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Analysis of the Caspian Shoreline Changes Effectiveness in Connection with Land-Use Changes (Case Study: Babolrood Shoreline)

Hamid Amounia[1], Siavosh Shayan[2]*, Mojtaba Yamani[3]

1- Graduated in Geomorphology Environmental Management, Tarbiat Modares University, Iran
2- Associate Professor Physical Geography, Tarbiat Modares University, Iran
3- Professor Geography, Tehran of University, Iran

1-Introduction

Beaches, due to environmental (natural-human) conditions, have many changes in the spatial-temporal dimension. Due to this fact, coastal areas are really important. Beaches are part of the complex system of the planet Earth, which occupies only 10% of the total area of the universe (Cai *et al.*, 2009). The majority of human beings choose beaches as their habitat so that about 60% of communities are located in coastal areas (Cracknell, 1999). Shoreline is an extension where exactly seawater intersects with land (Bird, 2008: 2). In international waters, the shoreline is defined as the line that connects the mean points between the maximum tide and the minimum tide. Regarding the dynamic nature of water and land, the coastline situation is not always stable in the short or long term. These shoreline changes can have adverse effects on the environment, natural resources, ecosystems, socio-economic, cultural, and ultimately defense security (Thoai, et al., 2019). A change in coastal land-use patterns can directly affect changes in coastal position (Griffiths, 1988). The coastline can change due to erosion and sedimentation (Rio et al., 2013) and by changing the pattern of land use near the coast, erosion or sedimentation occurs which leads to a change in the coastline (Erickson, 2006; Ahmed, 2011). This study aims to compare the shoreline changes in the digital shoreline analysis system and land use maps for 42 years, between the shoreline changes with the development of human activities and land uses, and then to analyze the relationship between the changes. Coastal land use during periods of the impact of Caspian Sea level fluctuations on coastline changes.

2-Methodology

The data used in this study are in two parts:

A. Sea level data that have been used to draw the Caspian Sea level chart of and its basis is Anzali.

* Corresponding Author: **E-Mail:**shayan@modares.ac.ir

B. Data including Landsat satellite images on TM and OLI sensors have been used to map historic coastlines and map coastal land uses. After registration, these images were downloaded from https://earthexplorer.usgs.gov. Sea level data was processed and analyzed with the help of Microsoft Office Excel software, and data related to satellite images were pre-processed and processed by Envi5.3 software. Coastline analyzes have been performed in GIS software (ArcGIS10.7) as well as the Coastal Line Digital Analysis System (DSAS) plugin. The present research method is analytical - comparison between data and sea-level information, shoreline changes, and land use maps. The land is 42 years old. After receiving the data from the Caspian Sea Research Center (CASPCOM), sea level data have been used to show the trend of changes in the Caspian Sea level at Anzali station.

3-Results and Discussion

In this study, first, the findings related to shoreline changes extracted through a digital analysis system; were analyzed and interpreted, and then the findings related to coastal land uses were presented and these findings were also interpreted.

To study the changes in the Babolrood coastline, regarding the trend of fluctuations in the Caspian Sea water level, the periods 1976 to 1995 have been selected as the period of increasing the level and 1995 to 2017 as the period of decreasing the level of water. In the first period, according to the Net Shoreline Movement (NSM) statistics in the shoreline digital analysis system, all transects along with the shoreline show negative numbers. This means that in this period, the coastline has retreated to the mainland, and in this way, in this period, the coastal lands have been associated with a decrease in area. In the second period, when the trend has been decreasing, the majority of the Net Shoreline Movement (NSM) statistics are positive. In the map of these two periods, which shows the trend of changes during the interval; In the first period, in the whole range of the level trend, the level increase was the same as the shoreline movement process, which varies from -139 meters to -33 meters. But in the second period, it is observed that due to the decreasing trend of sea level, it has been receded. In the map from 1976 to 1994, shoreline movements show the same trend as sea level data. But in the map of 1994 to 2017, in some parts, such as the estuary of the Babolrood River, where people have made changes in the coastline by constructing piers, the coastline has receded at a high level. This can show the relationship between land use and shoreline changes.

In the present study, land use maps for the three years 1976, 1995, and 2018 have been prepared. After preparing the land use map and evaluating its accuracy, the area of six

land use classes for each of the years in the study area was calculated. The results of the changes show that in the period from 1976 to 2018, the man-made use area and water compared to other uses has been increasing during this time, and in the meantime, the area of use of the rangeland has reached zero. To elucidate the type and percentage of changes from one use to another and to keep the same uses constant during the periods 1976 to 1995 and 1995 to 2018, diagrams of these changes have been drawn.

The percentage change graph between 1997 and 1995; reveals that most of the area in this period includes the same man-made land uses. In the second period, i.e. from 1995 to 2018, this trend continued, although in this period, man-made lands had the largest area in the total area; but other uses (which had a smaller percentage of the area); have been transformed into man-made uses, with barren lands showing the greatest value during this period.

A Diagram of the trend of land use changes reveals that man-made land uses have been increasing in both periods (first and second). Most other uses have become the same man-made uses at this time. This diagram also discloses the ineffectiveness of land uses from the fluctuations of the Caspian Sea water level fluctuations. Because, if this trend is affected, we should see a decrease in the area of man-made land uses, especially in the first period (when the shoreline progress conditions prevailed). The reason for this was a kind of shoreline management with the construction of dams and coastal walls.

4-Conclusions

The findings of this study indicate the existence of a relationship between coastline changes and land-use changes and vice versa, they indicate no relationship, especially in the second period with the sea level elevation trend in the study area. In the study period, the water level of the Caspian Sea has an upward trend (1976 to 1995) and a downward trend (1995 to 2017). The trend of changes extracted from the drawing of coastlines in the same years and their digital analysis shows the lack of coordination between some of these trends with the way forward and backward coastline in the study area. From the combination of two diagrams of sea level and man-made use, it can be seen that this lack of coordination also exists in this field. More importantly, it has been determined that man was able to manage the coastline in his favor during these 42 years by creating constructions. In a way, man has been able to succeed against the advance of the sea towards the land.

Keywords : Caspian Sea shoreline, land-use, DSAS, Babolrood, Babolsar

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