that is multi-institutional.

30. A major concern raised by the Working Group was the need to sensitize governmental institutions to facilitate the development of a National Policy on Coastal Management and the establishment of a coordinating institution for this effort.

2. Education

A common thrust in all the contributions on education was the identification of the participatory approach in formal and non-formal education. The examples shared in the forum clearly illustrated the utility of “learning by doing” and the effectiveness of first-hand experience in educational efforts.

Surveys have shown that environmental education in most African States needs to be reinforced and made to include issues and solutions about coastal zones. Environmental education efforts have been hampered by lack of resources, weakness in the training of teachers (who find it difficult to adopt the required multidisciplinary perspective to environmental education because they are specialized in particular subjects), the absence of relevant texts, and the lack of government commitment and funding.

3. Communication

33. The need to incorporate and include acceptable principles of effective communication was emphasized. Communication was defined as being two-way and not a linear top-down process. The centrality of the audience in terms of needs assessment and audience analysis and the key concern of participation from the starting point were key elements of focus in all the presentations on communication. It was proposed that the role of media as a public service function should be highlighted.

34. Much data about coastal zones are obtained sectorally by separate specialists from different institutions or authorities. Similarly, planning and decision-making, now generally sectoral, need to become integral.

35. Gender, as a concept, should be considered as a variable of analysis in the Information and Communication strategy. It was noted that the social construction of roles as male and female has had implications on the ownership, control and use of resources including the resource of information. Issues such as access to information, relevance of information, and the fluality of information are crucial in the study and the development of an information and communication structure in the context of policy and decision-making.

B. Recommendations

1. Higher education

36. Recognizing that useful programmes on coastal management exist in nearly every African country that has a coastal zone, it seems useful that this information be assembled and widely shared.

37. Recognizing that there is a need for greater awareness of environmental issues and the integrated management of coastal zones on the part of the general public, including decision-makers and professionals, and that this must include understanding the environmental and the human sciences.

38. Recognizing that these problems of coastal management and environmental issues are complex, inter-related and changing, and that successful programmes already exist at several African universities which can provide models for curriculum and programme development at under- and graduate levels as well as in-service training, we identify the following priorities:

a) conduct an inventory of relevant experience and expertise, both human and institutional, making full use of existing compilations of information;
b) develop training and research programmes in the following areas:
    i) training of trainers;
    ii) university undergraduate programmes to

include required courses on environmental issues;

iii) training of specialists in environmental sciences and coastal management at the postgraduate level;

iv) running special courses for professionals, e.g. government officials, managers, lawyers, teachers, business persons and journalists;

v) Establish UNESCO SICOM Chairs for the enhancement of regional capacities.

39. And the Technical Workshop recommends that:

40. African States in cooperation with UNESCO and UNEP and existing intergovernmental, international and non-governmental organizations coordinate, implement and monitor an interdisciplinary approach to training in Environmental Education and Coastal Management based on the above priorities;

41. The OAU Secretariat ensures that these recommendations are brought to the attention of Heads of States at the next OAU meeting.

2. School education

42. In view of the importance of the coastal regions in sustaining life, especially for those who live close to it, many African countries recognize the need for environmental education, and are making attempts at introducing environmental education within the school system. However, evidence shows that there is insufficient treatment of coastal development issues in either education or sciences at the primary or secondary school level.

43. The Technical Workshop recommends that:

i) Governments should review their educational policies to include environmental education which incorporates sustainable coastal development by:
   - setting up or reinforcing national, interdisciplinary and intersectoral bodies to map out and coordinate environmental education with special attention on sustainable integrated coastal development.

ii) Governments should initiate and/or reinforce training programmes on environmental education for curriculum developers, teachers and teacher trainers as well as administrators by:
   - Including environmental education in the pre-service and in-service education of teachers as well as organizing regularly seminars and training workshops with the cooperation of training institutions, NGOs etc.
   - Establishing a focal point for environmental education.

iii) Governments and relevant bodies should provide all necessary financial and logistic support for environmental education by making necessary budget provisions for environmental education and seeking the cooperation and assistance of international bodies agencies as well as the private sector.

iv) Governments should ensure that there is incorporation of coastal zone issues in environmental education and assure its continuity across all levels of education by incorporating the environmental dimension into the school curriculum in a progressive manner and establishing a mechanism for evaluation and follow-up; Developing and disseminating appropriate teaching and learning resources.

v) Governments should promote regional cooperation and exchange of information and experiences in curriculum development and teacher training by:
   - Organising, on a regular basis, forums for exchange of information between experts in coastal management and educators
   - Developing regional data bases and utilising resources such as the Internet, newsletters etc.

3. Communication

44. The Technical Workshop made the following recommendations:

1. Situations (Status): Lack of understanding of the communication process and vertical transfer of technology and knowledge on SICOM issues.

What is to be done:

- Develop human resources in communication and information processes (collection, processing and dissemination), of the various stakeholders based on sustainable integrated coastal management (SICOM) “best practices”.

How is it to be done:

- Training in participatory communication as well as information management for all the stakeholders (ministerial, media and private sector).
- Training of media professionals on SICOM issues.
- Training of community information officers in accessing, processing and disseminating SICOM issues.

2. Situation (status): Need for better understanding of the SICOM issues by the media to improve coverage.

What is to be done:

- Provide appropriate information and available data on ongoing and future SICOM initiatives to the media.

How is it to be done:

- Establish information and coordination structures between information officers for concerned ministries, SICOM managers and the media using Information and Communication Technologies (ICT).

3. Situation (status): Need for coordination between the different institutions and agents of the state on SICOM programmes, projects and activities.

What is to be done:

- Establish an inter-ministerial committee on information and communication on SICOM issues.
- Define communication and information policies at the ministerial levels.
- Define national information structures.

How it is to be done:

- Establish points of contact between information officers with concerned ministries/SICOM managers and the media.
- Create an interdisciplinary task force on communication of SICOM issues.
- Establish fora at all levels of the State for a needs assessment on information and communication of SICOM issues.
- Develop information networks as recommended in National Environment Action Plans – (NEAPs).

4. Situation (status): Need for the active participation of private sector in SICOM.

What is to be done:

- Recognize the crucial role of private sector in the SICOM process.

How it is to be done:

- Launch awareness campaigns directed towards the media.
- Increase information on environmental legislation through publications and programme productions on the subject.
- Promotion of active participation of private sector through the adoption of “environmental citizenship”.

5. Situation (status): Need for a Participatory Monitoring an Evaluation system to feed the State, the private sector and international stakeholders on SICOM issues.

What is to be done:

- Establish information feedback systems (monitoring and evaluation) between local communities, state institutions and UN agencies.
- Recognize and accept the role of the media in the promotion of SICOM.

How it is to be done:

- Establish participatory evaluation and monitoring systems between the grassroots communities and the various stakeholders through the establishment of a systematized feed-back flow of information;
- Sensitize the state, the private sector and stakeholders at all levels on the crucial role of the media in promoting SICOM programmes, projects and activities;
- Allow the establishment of independent as well as local community media to cater for the community needs of information on SICOM issues.

6. Situation (status): Need for effective social-cultural integration of grassroots communities in SICOM projects.

What is to be done:

- Integrate community indigenous knowledge, as well as social and cultural values in SICOM problem solving.

How it is to be done:

- Create special fora for communities to share experiences and to express their aspirations regarding SICOM projects to ensure their active participation.

3.3. Policy and planning for integrated coastal area management

A. Current trends and challenges affecting sustainable coastal development

Ecological threats and inter-dependence

45. Coastal areas are dynamic and important economically and ecologically. Conflictual spatial occupations, antagonistic and competitive uses, and unmanaged economic growth jeopardise the ecological balance on which present life and that of future generations depends. The emergence of global environmental concerns (such as climate change) and increased exchange of capital, goods, labour, and information has dramatically increased inter-dependence between different human economic activities and natural ecosystems.

Market, policy and information failures

46. Environmental goods and services are not reflected in the marketplace and trans-sectoral impacts of economic activities are not internalised. Clearly defined property and use rights are fundamental to the allocation and preservation of coastal resources. Lack of awareness of long-term implications of non-intervention and short-sighted economic gains do not allow taking into account coastal ecosystems degradation. Lack of information and awareness on the value of all goods and environmental services of the coastal natural capital, and on negative environmental impacts contribute to policy failures.

Multiple management dimensions

47. Management in time and space of the interactions between economic and ecological, and social and natural variability requires a dynamic, progressive and development-oriented perception, with a view to closer integration between conservation and development. The challenge is to couple the legitimate needs and interests of individual users with the collective interest, including the health of transboundary natural ecosystems.

Institutional responsabilities

48. The productive and management capacity of communities has been “eroded” by unsuitable policies which have disenfranchised key actors, deprived communities of their land rights and led to erroneous choices. Weakened legal frameworks contribute to coastal resources becoming open to over-exploitation. This highlights the role of governments in creating a political and legislative environment amenable to effective cooperation between interested groups and the implementation of appropriate policies. ICAM requires various types of integration to ensure that all relevant interactions and issues are considered and that coastal management interventions are consistent with national development policies, strategies and plans. Multi-sectoral cooperation and conflict resolution need horizontal, vertical and temporal coordination.

B. Recommendation for policy and planning

Legal framework

49. Integrated coastal management may involve changing the way existing institutions operate, creating new institutions, changing user rights, and introducing mechanisms to regulate human activities: Arrangements for integrated coastal management need to be backed by legislation to repeal or amend existing legislation and enacting new legislation. Legislation can also be used to establish mechanisms for resolving disputes. It is important to avoid adding further layers of bureaucracy and legal complexity.

50. Conflict resolution is one of the central concerns of any legal system. Disputes and claims over natural resources are very high in coastal areas. Alternative dispute resolution techniques aim at building consensus by engaging the disputants actively in seeking a result acceptable to all the parties involved. These techniques include negotiation, conciliation, facilitation, mediation, arbitration and negotiated rule-making.

Institutional framework

51. Institutional arrangements vary from creating new integrated institutional structures to multi-sectoral collaboration. It is important to adapt management modes to existing institutions, organizations and cultures. Where existing arrangements are inadequate for effective management, changes should be introduced gradually and adjustments made over the longer term.

52. While coordination is recognised as vital in multi-sectoral policy and planning, it requires agreement on a number of issues:

There should be agreement on goals at central, area, and sector level. Distinctive but complementary institutional roles/responsibilities and jurisdictional boundaries should be defined at different levels of governance.

The planning process

53. A carefully prepared and agreed integrated coastal management strategy provides the basis for developing sectoral plans along common objectives. The strategy should provide a long-term vision of the desired future. It is essential that objectives are set following broad-ranging consultations and understanding of their costs and likely benefits. It is fundamental to build a constituency that can survive government changes. Objectives should be modest and expanded as experience is acquired. The time required to change attitudes and behaviour should not be underestimated.

54. The means to achieve an integrated management strategy include a variety of policy instruments: direct government investment for infrastructure, research, and training; legal restrictions; economic and market-based incentives and disincentives; or new channels for public participation.

55. Agreement on the rules of the game are necessary before defining policies. The rationale for the selection of policy instruments should be considered. Because participatory analysis, monitoring and evaluation identifies lessons learned and further learning needs, it should be built in the management process to provide a continuing educational and formative orientation.

56. Management options ultimately rely on informed choices. Information required includes biophysical characteristics of the area, social issues and related economic linkages, and the governance framework, embracing laws and institutional characteristics. Data collection and monitoring should be pragmatic, focused on management needs, and based on agreed selection criteria and local cultural preferences. It may be necessary to redirect research according to identified needs. Information should allow understanding of inter-sectoral relationships, recognition and anticipation of trade-offs, and critical assessment of benefits and alternatives.

Prioritisation of management issues should consider alternatives for coastal dwellers' livelihoods.

Grassroots level

57. Grassroots level communities are the prime natural resource users. Their traditional knowledge of the ecosystem and management practices are an invaluable resource. Grassroots communities should be fully involved with policy and planning that directly impact their lives. Line ministries should ensure that the knowledge of resource users is properly taken into account. Special attention should be given to women's groups. Customary conflict resolution and community management should be enhanced.

58. To be successful, management measures require a conviction on the part of those affected that the process is fair, responsible and legitimate. Property rights should be allocated to groups who, in return, have an obligation to manage them sustainably. Resource users should be part of an institution or a group that is able to exercise management authority.

59. Individual groups may cannot fulfill all the requirements for integrated management. The potential contributions of different groups of society can create a collective capacity:

Participation of communities and civil society organizations should be a priority. Local NGOs can be valuable partners for keeping management focused on local issues. They can provide useful lines of transmission from the local community to the authorities and vice versa, and links with the business and private sector can be explored.

Government level

60. While devolved management is effective, local managers require enforcement to stop encroachment, as well as considerable training and technical support. There is a need to redefine the effective role of the State at both central and local levels as well as its productive interaction with civil society and private-sector institutions. More specifically, decentralised structures should be established on the basis of effective participation at the local level. Legislative measures should be developed which relate to the long-term sustainability of the natural environment. Economic incentives for producers should be installed, and investments deployed for interventions which local institutions cannot afford.

61. Line agencies rarely have expertise in integrated natural resource management. Institutional capacity-building should be developed as part of the integrated coastal management strategy. Participatory techniques, negotiation, facilitation, and cross-sectoral policy analysis are skills that need to be created. A mix of hiring *ad hoc* project staff and mobilising professionals from relevant line agencies and institutions would allow higher efficiency and wider dissemination of the approach among local institutions. Public officials should be educated on existing enabling laws.

Regional and international levels

62. Local level concerns and needs ought to be voiced in the macro-policy arena in order to truly mirror environmental,cultural and economic diversity and potentials. The different hierarchical levels (i.e. communities, watersheds, national policies, international agreements) should be linked. Reconciling local needs with global interests requires skills to resolve conflicts. Co-management allows institutions, at all levels, to take collaborative actions.

Funding

63. Earmarking domestic funds for ICAM not only creates local commitment, it also demonstrates willingness to international aid agencies. Considerable funding could be unlocked nationally through the following reasons. At sectoral level, reallocation of sectoral funds should be made to address interactions, providing that line ministries can perceive the returned benefits. The "polluter pays" principle can pool funds that should be reinvested to the benefit of the communities affected. Private investments can be attracted to capitalise on environmental opportunities such as ecotourism. Voluntary contributions can create micro-funds for community use.

V. SUBTHEME 4: EARTH RESOURCES AND SICOM

Geological Background for SICOM —
Sustainable Management of Earth Resources
in Coastal Zones of Africa

A. Situation

64. The coastal zone is a broad area where continental and marine processes interact. Coastal areas are different in type, shape and size. They are dynamic systems and do not lend themselves to strict definition by spatial boundaries. The coastal zone is characterized by the co-existence of biotic and abiotic earth resources. Coastal zones are valuable areas exposed to natural (erosion, sea level changes, earthquakes etc.) and anthropogenic pressures, and therefore deserve to be protected. Minerals of greater economic importance such as diamonds, gold, heavy minerals, industrial materials (e. g. sand, gravel, limestone, kaolin) and phosphates occur widely in coastal zones of Africa. Fossil energy (oil, gas and coal) is also found in the same environment. Additionally, the coastal zone contains a substantial amount of fresh ground water. The sustainable management of coastal areas is influenced by both natural and anthropogenic processes.

65. The current role of geoscientists is incorrectly perceived to be restricted to exploration and economic aspects of the mining industry. The mining industry is a major factor in the economic development of most African countries. The professional potential of geoscientists for SICOM is underestimated and underutilized.

B. Problem identification

66. The coastal zone represents one of the earth's most complex and dynamic ecosystems that is

compounded by natural and anthropogenic pressures. The workshop identified the following problems:

- Mineral exploitation affects quality and quantity of catchment and groundwater resources.
- Rapid population growth and tourist industry along the coastal zone compromises the sustainable use of groundwater resources.
- Encroachment of salt water into freshwater reservoirs is a major problem in the coastal zone.
- Mining activities in the coastal zone contribute substantially to environmental degradation and health hazards leading to loss of lives. There is an inadequate integration of artisanal mining in the economic growth of African countries.
- There are insufficient human resources and scientific infrastructure in the field of environmental geosciences.
- The causes of natural hazards in coastal zones are poorly understood.
- Existing mining and other land-use policies and legislation are often inadequate for the sustainable management of the coastal zones and for the protection of the socio-economic interests of the local population.
- Undesirable side effects of mineral exploitation in coastal zones may lead to local and regional conflicts.
- Important geological and archaeological sites in coastal zones are not properly protected. There is insufficient exchange of information and lack of standardized environmental geo-data.

C. Recommendations

67. The workshop made the following recommendations:

- To define and undertake sound environmental management strategies and proper hydrogeological investigations in groundwater utilization.
- To carry out environmental impact assessment procedures-type on mining and other land use.
- To develop and implement capacity building programmes in the field of environmental geosciences and to establish regional centres of excellence with functioning scientific infrastructure.
- To formulate and implement mining policies and legislation that guarantee and protect the socio-economic interests of the local population.
- To conduct a proper rehabilitation during and at the end of mining operations, leaving the site in the same or better state than before mining operations begin.
- To identify and document significant geo-sites in the coastal zones and protect them.
- To fully integrate the expertise of geoscientists into SICOM.
- To create national and regional geoscientific data banks for SICOM.

D. Follow-up

68. The Working Group identified the following priority areas for action:

- Continue evaluation of mineral resource potential for socio-economic development;
- Initiate research projects on earth resources management and environmental geo-sciences in coastal zones including a capacity building component; and
- Provision of funds from national and international institutions for research and training facilities.

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