

# ENVIRONMENTAL MONITORING IN THE COASTAL ZONE

**NYALI BEACH HOTEL, MOMBASA:  
Wednesday 23rd - Friday 25th April 1997**



A contribution to the UK Overseas Development Administration (ODA)  
Land-Ocean Contamination Study (LOCS) in East Africa.

Organised by the British Geological Survey and Kenya Marine and Fisheries  
Research Institute.



**KMFRI**

**ODA**



ODA LOCS

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*Bibliographic reference:*

Rawlins, B. G. and Williams, T. M. 1997. Abstracts of the ODA / LOCS Workshop-Environmental Monitoring in the Coastal Zone, Mombasa, Kenya, 23rd-25th April, 1997. British Geological Survey, Keyworth, Nottingham, U. K.

# WORKSHOP PROGRAMME

**WEDNESDAY 23RD APRIL**

## **Introduction and Coastal Zone Management**

- 9-00 Registration
- 9-45 Martin Williams (BGS) Introduction: background to the ODA LOCS project
- 10-30 Coffee
- 11-00 Martin Williams and John Rees (BGS) Contaminant monitoring in estuarine and nearshore marine systems. 1: Survey framework, design and sample collection
- 12-30 Lunch

## **Chemical oceanography and pollution**

- 14-00 Abdalla C Yobe (KMFRI) Assessment of land based sources of pollution along the Kenya coast
- 14-20 Peter J Shunula (IMS) Considerations on sources and control of pollution of the coastal zone in Tanzania
- 14-40 Alfred Muzuka (IMS) 1. Methods of dating coastal sediments and corals.
- 15-00 Alfred Muzuka (IMS) 2. Can stable isotope compositions of tropical East African flora be used as source indicators of organic matter in coastal marine sediments?
- 15-20 R. B. Owen (Dept. of Geog., Hong-Kong) Heavy metals in Hong Kong coastal sediments
- 15-40 C. Z. Kaaya (Dept of Geology, Dar-es-Salaam) Sources of Chemical Pollution in Dar-es-Salaam Coastal Waters
- 16-00 Coffee

## **Remote sensing in Coastal Zone Management**

- 16-20 Peter Mumby  
(CTCMS, U. K.) Practical remote sensing of coral reefs and seagrass beds: a cost benefit assessment.
- 16-40 Edmund Green (CTCMS, U. K.) A Comparative Assessment of Mangrove Areas using Remotely Sensed Data from Satellites and Airborne Sensors.

## **THURSDAY 24TH APRIL**

### **Interpretation of marine pollution data**

- 9-00 Martin Williams (BGS) Contaminant monitoring in estuarine and nearshore marine systems. 2: Analysis, interpretation and integration of chemical data.
- 9-45 John Rees (BGS) Estimation of residence time of sediment-hosted contaminants, based on interpretation of sedimentological and oceanographic data
- 10-30 Coffee**
- 11-00 Barry Rawlins (BGS) Obtaining pollution chronologies in marine sediments
- 11-30 Jason Weeks (ITE) Biomarkers in marine pollution monitoring

### **12-30 Lunch**

### **Biological / Ecological studies**

- 14-00 Nyawira Muthiga  
(Kenya Wildlife Service) Coral reef monitoring within protected areas in Kenya
- 14-20 Johnson Kazungu (KMFRI) Nitrogen transformational processes in a mangrove ecosystem
- 14-40 Jacqueline N Uku (KMFRI) Submerged marine flora as indicators of environmental health
- 15-00 Coffee**
- 15-30 Omondi Wawiye (KMFRI) Phytoplankton as bio-indicators of environmental stress: comparison between a polluted and a pristine environment along the Kenyan coastline
- 15-50 Patrick Gwada (KMFRI) Regeneration structure of Kenyan mangroves after human perturbation: case study of Mida creek
- 16-10 Helida Oyieke (National Museums of Kenya) Coastal zone environmental quality vs biological diversity

## FRIDAY 25TH APRIL

### Physical oceanography

- 9-00 Mika Odido (KMFRI) Tidal flushing of the creeks around Mombasa Island
- 9-20 Michael Mutua Nguli (KMFRI) Water exchange and mixing in tropical inlets - a case study of Tudor inlet, Mombasa
- 9-40 Johnson Kitheka (KMFRI) Coastal water-circulation, groundwater flux and salinity anomalies at Mida Creek, Kenya

### 10-20 Coffee

### Coastal zone management and GIS

- 11-00 Dirk Van Speybroeck (UNEP) UNEP's eastern African Coastal and Marine environment resources database and atlas project
- 11-20 Dixon Waruinge (UNEP) Integrated coastal area management in Eastern Africa
- 11-40 B. A. J. Mwandotto (Coastal Development Authority) Kenya integrated coastal area management (ICAM) Pilot project
- 12-00 Prof. J. Bauer (ECO-TERRA) Holistic coastal zone protection in areas of conflict (the case of Somalia's coast during the last 10 years)

### 12-30 Lunch

### Beach erosion

- 14-00 Jeremiah Daffa (NEMC) Oil spills and marine contingency planning in Tanzania
- 14-20 N. Nyandwi (IMS) Man induced coastal erosion and its management in Tanzania
- 14-40 A. M. Dubi (IMS) Beach erosion and the role of coastal structures in beach protection
- 15-00 Yohannah Shagude (IMS) Sediment distribution and transport off the western coast of Zanzibar
- 15-20 Pamela Aboudha (KMFRI) Beach erosion and its management strategies in Kenya

### Acronyms:

- KMFRI: Kenya Marine Research Fisheries Institute  
IMS: Institute of Marine Sciences (Tanzania)  
UNEP: United Nations Environment Programme  
NEMC: National Environment Management Council (Tanzania)  
BGS: British Geological Survey (U.K.)  
ITE: Institute of Terrestrial Ecology (U.K.)

## **AN ASSESSMENT OF LAND BASED SOURCES OF POLLUTION ALONG THE KENYA COAST**

D Munga 1, A C Yobe 1, M Owilli 1, S M Mwangumi 2

1 Kenya Marine and Fisheries Research Institute, Mombasa

2 Government Chemist Department, Mombasa

Report presented to the WHO, Regional Office Brazzaville.

The exercise was carried out in 1992 with the objective of assessing types and quantities of pollution contaminating the marine environment from the land based sources along the Kenya Coastal area. The output of this rapid assessment is expected to provide an indication of pollutants that are of immediate concern, which require appropriate action in terms of monitoring and management.

The data and information used in the assessment was obtained from various Kenya Government ministries, local authorities and also directly from the management of some major industrial establishment. The study involved the estimation of waste volumes and pollution due to domestic waste, industrial effluents and agricultural activities including livestock waste.

To facilitate the exercise administrative boundaries were considered because the district authorities are directly involved in planning and sanctioning of development activities in the area.

The Kenya coastal area is made up of the districts, Kwale, Mombasa, Kilifi, Tana River and Lamu. Mombasa is the principle seaport and industrial and commercial centre.

Only 17% of the population of Mombasa is sewerred. The municipality operates two separated sewage systems for domestic sewage and storm water runoff which are both unoperational due to overloading and unserviceability. The rest of the inhabitants utilise pit latrines (59%) and septic tanks and/or sewage pits for sewage disposal.

The Municipality operates a refuse collection service which disposes about 60% of the domestic refuse at an uncontrolled dumpsite know as Kibarani. Few industries have facilities for effluent pre-treatment before disposal into the sea. The Mombasa port has no reception facilities for bilge's or other wastes from ships.

No other urban centres along the Kenya Coast have sewage systems and treatment plants. Dumping of solid waste on mangrove shore is practised.

Industrial effluents from Mombasa district accounts for 70% of the total Biological Oxygen Demand (BOD5) with 90% of the organic load die to food and beverage industries. Domestic and solid waste from the municipality and beach hotels generate about 20% of the BOD load.

Industrial effluents do generate about 60% of the suspended solids (ss) with storm water runoff and domestic sewage contributing most of the rest of ss load. At least 65% of waste oils are

produced by slaughter house and fish processing plants, with the iron and steel industries contributing most of the rest of the load.

Domestic sewage is a source of about 40% of nitrogenous compounds with storm water runoff contributing 30%. Major contributors of phosphorus compounds are livestock waste and domestic sewage at 50% and 30% respectively.

The assessment gives an indication of emissions of chromium, zinc and iron from iron and steel industries, with relatively lower levels from power generation and petroleum refining. Most of the water from industrial and domestic activities is discharged into the inshore creeks.

In Kwale District, domestic sewage from market centre and beach hotels generate at least 75% of the BOD load. Storm runoff is the source of about 70% of the suspended solid load. About 50% of nitrogenous compounds is due to domestic sewage, with storm water runoff contributing about 40%. Over 80% of phosphorous compound load is due to livestock waste.

In Kilifi District, liquid and solid domestic waste is the source of over 70% of the BOD load. Storm water runoff produces more that 80% of the suspended solid load. Domestic sewage contributes about 45% of nitrogenous compounds, with agricultural runoff and livestock waste making about 45% of the total load. Livestock waste is the source of about 60% phosphorus compounds, with domestic sewage accounting for 30% of the load.

In Lamu District, the few industries generate some 45% of BOD, with domestic waste contributing about 25% and livestock waste attributed to 25% of the total load. The high concentration of donkeys in Lamu attributes 90% of suspended solids, nitrogenous compounds and phosphorous compounds loads generated.

It is recognised that the major rivers, Tana, Sabaki etc are main sources of sediments, nutrients and contaminants resulting from agricultural activities in the river basins. Riverine loading has, however, not been estimated due to unreliable data or discharge rates and other hydrographic parameters.

The high quantities of waste generated along the Kenya coast raises the need for proper waste management to reduce the pollution loads.

Monitoring levels and effects of pollution in sensitive inshore waters areas, for example, the mangrove ecosystems, coral reefs and tourist beach resorts is recommended with great emphasis on the following:

- (i) Organic pollution (BOD), microbiological contamination and nutrient level and their effects on the marine environment.
- (ii) Heavy metal contamination and effects on biota.
- (iii) Petroleum hydrocarbons in the marine environment.