

Data on the phenomena of deposition and erosion on the coast of Shëngjin-Vlora, issues and results

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Abstract

Overpopulation of the Albanian coast has also prioritized, along with the studies of demographic and social issues, the detailed study of natural elements of the coast, in order to foster its stable development. The analysis of endogene factors on the modulation and development of the territory is properly handled by the policies on the coastal area development and management; as a result, its study is of practical interest. This paper focuses on the general morphotechnical and morphological conditions of modulation of the coast of Shëngjin-Vlorë, which over the last half century has undergone a great morphological and environmental transformation, and brought out several acute scientific issues in Physical Geography, particularly in Coastal Geomorphology. The main aim of this article is to evidence the phenomena of erosion and deposition in the most dynamical zones of this coastal area by using the method of comparison of maps and satellite images. We would like to emphasize that the ratio of erosion and deposition on the coast of Shëngjin-Vlorë have changed in time and space, but the recent years have shown a tendency for a rapid increase of erosion along a considerable littoral, which has brought about complications on beaches, their shrinking, and naturally a retreat of the coastline in the low areas, and which are not under the direct influence of rivers. The paper also gives a short prognosis for the coastline of Shëngjin-Vlorë during this century.

Key words: Coastline, geomorphology, erosion, deposition, environment

1. Introduction

This article intends to provide a general overview of the present situation of the Albanian coastline morphology, focusing on the dynamics of the coastline in recent decades. Through comparing topographic maps of scale 1:25 000 of 1957 and 1985, as well as the topographic map of scale 1:10 000 of 1994, including graphic materials of later years, mostly satellite images, there has been made possible the observation of the phenomena of erosion and deposition on the extent of the coastline in the area of Shëngjin-Vlora, just as are also evidenced large morphological transformations in specific sectors at the outlets of the rivers Mat Ishëm, Erzen, Shkumbin, Seman, and Vjosa. Precisely through the method of comparing maps and ground surveys there has become possible to also predict in general the dynamics of the coastline during the 21st century.

2. Extent, boundaries, and size

The coastal area of Shëngjin-Vlora includes the westernmost part of Albania toward the north-south, with a total length of 230 km. Its width varies from 4-5 km in the hills of Rodon to 25 km in the sector between the outlet of the Seman and Vjosa. But the scope of our work takes into account only the part that is in continuous contact with the sea, or to such extent that the sea has its indisputable influence (Fig. 1). As natural eastern border is taken the north-westernmost part of the synclinal field of Tirana, the northwestern part of the hills of Preza, Durrës - Bisht-Pallë, the northwestern part of Kavaja field, hilly range of Ardenicë-Divjakë-Kryevidh, thus including all the coastal area from the outlet of Shkumbin to the bay of Vlora.

The coastal area of Shëngjin-Vlora is included in the Western lowland from the physical-geographical standpoint. It is formed by various rocks, where there dominate the Plio-quaternary sedimentous deposits, terrigenous sediments, and numerous alluvial and sea deposits. From the tectonic perspective, this area lies entirely in the near-Adriatic Plains. It has a Mediterranean field climate, and is traversed many rivers, represented by the lower sectors of their flows, which have a crucial role in its geomorphologic evolution.

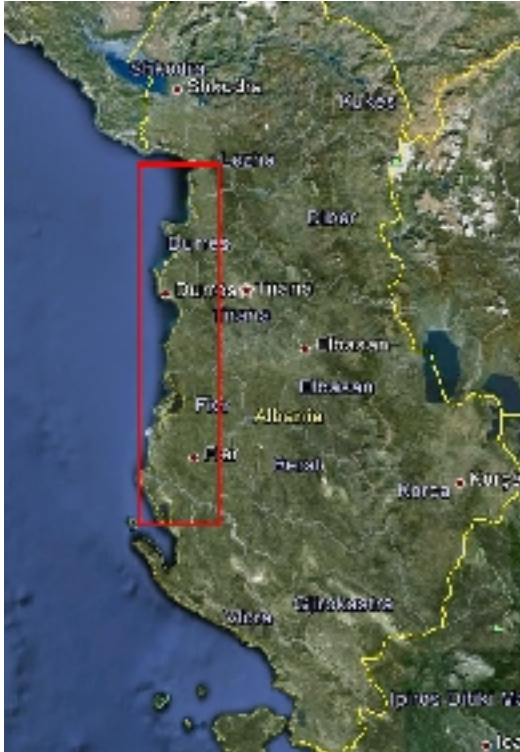


Fig.1. Satellite image of Albanian coast (sektor of Shëngjin-Vlora bordered).

3. Importance of studies on the evolution of the coastline

The coast is one of the most sensitive zones, environmentally speaking, which is related to the conditions of development and use. On it lie some of the most protected areas of the country, as they are subject to research for many fields. The economic and tourist potential of our coast is enormous, therefore it requires a better management and rational use of resources. This use should be made after having known the conditions of development and evolution of all natural factors. A better understanding of the geological and geomorphologic reality of the coast thus also helps researchers of other fields. It is an undeniable fact that the coast is one of the areas that presents a great variety of exposure, consequently scientific studies of it require careful treatment of all factors influencing its rapid development. So, factors should be seen in permanent interaction with one another, by integrating the multidisciplinary scientific opinion.

4. Basis of data and method of work

To analyze the evolution of the coastline in the area of Shëngjin-Vlora, we have considered the topographic maps of 1957 and 1985, other cartographic materials, as well as satellite images of recent years. It is understandable that the literature has been very helpful, it being rich, just as the treatment by former authors has aided us considerably in achieving our objective. For the Holocene epoch as a whole, we are mainly based on the drilling done by the Geological Service in this area for groundwater and of course electrometric drilling {6,7,9} that brings closer the standard of accuracy of the littoral at the outset of Holocene, in the ancient period, and nearly a century ago. Naturally frequent field trips have given us the opportunity to observe more closely the most dynamic sections, which certainly belong to river deltas and their area of influence.

5. Results and their discussion

5.1. Study of the coastline in time and space

The first effort to map the Albanian Adriatic coastline can be considered what was published in the work "Military Battle of Caesar against Pompey" by G. With in 1920. The most important geographical data from the study is that Shkumbin flowed two thousand years ago into the Bay of Durrës, after traversing the field of Kavaja. This historical data gives a major explanation of powerful sandy-conglomeratic formations, thus alluvial deposits. A map of the Austrians (1916-1918, 1936) 1:200 000 scale, to the after the liberation maps, which are renowned for their accuracy, constitute a satisfactory basis for qualitative and quantitative interpretation of the rivers' outlet position, extent of the Albanian coasts, and dynamic movements of the coastline. Proper scientific studies on the morphology and morphogenesis of the Adriatic coast were conducted only during the second half of the 20th century.

Taking into account the wide range of factors that modulate the coastline, but also the fact that during this century is expected to be an alarming increase of the sea level due to global warming {8}, we arrive at the conclusion that on the Adriatic Coast are threatened a lot of beaches, even many coastal sectors. The first attempts to prognosticate the coastline based on the rate of erosion and deposition appear far from giving accurate recommendations (engineering-geological maps of the coastline forecast, 2000, etc.).

In preparing the models for the prognostication of the shoreline not only should be considered the current average rate of silting up or retreat by sections, sea level increase, shoreline interventions etc., but also interventions in the riverbeds, natural tendencies to avoid their outfall, port engineering construction, increasing pressure on the territory as a result of population growth and constant change of economic activity and the modification of the whole geographical area, the complexity of agricultural use of the fields near the coast, neotectonic and wavering movements, studied and unstudied interventions in the water-collecting basins, soil erosion nationwide etc. thus, an accurate coastline forecast is difficult to achieve. However, there can be offered information of approximate value, dictated primarily by the to date accomplishments of institutions and authors who have studied the phenomenon of change of Albania's coastline.

Studies on the evolution of the coastline require consideration of all the factors that shape the coast, them being whether of geological character, as well as external geodynamic one. Essential for us is the constantly changing dynamics of the solid and liquid flow of rivers, which are dictated by climate changes and characteristics of water-collecting basins. The deeper the knowledge of solid flow characteristics, its changes over time and what is most important the trends of the pendulous movements of rivers' outfalls, the greater will be the accuracy of measurements, management and after all the control of the coastline. Shoreline changes require continuous observation in the field, tracking its dynamics step by step. In terms of time it is important to specify the period required to have a result from measurements. It is obvious that graphic materials year after year help us in this regard. To enable the accuracy of the measurements there help us the field methods associated with specific objects (a bunker, a building, etc.), but it is more accurate to place particular metal devices, scalable, which also bring data on the dynamics of waves according to the seasons and years. Various research institutions have practiced this mainly in deltas, or near outlets of rivers and the results have been really interesting. If the annual analysis is sufficient to have a precise study on the evolution of the coastline, it remains to be discussed, but given the previous experience, it can be said that the

prognostication of the coastline, also referring to foreign authors, (Bird 1985, 2008, etc.), requires at least a 5-10 year period. The construction of bunkers in the 70s and 80s of the last century, while some of them remaining in the sea, shows how unpredictable the coastline is. Driven by this fact, but also other important elements associated with port constructions, or buildings for tourism purposes etc, we believe that the topographic maps produced in our country (in 1957, 1985) have given us such comparative information in this regard that today our geographical science carries weight. Given a span of about three decades since their publication, the change has been great and we are now able to work out a pattern on the prediction of the coastline. In the future, there will be more challenges in this regard, as there has changed by nearly 50% the total quantity of fragmentary material as food for our beaches {4,7,9}. The cause is related to hydric cascades over river-beds where the effects will be felt more and more in the future.

Another problem that arises as a challenge for the future is related to the areas being eroded and silted up. In comparing the maps it becomes clear where erosion has dominated and where there has been a tendency of silting up. On this basis, we are able to know the length of the coast being eroded and the one being silted up. This method gives a correct result on the stability of shores, also with regard to taking measures to manage the coastline. Although it is quite important to know the sections being silted up and eroded in their extent, for the geographical science but not alone it is important the surface eroded and silted up over a span of "x". When we talk about length, it is obvious that it varies by year and is subject to the influence of rivers (pendulous movements of their solid and liquid flow etc.), but when it comes to the surface we are more accurate, since it obtained after a long process of silting up{8}. The same thing can be said about the areas affected by erosion. On this basis, thus the corrosion-deposition ratio, derived from the balance of sections being eroded and those silted up, enables us to know how much land is actually obtained. In 1980 this ratio was 3:1 in favor of deposition {6,9}. The last graphic materials, compared with the 1985 maps show that this ratio is currently 2.2:1, still in favor of deposition. But here should also be considered as a challenge the impact of the world sea level increase, and to what extent it will influence our shores qualitatively and quantitatively.

Here arises a problem with the sectors that are affected by erosion or deposition phenomena in negligible amounts, generally belonging to the lower sectors recognized as relatively stable (the coastline of the bay of Durrës, etc.), or also high coastal sectors that retreat so little that the change on maps over several decades is negligible. To get a clearer picture between erosion and deposition on the Adriatic coast of Albania, there is required a continuous monitoring of all sectors, i.e. to all its extent.

5.2. Today's dynamics of the littoral, erosion-deposition ratios, and morphological changes

The evolution of coastline is one of today's and future's basic scientific problems of the country. Driven primarily by the priorities of coastal tourism, economic, industrial, and agricultural etc. development, the analysis of the coastline and its continuous monitoring is a future task for geomorphologists (but not only).

To see how our coastline has evolved in time and space, it is enough to compare maps of different years and for the recent years to compare satellite images. The cartographic material for the coast is very extensive and this helps to a fuller commentary. To make an accurate monitoring of coastline, we are based on the relationship between the deposition and erosion. So we have to do with a balance deriving from the interaction of two opposite phenomena. By

referring exactly to topographic maps, we can observe that the Adriatic coast has undergone a spectacular transformation during the Holocene, with an almost absolute dominance of deposition over erosion. Still today silting up dominates over retreat, which is shown by the continuous advance of the coastline to the west.

The deposition and corrosion rate is different in different areas. This depends both on internal geodynamic factors, and external geodynamic factors. In the first category there influences the lithological composition, characteristics of structures (mainly direction, stratigraphic elements, etc.) and, especially, tectodynamic elements, i.e. tectonic movements and their character {4,5}. In the second group, of paramount importance are waves {8}, but actually the change of the littoral, and predictions of its evolution cannot be understood without knowledge of the rivers that flow into the Coastal Plain, their solid and liquid flow, characteristics of water-collecting basins, and, what is most important, pendulous movements of their outlets. The deposition-erosion ratio has also been strongly influenced over recent decades by anthropogenic interference, which directly or indirectly is becoming an important factor in the dynamics of the Albanian coastline {1,2,3}.

By comparing the maps of 1957 and 1985, i.e. a period of approximately 30 years, the dynamics of change has been spectacular (experiment 1 and 2, picture 3 and 5). The silting up was present in many areas of the Adriatic coast. The ratio between erosion and deposition was 1:3 {7,9} and such a domination of the silting up has led to a significant increase of land surface. Subsequent maps, those of 1994 (1:10000) confirm the dominance of deposition, but at the same time there is erosion in many sections, which is shown by remaining military facilities (bunkers) at sea, or even in endangering some tourist facilities (Patok, etc.), as well as through the retreat and endangering of many beaches {3,7,9}. Satellite images of recent years show an increase in the length of the coast suffering from erosion, especially in many areas under the influence of the river Drin of Lezha, the old outlet of the river Seman, on the beach of Vlora, etc.



Fig.2. View from the coast of Kune-Vaini, where the bunkers remaining in water show clearly the powerful erosion over the last 30 years.

However, deposition continues to dominate over erosion, although there is a decline in the pace of silting up in its entirety for the whole Adriatic coast. The highest rate of deposition is at the current outlet of the Seman, with approximately 70-80 m / year, while that of erosion in the section of the old outlet of the Seman, with 25 m / year {1.2}.



Fig.3. Evolution of littoral in the zone of Patoku.

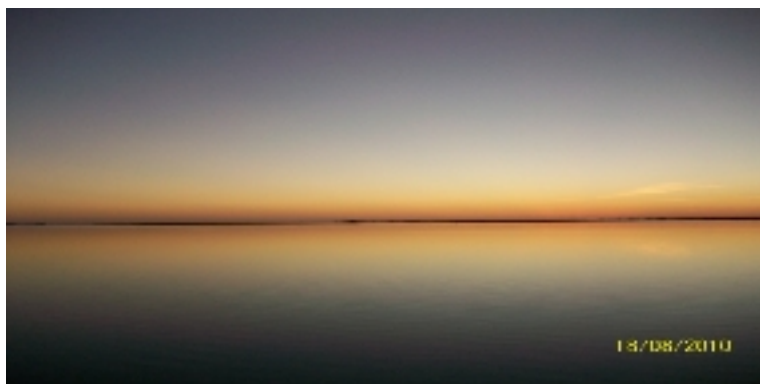


Fig.4. View from the new littoral cordon of the river Mat, formed after 1995.

In the total length of 235 km, from Shëngjin to Vlora, 122 kilometers have silted up, 71 km have been affected by erosion, whereas 42 km appear stable. Three decades ago, erosion was present in no more than 50 km of Albania's Adriatic littoral (including the sector from Shëngjin to Buna) {6,8,9}. Despite the figures, the ratio between silting up and retreat in extent, i.e. in concrete length, is not an indicator to be taken as definitive in scientific analysis because the dynamics of the coastline is very complex, and so are the causes of this change, i.e. stimulating natural and human factors. The length does not indicate the force of phenomena, even though the indicator remains essentially important and orienting. This because the erosion-deposit ratio on the Albanian coast, although important, does not represent the real strength, and environmental and

morphological reality on the ground for a longer time than one year. In other words, the trial, i.e. the analysis, should be done on the surface, for a specific period of time. Only the differences between the increased (silted up) surface and retreated (eroded) surface do properly and timely show us the relationship between erosion and deposition on the Adriatic coast.



Fig.5. Evolution of littoral in the zone of influence of the rivers Shkumbin and Seman.



Fig.6. Satellite image of the Adriatic coast. Shown are sectors being silted up, retreated, and those on balance.

6. Conclusion

Albania's coastline has undergone significant changes during the Holocene, but has shown a very clear trend to shift westward. The coastline continues to change rapidly today too. Over the last

100 years, it has been characterized by further refractions, but there continues the westward movement, although it is already evident that many sectors of our coast are suffering from severe erosion. The total length of 235 km, from Shëngjin to Vlora, 122 kilometers are being silted up, 71 km have been affected by erosion, and other 42 km appear stable. Three decades ago, erosion was present in no more than 50 km of Albania's Adriatic littoral (including the section from Shëngjin to Buna). The sections being silted up continue to dominate over those being eroded, regardless of silting up-erosion ratio having decreased from 3:1, four decades ago, to 2.1:1 nowadays.

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