

Study of the Vulnerability of Coastal Areas Using a Geographic Information System (GIS): Case of the Bay of Algiers

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Abstract

Bay of Algiers is situated at the heart of the Algerian capital, where the population density and urban important, and many factories and commercial activities, making it vulnerable to pollution, especially along the coast, in addition to climate change that result on the planet, all this lead us to study the impact on the coast of the Bay of Algiers, and its exposure to risks of erosion and marine intrusion. The aim of this work is the perception of vulnerable coastal areas, by determining the Coastal Vulnerability Index (CVI) at the level of the bay of Algiers, through reliance on physical factors. Through the Geographic Information System (GIS), we can process and analyze the information, and propose technical solutions to protect and manage the coastal, especially the sensitive areas near river mouths, a place of exchange and interaction of intense sediment transport.

Keywords: Vulnerability – coastal areas - coast line - Geographic Information System – CVI.

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INTRODUCTION

In our case study, we determined the vulnerability of coastal zones at the level of Algiers Bay, using the Coastal Vulnerability Index (LCI) which is based on the combination of six different variables (hydrodynamic parameters, morphological and historical), using MapInfo 8.0 software, we obtained the final map of coastal vulnerability of the Bay of Algiers, that can explain the degree of degradation of the coastline (decline of the dryness of the coast).

MATERIALS AND METHODS

Définition De L'indice Côtier De Vulnérabilité (ICV)

L'ICV est calculé d'après la formule de Gornitz *et al.*, C'est la racine carrée du produit des différentes paramètres ou variables divisée par le nombre de variables utilisées [1] :

$$CVI = \sqrt{\frac{a b c d e f}{6}}$$

Where,

- a- Geomorphological features;
- b- Slope of the coastal zone ("low" or "high" rating);
- c- Historical local rise in mean sea level;
- d- Shoreline recession rate, indicator of coastal erosion;

e- Average amplitude of the tide;

f- Average wave height near the coast.

After determining the ICV values, four categories are created using the statistical quartiles (0-25%, 25-50%, 50-75% and 75-100%) and visual inspection of the data [2]. These categories are characterized respectively by low vulnerability, moderate, high and very high. Each calculated value falls into the relevant quartile, so each coastal region is characterized accordingly.

We used the MapInfo Professional 8.0 software, which allows you to build a database and develop processed maps through three essential operations: calibration, digitization and thematic analysis [3].

RESULTS AND DISCUSSIONS

Risk Factors

- Coastal geomorphology: the vulnerability is very low at both ends of the bay of Algiers, but the trough of the bay is very vulnerable.
- Coastal Slope: Vulnerability is higher along the trough of Algiers Bay and the eastern shores than the western areas [4, 5].

- Sea level rise rate: does not exceed the value of 1.1 mm / year, this value does not constitute a risk on the coast.
- Shoreline retreat: the evolution of the shores of Algiers Bay does not exceed 1m / year, and the risk of this factor is moderate.
- Mean tidal range: The average tidal range is 0.34 m, and the risk of this factor is very high.
- Average wave height: The risk levels of this factor are varied along the coastline: (55%

very high), (20.4% high), (1.6% moderate), (1.9% low). (21.1 very low)

Coastal Index of Physical Vulnerability

The eastern and western regions of the Bay of Algiers are less affected (moderate vulnerability), except for some shores that have low vulnerability (Raïs Hamidou, El Marsa, and at the port of Algiers) [6, 7].

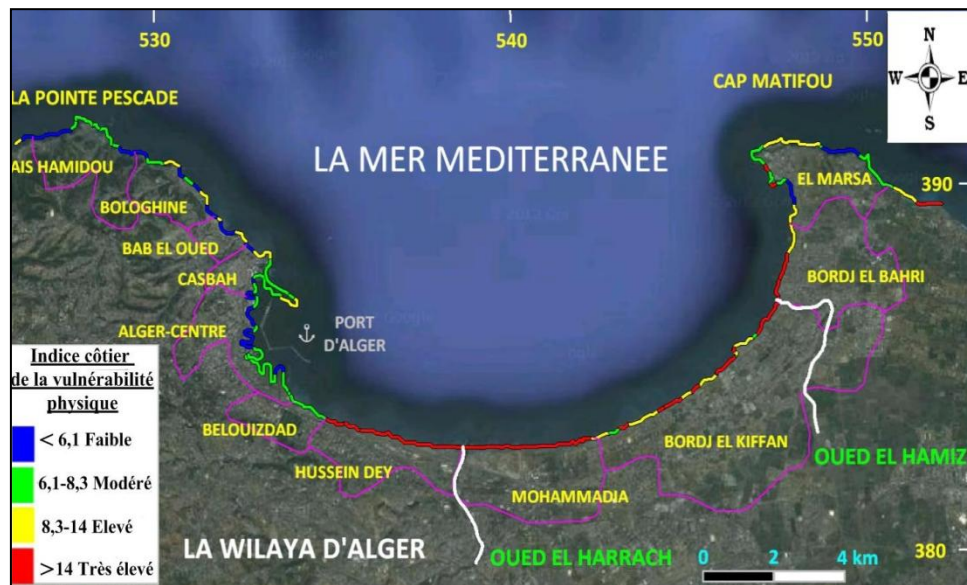


Fig-1: Map of the Coastal Vulnerability Index (CSI) for the Algiers Bay coastline

The vulnerability at the shores of: Hussein Dey, Mohammadia, and much of Bordj El Kiffan and Bordj El Bahri is very high, this is mainly due to the morphology of these areas, the structure of the beaches

here is sandy or alluvial, where the slope is very low, which makes the coast more vulnerable to soil erosion and flooding, especially at the mouth of Oued El Harrach and Wadi El Hamiz [8, 9].

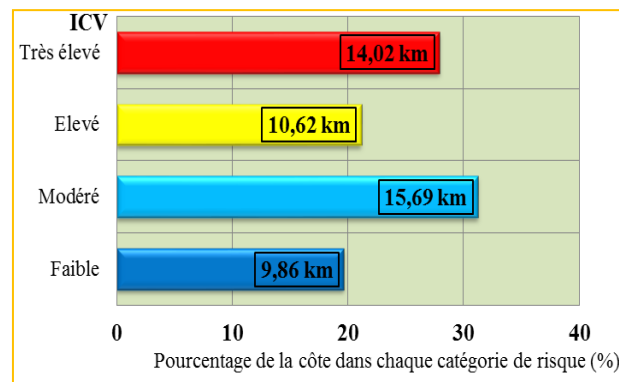


Fig-2: Percentage of Algiers Bay coastline for each degree of physical vulnerability

The degrees of risk on the coast are summarized by the following proportions:

- 28% very high
- 21% high
- 31% moderate
- 20% low

CONCLUSION

The objective of this study is to know the current state of the coast of the bay of Algiers, highlight the complex actions of the sea and the sensitivity of the coastal fringe. The results revealed a strong physical vulnerability almost to all beaches, except both ends of the bay, this is due to the specificity of these regions, which are characterized by:

- Their morphological structure (alluvial and sandy);
- Their slope, that it is weak in these zones;
- Existence of two estuarine zones (the outlet of Oued El Harrach and Oued El Hamiz).

At the mouths of Oued El Harrach and Oued El Hamiz, there are accumulations of sediments that impede the regular flow of water and increase the risk of flood probably resulting in the formation of muddy plugs.

REFERENCES

1. Bencherif, S. (2011). Pastoral farming and cereal farming in the Algerian steppe Evolution and development possibilities (Doctoral dissertation, AgroParisTech).
2. Babouri, K., Pennino, M. G., & Bellido, J. M. (2014). A trophic indicators toolbox for implementing an ecosystem approach in data-poor fisheries: the Algerian and Bou-Ismaïl Bay examples. *Scientia Marina*, 78(S1), 37-51
3. Latreche, M. L. (2013), Contribution à l'étude de la vulnérabilité de la zone côtière Algéroise à l'aide d'un système d'information géographique (SIG); Mémoire de Magister; Université ZIANI Achour de Djelfa.
4. Niazi, S. (2007). Evaluation des impacts des changements climatiques et de l'élévation du niveau de la mer sur le littoral de Tétouan (Méditerranée occidentale du Maroc): Vulnérabilité et Adaptation.
5. Planton, S., Cazenave, A., Delecluse, P., Dörfliger, N., Gauffrès, P., Idier, D., ... & Peings, Y. (2012). Evolution du niveau de la mer. *Changement climatique et niveau de la mer: de la*.
6. Pendleton, E. A., Thieler, E. R., & Williams, S. J. (2005). *Coastal vulnerability assessment of cape hatteras national seashore (CAHA) to sea-level rise*.
7. Babouri, K., Pennino, M. G., & Bellido, J. M. (2014). A trophic indicators toolbox for implementing an ecosystem approach in data-poor fisheries: the Algerian and Bou-Ismaïl Bay examples. *Scientia Marina*, 78(S1), 37-51.
8. Drhee. (2011). Development study of El Hamiz wadi, Mission 1: Preliminary study and data collection, Volume 3 A: Geological and geotechnical study, Wilaya of Algiers, 43.
9. Drhee. (2010). Planning Study of El Harrach Wadi, Mission 1: Data Collection and Preliminary Studies, Volume A.1-Data Collection, Wilaya of Algiers, 70.