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THE IMPACT OF SCARCITY OF BEIRA CITY SHORE PROTECTION

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Seaside erosion, seaside protection, human activity, natural activity, dunes, sea level, climate change.

ABSTRACT

The Beira city shore is vulnerable to seaside erosion, a scenario that is heavily coaxed by the human activities around the same shore. This study is based on the observation and analysis of pictures and bibliographic research appurtenant to this topic, brings as areas of sizeable vulnerability within the city of Beira, the Chaimite and Ponta Gêa's zone, a fact prompted by the high untidy land occupation, knocking down of mangrove that watch over the seaside for uses such as wood fuel, building material, tearing down of the dunes protecting the coastline by fishing activities, as well as natural factors such as those arising from climate change. The study aims to reference the effective forms of seaside protection on the Beira city shore, looking at the feebleness in long-term seaside protection. There are sundry projects carried out in the city of Beira with a unique aim of lightening this phenomenon, such as the revival of the main straining of Chiveve, rehabilitation of macro drainage, building of walls or dikes to refrain the tidal force. To sum up, this work in general provides knowledge and essential information to comprehend unconnected environmental conditions of the city, as well as the glimmering on measures to be applicable in the handling of the Beira city

FOREWORD

The Beira city, the capital of Sofala, was inaugurated in 1884, and since ancient times this city has suffered from an embryonic problem. The city is located between the estuaries of the Pungue and Buzi Rivers, and a shore area characterized by high dynamics, which obviously contributes to greater deposition of sediments in the sofala bay, which can give a high intervention forecast in order to stop the evils now caused by this deposition of sediments.

Moreover to this negative influence of the geographic location of this city, it is characterized by a marshy plain, where in some points it is even below the level of the sea level, which makes it vulnerable to coastal erosion. In the middle is the River that also calls the city, the River Chiveve, which serves as the main branch of the various drainage ditches that are found in the city of Beira. The same branches are in a state of misfit with the needs of the city, as many are clogged, with diverse vegetation and constructions in the natural water retention basins.

In a predictability of the problems that could be caused by the points described above, several spurs (50) were designed with the main objective of dampening the strength of sea waters and, thus, minimizing their impact on the coast. However to mention, that currently only 23 of these spurs are in full operation.

Any weather change in Beira is a big cause for alarm because it is extremely exposed and vulnerable to cyclones, storms and heavy rains, and as is known, the earth is experiencing a temperature increase leading to occurrences of climatic changes that give us unpredictability as to weather conditions in addition to raising the normal level of sea water.

The study of coastal erosion is an important means of analyzing the vulnerability of certain territorial areas and their inhabitants. And, its scientific, economic and environmental importance is high, constituting a delicate ecological balance where there is a great anthropogenic pressure and resource exploitation. (Manso, 2004), cited by Mário Uacane, 2014.

The main objectives of this research are to bring effective forms of coastal protection to the coast of Beira, taking as a directional line, the long-term weaknesses in coastal protection of Beira (coastal erosion, heavy rains, outbreaks of extreme storms) due to cyclones that reach the coast in Beira; and conceptualize an integrated strategy to improve levels of protection in the city against these risks.

With this, knowledge and even information necessary to understand different local environmental conditions are generated here, as well as for reflection on the measures to be implemented in the management strategy of the city of Beira

MAIN HAZARD TO THE SHORE

The main threats to the whole plan implemented as well as to be implemented are: climate change (rising sea levels, changes in precipitation patterns “more frequent and high-intensity precipitation”), coastal protection, reduced drainage capacity. Figure 01 shows the Map of the City of Beira, and the drainage systems of the City.

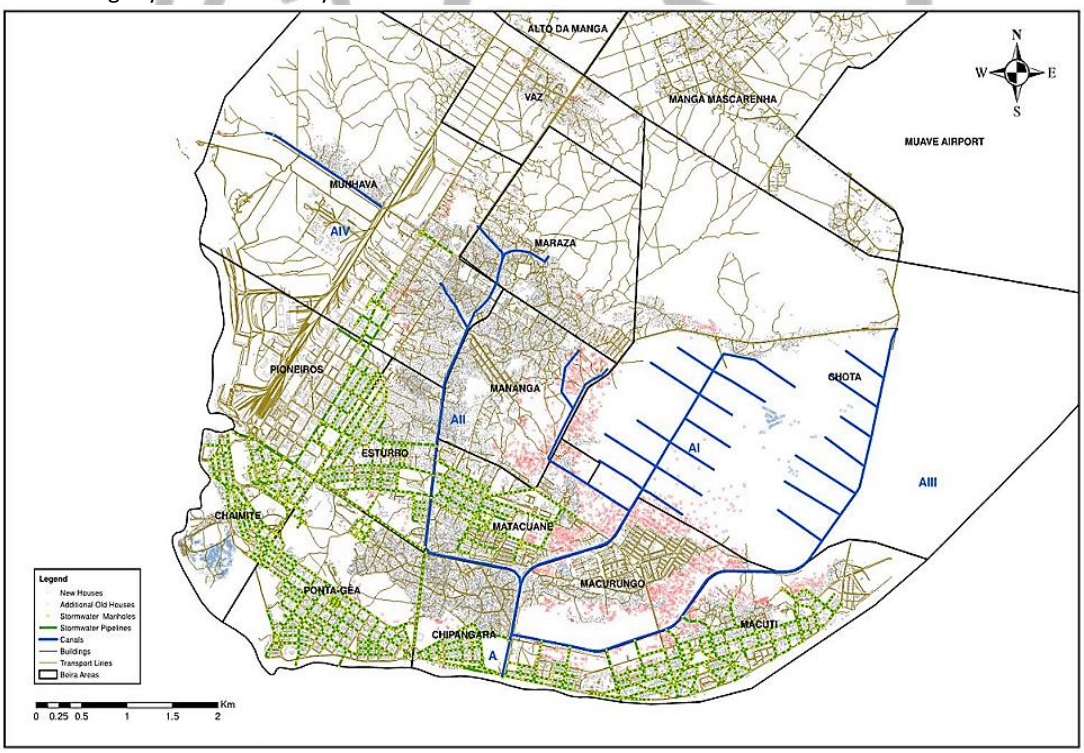


Figure 01 – Beira City Map.

As can be seen in Figure 02, the city of Beira is one of the areas with the greatest influence of storms, and has higher wind speeds than other cities on the coast, reaching 45 to 50 km / h. The maximum levels are found on the coast of Maputo and Beira, with the particularity that the City of Maputo is not below sea level. In terms of tide, the same figure shows that the city of Beira is the one that reaches the elevation highest in the entire coast of Mozambique, reaching up to about 6 meters in height.

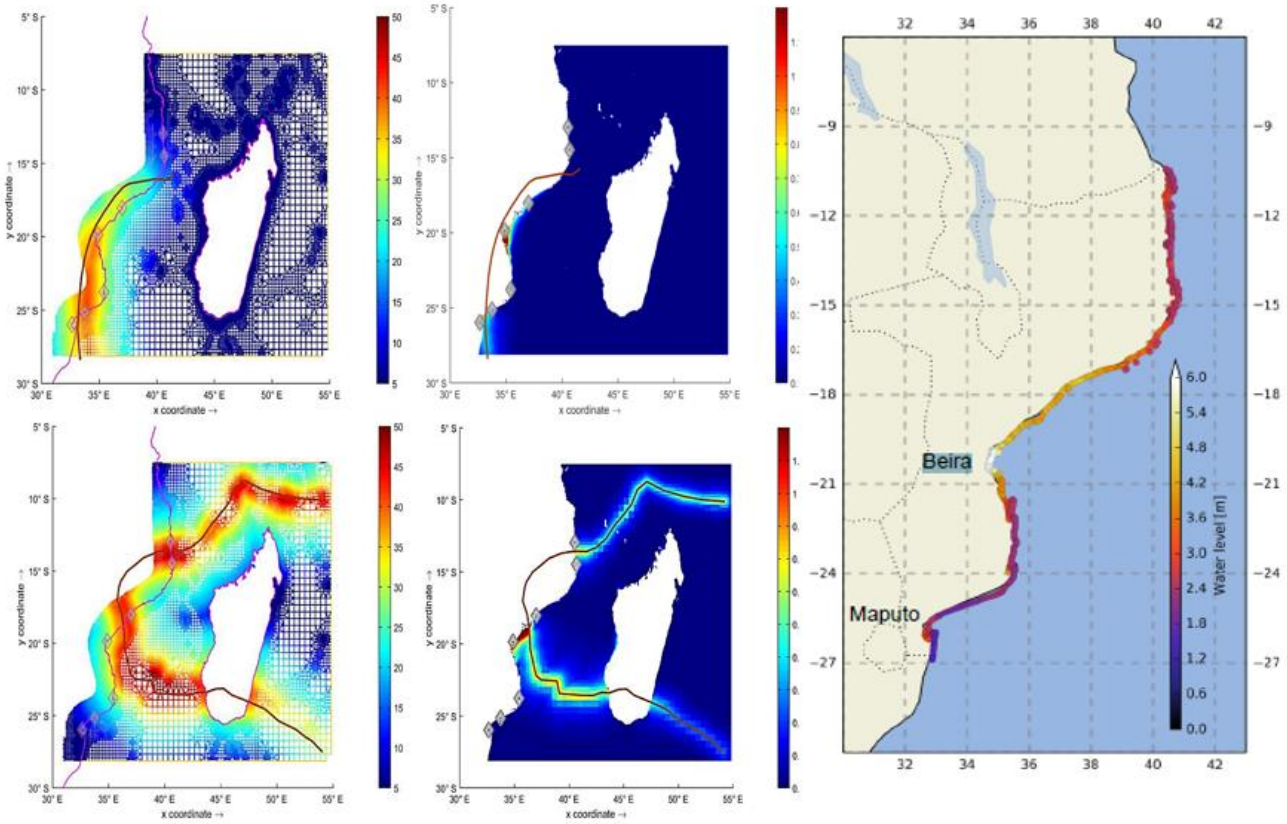
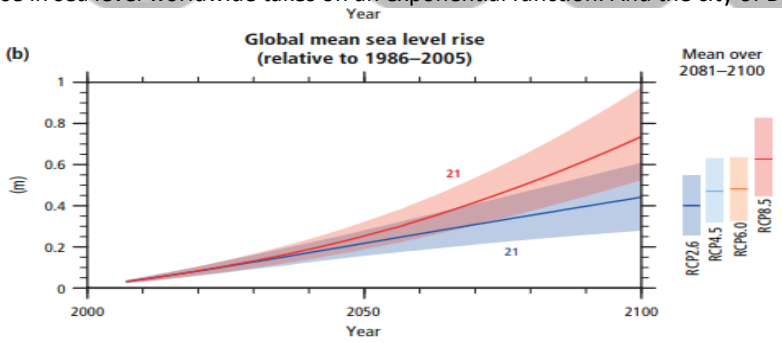


Figure 02 - Levels of Tropical Cyclone on the Mozambican Coast: a) Synthetic bands and maximum wind speeds; b) Maximum levels of the outbreak; c) 1000-year tide.

As shown in Graph 01, the rise in sea level worldwide takes on an exponential function. And the city of Beira is not a part of this allocation.



Graphic 01– Rising sea levels on the World

HUMAN ACTIVITY INFLUENCE ON SEASIDE EROSION

It is clear that any activity of man in the environment will cause some environmental impact, which can be positive or negative. Several of the negative impacts of the coast of the City of Beira are directly related to the increase in urban areas, which have been created by municipal authorities in areas with natural water retention basins, which reduces the city's capacity to sustain water flooding, reduces water transit paths, among other factors that are listed here.

The exaggerated consumption of material goods and the constant production of garbage, competes greatly in the degradation of the coast, as these increase the dragging of soils, originating ravines that later form the preferential path of the waters, and as it is obvious the destruction of the protection structures.

The extraction of sand from the beach for various activities of man, is part of the human factors for the destruction of the coast, as these increase the depth and thus the potential energy of the water that is made there, increasing efforts on protective structures, which in a good sense are in small quantities on the coast of Beira.

The dredging activity in the port of Beira (beach area) has not been very efficient as there is little sand to be dredged.
In short, the acceleration of this erosion process on the coast is evidenced by the following reasons:

- Removal of vegetation from the dunes;
- Constant dragging of canoes, fishing nets and other material across the dune area;
- Precarious construction on the coastline;
- Use of sandbags as alternative measures to contain the erosive action of the waters;
- Deposition of sediment (waste) in the laser zones.

Figure 03 illustrates the effects of human activity and the areas with the highest numbers of people.

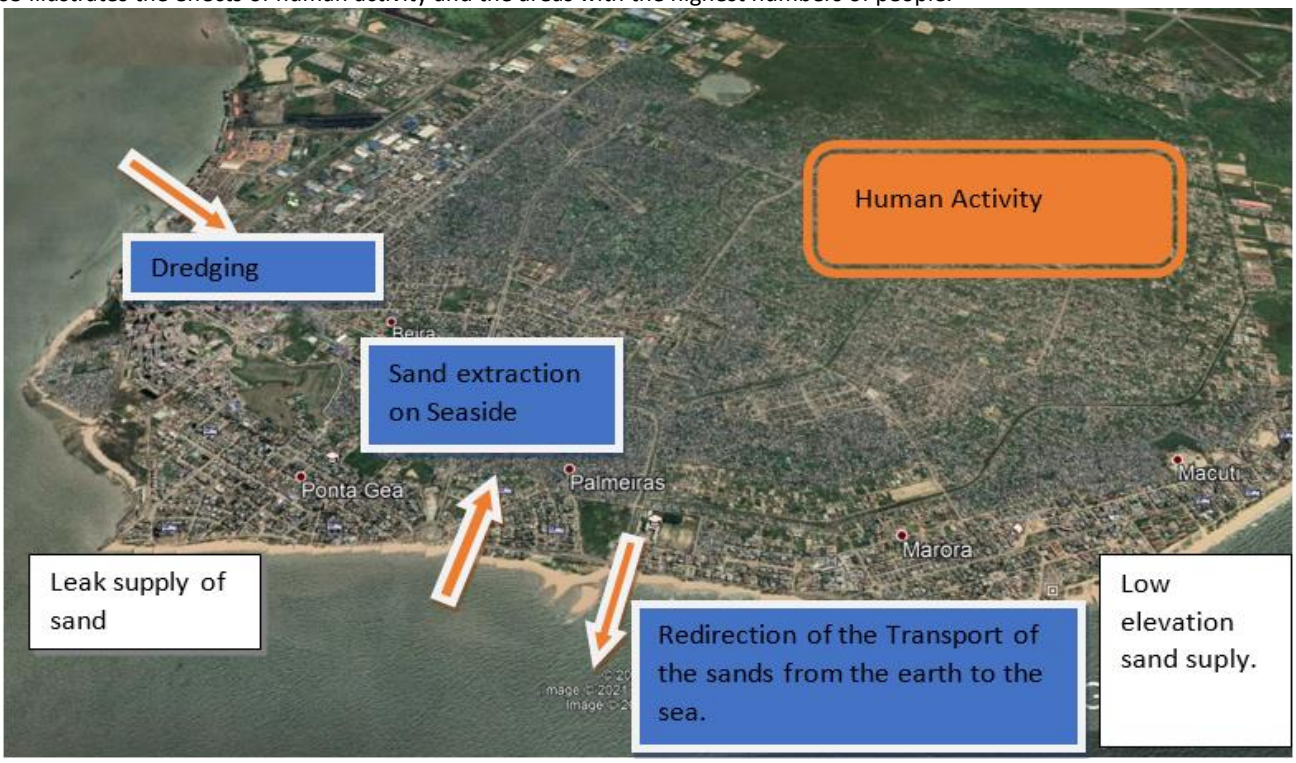


Figure 03 – Human activities that levarage the seaside erosion..

Figure 04 – Praia Nova's Population Placing bags with sand for shore safeguard.

NATURAL INFLUENCE ON SEASIDE EROSION

One of the main natural factors in the smashing of the shore zone of Beira is the enlargement in sea level, which on stormy days is accompanied by waves of greater intensity, and which, due to the lack of resilient protective structures, ends up overshadowing the few less resistant that during the coast are verified. In figure 04, some of the protection structures frequently used in the city of Beira can be seen, the same ones that do not have a good resilience, and that are easily destroyed in the event of the occurrence of tides.
Figure 05 illustrates the natural factors that contribute to the erosion of the coast.

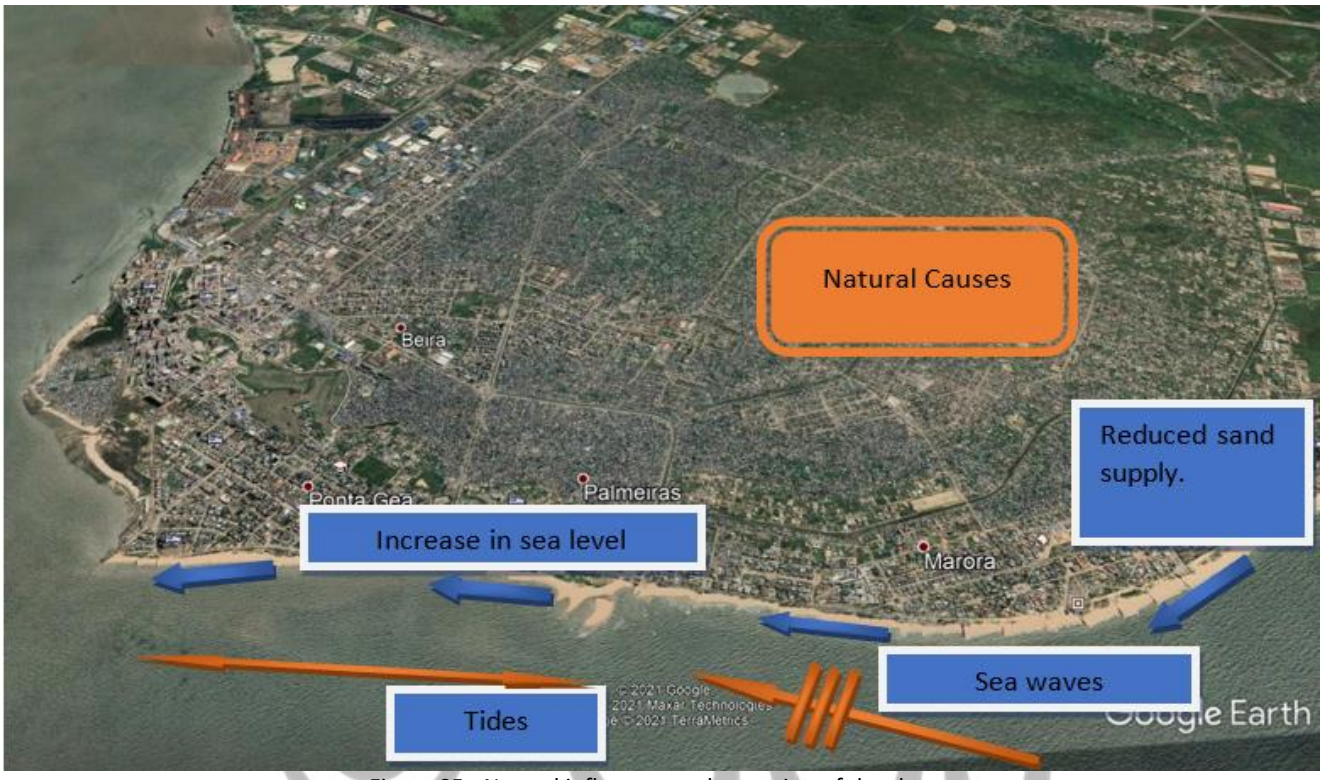


Figure 05 - Natural influence on the erosion of the shore.

SORTING OF AREAS OF HIGH RISKS

As the City of Beira is a deposition zone of the Pungue River, it presents itself with the entire coast as being at risk, however there are areas that suffer more impacts than others. The areas of Ponta Gêa and Chaimite, as you can see in Figure 06, are the ones that are most exposed to strong erosion and flooding from the sea. which are well below sea level which makes it always suffer the impacts when the climate changes. These are the areas that deserve more attention, along with the area of Praia nova. They show studies that are the areas that most reduced their coastline perimeter compared to the rest of the city of Beira. We also have a part of Ponta Gêa and all Chipangara that suffer a regular flooding of the sea, this due to its elevation in relation to the level of the sea. The Macuti area presents more local and occasional sea flooding, a scenario that has been observed more in the Clube Náutico and Praia dos Biques area.
The estoril zone is where there is no flooding of the sea due to the biological protection of dunes, which are physical units formed by sandy sediments that are transported by the action of the winds. In coastal areas, dunes, or so-called frontal or ante-dunes, often have the role of reducing wave energy, especially during the occurrence of undertow (Reis, 2001).
In this area, a greater risk of future flooding is expected due to the erosion that occurs on the coast, coupled with urbanization works that are taking place.
This will be the reality of several inland areas of the city of Beira, if the drainage of the chiveve that is currently benefiting from rehabilitation is not maintained by basic maintenance works, if the buildings along the ditches that block in large areas are not removed part of this maintenance activity and that urbanization be stopped in areas with natural water retention basins. Figure 06 shows the risk levels of different areas of Beira City. que bloqueiam em grande parte esta actividade de manutenção e que seja estancada a urbanização em zonas com bacias natuarais de retenção de água. A figura 06 mostra os níveis de risco de diversas zonas da Cidade da Beira.

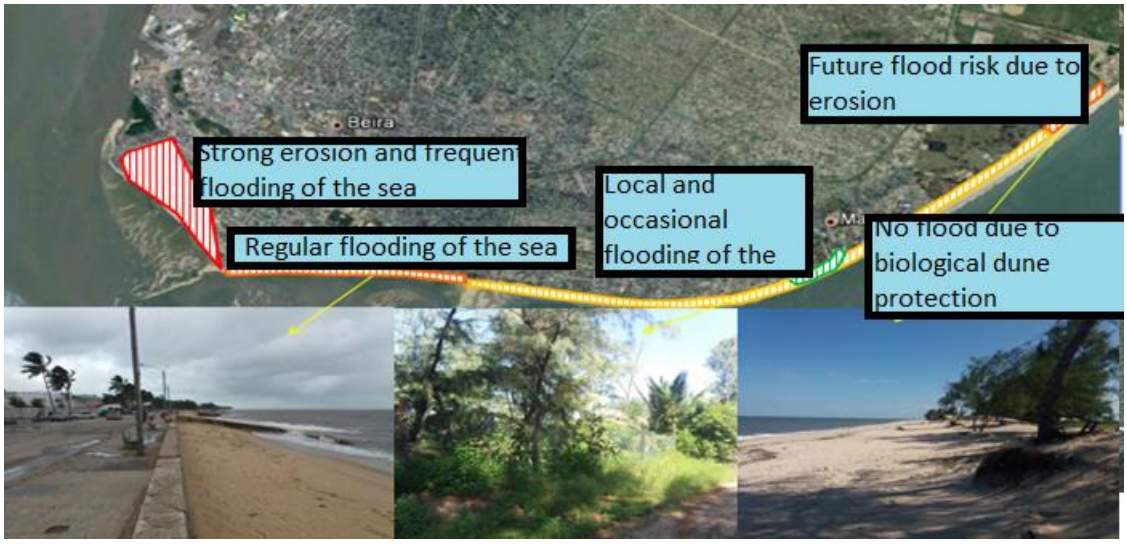


Figure 06 - Levels of risk to coastal erosion.

AREAS OF HIGH VULNERABILITY FOR EROSION AND FLOODING

As Figure 07 illustrates, the most vulnerable areas are Chaimite and Ponta-Gêa (Praia nova, Palácio dos Casamentos, Mira-Mar). Note its greater degradation over time in these areas, and as mentioned above, most of the infrastructure at this time is already in the aquatic environment. These are the areas that deserve careful attention by the authorities, as well as anyone interested in analyzing the impacts on the coast, this due to their level of degradation, as well as the lack of placement of resistant protection infrastructures. Figure 07 illustrates the most vulnerable areas.

Figure 07 - Areas of Beira City with greater vulnerability to coastal erosion.

As can be seen in figure 08, there is a tendency to reduce the coastline in the entire shore area of Beira City, with more advanced effects in the Ponta Gêa and Chaimite areas.

Figure 08 - Areas of Beira City with the greatest potential for erosion and flooding.

Figure 9 shows the problem of urban growth in the area of Praia Nova, which causes the mangroves that protected the coast to be destroyed, leaving the area with greater vulnerability to erosion and flooding. Situation of the new beach from 1920 to the present day..

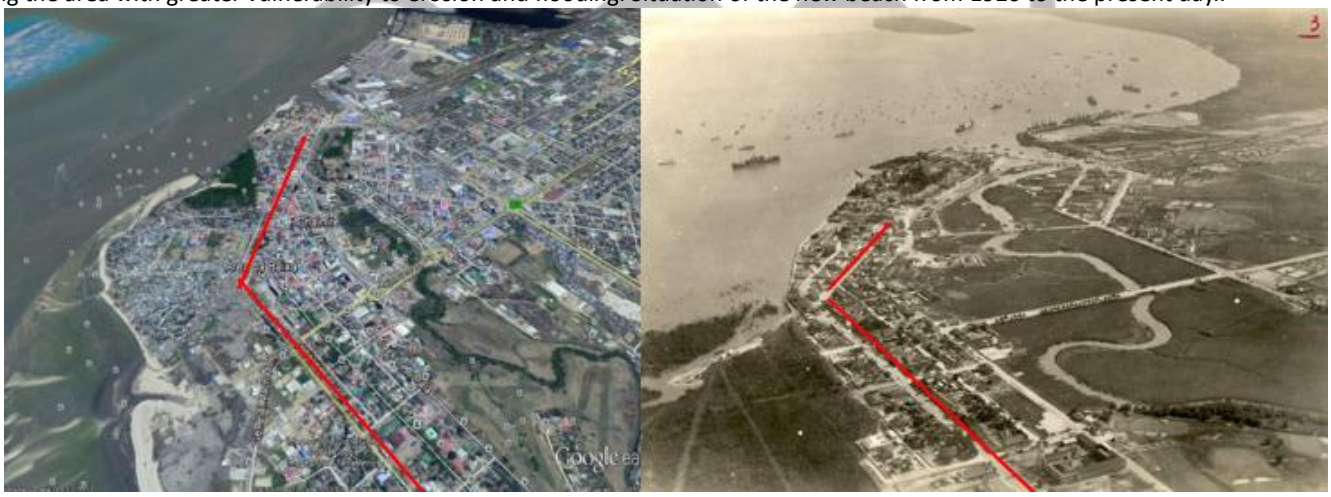


Figure 09 - Urban Growth in the Praia Nova Area (1920-2018).

In the 1920s, Praia Nova was an area covered by a plenty of mangroves, but due to the search for the support of sundry families, they were destroyed without proper replacement (in search of wood fuel, means of housing construction, invasion of the mangrove area for housing), and that these days are completely gone. It is an area that immensely receives the sand from dredging activities on the coast.

Urbanization has been happening practically in the body of water, and at this moment all attempts to vacate the area have been frustrated because the population recurrently retakes this area.

Conclusion

- From the study carried out on the impacts resulting from seaside erosion in the Beira city, the following was observed:
- The city of Beira is trapped in a flow confluence zone, which is naturally humid (swamp), with few exits to the sea and with infra-structures that prevent the natural drainage of the waters (increased urban expansion). The city of Beira is also located in a low area close to the ocean and, that's why, is highly vulnerable to climate change (wave outbreaks, cyclones).
- The Púngue River is limited near access lines crucial to Beira (EN6, railway) and represents a greater risk of flooding for various infrastructures.

- The coastline is receding due to disruption of sand transport along the coast at various drainage points. This problem is also accelerated by the activities of man along the coast. The coast's natural protection line (dunes) is in poor condition and is deteriorating.
- The strengthening of this line of defense is necessary to protect the city from sea impulses and rising sea levels. Behind the dunes, part of the city is in low-lying areas and if the line of protection breaks, much of the city may be at risk of flooding.
- Beira (Chiveve) natural drainage drains only a small part of the city, even though the new macro drainage is working well, however without sediment balance. It is also noted that several micro-drains are not connected to the main drainage system.
- The city of Beira has few retention basins or other drainage outlets (natural) in the city to support further urban expansion.
- There are no clear zoning rules to manage urban sprawl and mitigate the risk of flooding, which makes integrated urban planning necessary.
- Natural factors (rising sea levels) are making the *city of Beira more vulnerable to erosion and flooding.*

Remembrances

As suggestions for this study, the following points arise:
• Consideration of drainage systems (ditches and retention basins) in urban and peri-urban planning processes;
• Creation of spaces for the Pungue River to alleviate the threat of flooding when accessing roads (EN6, railroad);
• Ensuring sufficient drainage, retention and protection against flooding;
• Restore the dunes, and stop small activities that contribute to erosion (transport of different means through the dunes);
• Restructure the infrastructure to facilitate the maintenance activities of the drainage ditches;
• Consider new retention areas and avoid urbanizing them;
• Develop and implement early warning systems;
• Make infrastructures more resilient;
• Improve inspection of buildings to prevent buildings along the shore and or in the access area to drainage ditches.

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