

Assessment of environmental vulnerability of Maputo bay using Remote Sensing data and GIS

Introduction

In tropical countries we can identify two types of ecosystems in risk along the cost: mangrove and coral reefs (Mann, 1982). Along the cost the bay comprise the extensive marine environment ranging from pen plan, islands, coral reefs, mangrove this is habitat and feeding sources for mollusks, crustaceous and fishes.

Maputo bay is about 40 km long and 30 km wide covering 1200 square km is located surrounded the Maputo city in north, Matola city in west and Catembe village in south (fig. 1). Within the bay we have Portuguese and Inhaca Islands. Similarly to other major African cities, Maputo is experiencing rapid expansion which raises the sanitary problems and exposes more the bay with pollution (Achimo et al., 2003). In the bay we also have the major port which supports big sheep's.

The principal constraint for coastal management is related to: rising of tidal level (global warming), development of tourist infra structural consequently could cause acceleration of erosion process, reduce vegetation cover, and lose

of biodiversity which lead to degradation of environment. Also, people living along the cost use the mangrove trees for construction of the houses, small boat and use as fuelwood (Anthropogenic factors).

In order to have sustainable coastal management it is important to understand the vulnerability change

along the coast, that way in this paper the GIS and Remote Sensing have been used to evaluate the environmental sensibility.

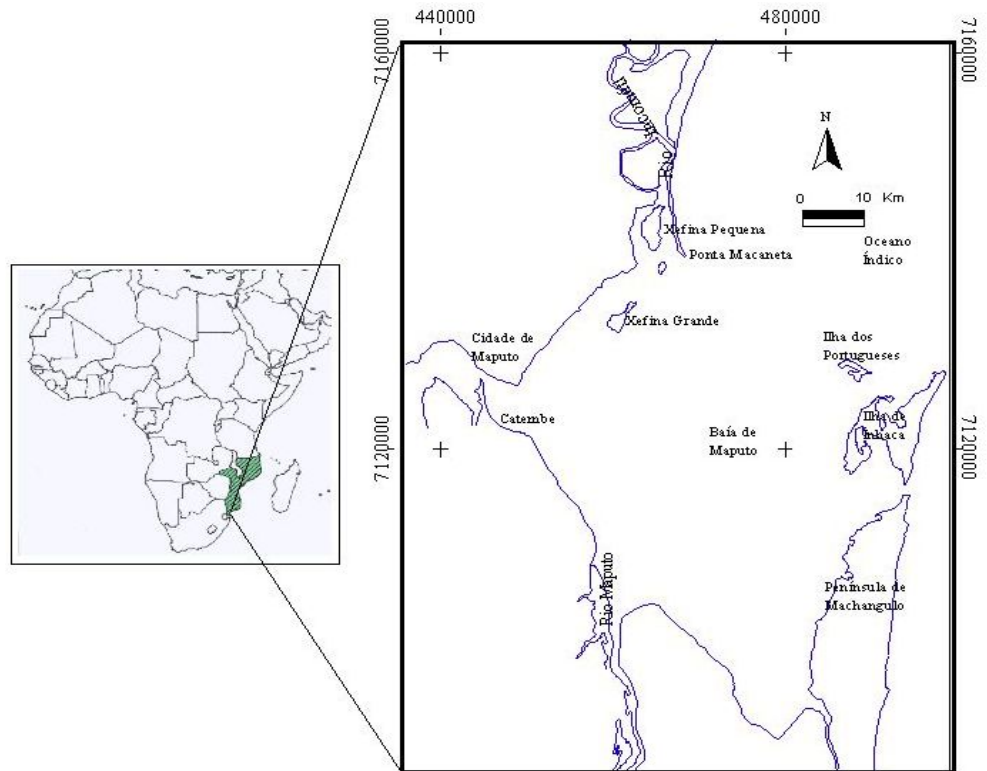


Fig 1- Localization of Maputo Bay

Morphological and environmental background

Morphological the bay present sand bank, sand dunes, depressions including marine channels and sand beach. Predominantly within the bay we have sand beach and channels with most of the channels about 10 m deep (Maputo and Machangulo channel) also occur dapper channels more then 15 m (Inhaca and Grande Machangulo. The sand banks covers 381 square km and sands occur in east and muddy in west (Hoguane & Dove, 2002).

Three environment can be identified from beach which is a transition from continent to ocean, intertidal zone with deep ranging from 0 to 2,5 m and subtidal which is the deeper part of the bay.




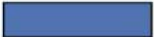



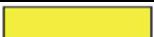


The main phenomena processes affecting the bay are the erosion and pollution. Erosion is considered to be a major factor for coastal degradation and is unstop process taking in account that the sea level continuo to rise, construction of touristy infrastructure, salt production/reserves and use of mangrove for fuel wood, etc. Pollution is due to industrial residuals from Matola and residuals from Maputo port.

Methodology

Data was provided by different organizations: topo sheets by Survey Center (DINATEF), environment sensibility map and National Oceanic Atmospheric and Administration (NOAA) methods by Environmental Department (MICOA), Landsat TM Image from 1991 and 2004 at Remote Sensing Center (CENACARTA) and geological map of Maputo and Catembe by Geological Survey (DNG).

The first phase was followed by data capture and image processing. Interpretation was done on landsat TM comparing with morphology and geological units from topo sheets and geological map. MapInfo and Ilwis software were applied during this phase for map production, enhance the images and classify different morphology.

It was necessary to establishing ISA table in order to indicate environmental sensibility regarding to physical characteristics ranging from sand beach, rock beach, cliffs, mangrove, shoreline, etc, based on Brazilian regulation. Table 1 show different indicator:

Índex	Color	Slope	Type of material	Petroleum permeability
ISA 1		>30°	Rock along the cost	Impermeable
ISA 2		<30°	Rocky beach	Impermeable
ISA 3		<5°	Fine to medium sand (0,06-1mm)	Semi-permeable (<10cm)
ISA 4		5-15°	Sands (2-4mm)	Permeable (=25cm)
ISA 5		8-15°	Sand and bolders	(=50cm)
ISA 6		10-20°	Bolders	High permeable (=100cm)
ISA 7		<3°	Sands	Limited permeability
ISA 8		>15°	Sediments	-
ISA 9		<3°	Muddy	Low permeability
ISA 10		<10°	Sand and muddy	Low permeability

Two field work were undertaken in order to collect data and get in touch with environmental change in the field.

Finally the Arcview 3.2 software was used in order to superpose all data and final interpretation.

The image processing was done using the following process image enhancement, color composite and image classification. The following bands from Landsat TM were the most applicable:

	Spectral signal	information
R (Red) 4	0,76-0,90 μm	vegetation
G (Green) 3	0,63-0,69 μm	soils
B (Blue) 2	0,52-0,60 μm	water body

For the study the Landsat image could show the difference in vegetation cover (mangrove).

Interpretation

Based on land use information and analyze the level of expose to waves including the petroleum ship itinerary it was then possible to manipulate the data in order to produce the sensibility index for different zones within the bay (fig 2).

Xefina Island located in NE protect Costa do Sol beach for tide waves from the ocean as a result it was classified as low grade compared to Macaneta beach which is open to ocean. However the Costa do Sol beach was classified as very sensitive (index 10) due to mangrove.

Catembe beach near Ponta Três Marias it is composed by fine sand leading to less permeability, also the slope is very high in this beach contribute to rapid cleaning in case of oil spillage, resulting in low sensitivity index.

In Catembe, from the bridge to Restaurante Diogo the sand beach is very plane and safer less from waves that retain pollution resulting in high sensibility index.

The mangrove trees protect the beach from tidal waves. This is the case with part southwest of Inhaca Island (low sensibility index).

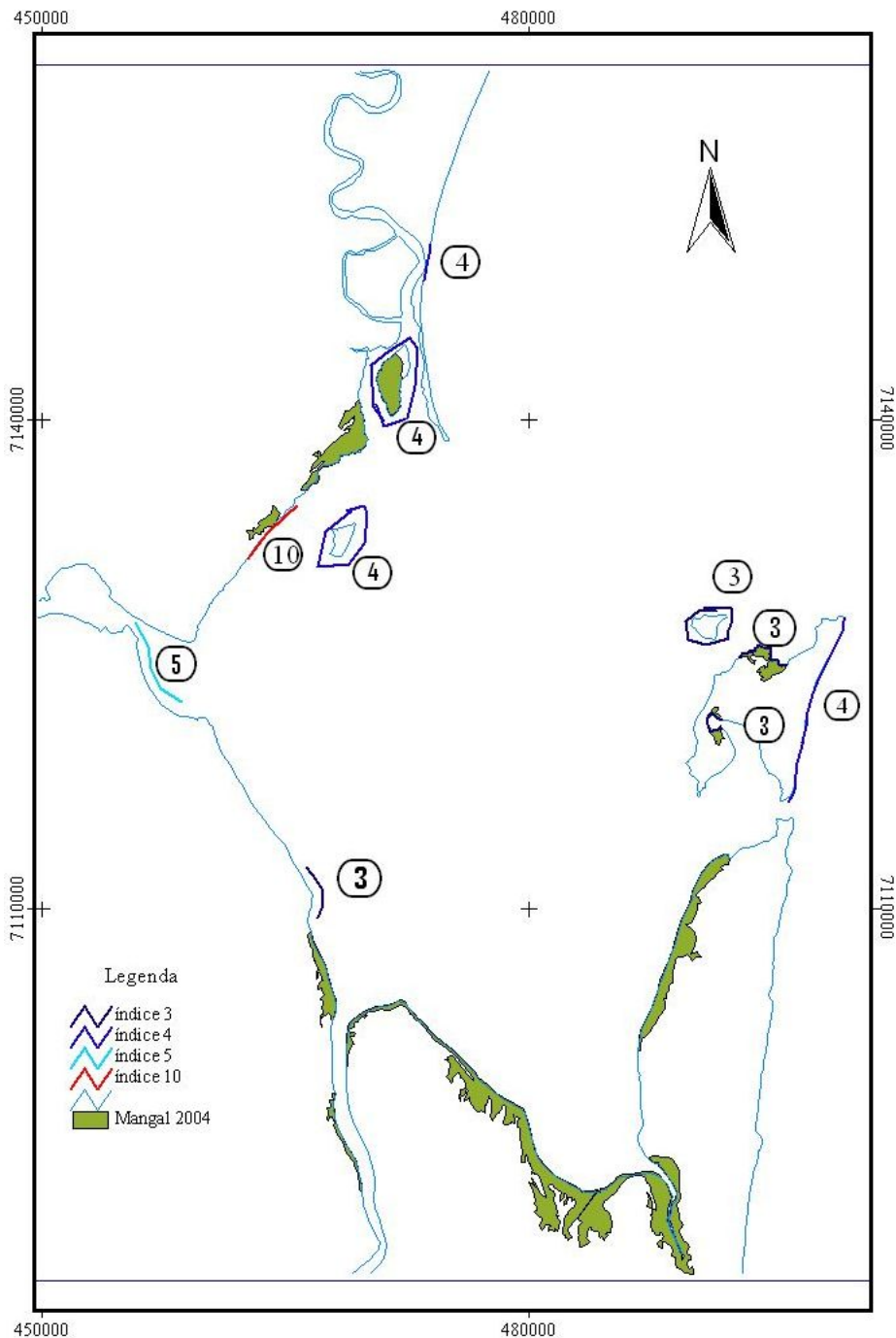
The port is considered as main source of pollution in the bay.

Conclusions

As result of this investigation the following was the conclusion regarding to pollution: Costa do Sol area, west part of Inhaca Island, Catembe and Xefina Island are sensitive areas due to expose of mangrove vegetation to anthropogenic factors (drastic reduction of mangrove).

The Industrial city of Matola plays a major role for pollution in the bay.

The landsat TM images are useful for first assessment for environmental change.



References

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