

Bhandal Island under the evolutionary geomorphic process of formation and deformation

Abstract

Bhandal Island is the part of the Indus delta, which is the largest wetland in Pakistan and is located near the Karachi. Temporal study over the last three decades has been done over this island. Land sat satellite data was used to evaluate the spatial and temporal changes, occurred over this island. Satellite images, dated 1988 and 2018 were over laid and difference were estimated. It was determined that about 1240 acre land has been expanded. Most of the part of the land has been expanded by accretion process. Sea wave action, location of the island, global sea level rise, tidal impact, and flora found in the island and many other activities reshaping the island have been discussed. In conclusion, changes occurred over the island has been confirmed and It was evaluated that intensity of which process effecting the island is higher.

Keywords: Arabian Sea, thematic mapper plus, color composit images, transverse mercator, old saint, ecological important, coast, Indus delta, millimeter, village

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Gohar Ali Mahar,¹ Noor Hussain Chandio,² Ahsanullah Khan,¹ Basharat Hussain¹

¹Department of Geography, Federal Urdu University of Arts, Sciences and Technology, Pakistan

²Shah Abdul Latif University, Khairpur, Sindh, Pakistan

Correspondence: Gohar Ali Mahar, Department of Geography, Federal Urdu University of Arts, Sciences and Technology, Gulshan Campus Karachi, Pakistan, Tel 00923352524699, Email goharmahar@gmail.com

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Abbreviations: TM, thematic mapper; ETM+, enhanced thematic mapper plus; UTM, universal transverse mercator; CCI, color composit images; WGS, world geodetic system

Introduction

Bhandul Island is a unique island of Arabian Sea located near the eastern coast of Karachi. An old community of native fisherman has been living in the island for many centuries. This island is located on northwest of the Indus Delta. A channel between this island and Karachi city provides a passage to the port Qasim located towards the north (Figure 1). It was a popular island in a time and occupied by a large number of fishermen with permanent settlements. Ibrahim Haidery is a nearest village located on western side of the island in Karachi. In the 1960s, the population of the area started moving. Now the entire island has been evacuated and its population has been moved to Ibrahim Haidery from where fishermen continue their fishing activities. There is a shrine of a religious saint in the island and large number of people annually come to the island to participate in the anniversary of the old saint. This area is environmentally as well as ecologically important because mangrove forests are found in this island. Siberian birds come each year in winter to this island. This area also provides home to 96 species of fishes as nursery and feeding ground (IUCN, 2005). Existence of mangroves for the sustainability and stability of the coast as well as for the island is necessary.¹ This Island comes under the IUCN wetland protected list for Ramsar site. Eastern part of the Pakistan coast is also under the threat of rising sea level. Sea level rise rate in Karachi and surrounding areas is 1-2 millimeter per year.² As the island is unique in its position having western side a big metropolitan city of Karachi and on eastern side the biggest wetland "Indus Delta" of country.³ Business tycoons keep their interest in developing a new city on the island, and on the other side, environmental stakeholders are continuously pushing to protect this island and keep this island a safe haven for natural habitat and biodiversity. It seems from the current and past records of aerial view that this island has not been in a stable position since many decades. That's why; it is constantly under the process of formation and deformation. It is because of natural processes, which have always

been dominant over this island. The other reason is keeping this island secure from intense commercial activities.

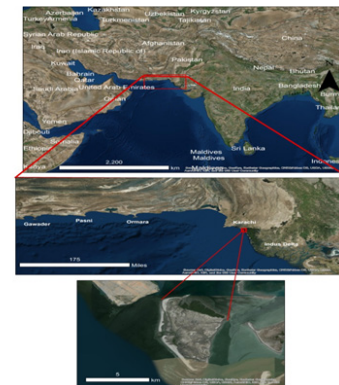


Figure 1 Location map of Bhandal Island, Pakistan.

Material and methods

It was scientifically observed with the help of satellite data that how the island has been reshaping and displacing since many decades. Satellite images of landsat Thematic Mapper (TM) that acquired data in 1988 have been collected and landsat image of Enhanced Thematic Mapper Plus (ETM+) that acquired the data in 2018 have been downloaded from online available data of USGS site (www.usgs.com). Universal Transverse Mercator (UTM) projection was given with the datum World Geodetic System WGS-1984. Color Composit Images (CCI) with all collected bands was prepared from both the images of the Island. CCI was made to get the natural overview of the island by selecting different combinations of bands. Coastlines of the island from both images have also been digitized. Band 4 was selected from landsat TM and band 5 was selected from landsat ETM+ so that land water boundary could sharply be differentiated and easily be digitized. Analysis was also made by overlaying both the images (keeping newer on upper side) so that differences and trend of changes could easily be observed. This figure identify the change occurred between 1988 and 2018 over this island.

Results

In view to analyze the aerial changes over the island, an overlay of the two images have been recommended to get results (Figure 2). In this figure, the changes have been detected with the help of satellite image of 1988 and 2018. Their boundaries have also been digitized to identify how much area has been modified. Red color line shows the boundary of island dated 1988 and purple color line shows the boundary of island dated 2018. It seems from the figure that in 1988, this island was comparatively smaller and it was divided into two parts. It was in process of accretion from southern side and a water passage was also found between two parts. The island in 1988 also seems to be smaller from the northern side. But the overlaid image of 2018 shows the complete one island. Accretion process from southwest has pushed the island from wave action in northeast direction and this way a bigger size island was built but it seems that the island has also expanded from the north. Bhandal Island exhibits consistent variations in their sizes and shapes. Figure and calculated data show that due to the accretion and other processes in the island, the area has increased. It was found after the area calculation in GIS program (Arc Map 10.3) that in 1988 the covered area of the island was 5860 acres and in 2018 the area increased to 7010 acres. A big difference of 1241 acres land in 30 years shows that the islands are continuous evolutionary process of formation and deformation.



Figure 2 This is a figure of two overlaid images of land sat on dated 1988 and other dated 2018

Discussion

Evolutionary morphologic changes occurring over the coastal islands or the island located near the coast on shallow shelf are caused by many factors but it depends on the site and situation of the features. Khan et al., (2002) stated that deltaic creek system near Karachi is more vulnerable than other part of the coast, as natural phenomena in this region are more intense such as tidal current, wave action and rise of sea level. Ejaz et al., (2018) expressed his opinion that cultural activities as well as natural processes are responsible for morphologic changes over the region. Some scientists are of the opinion that physiography of the features; their contextual placement, inundation of coastal features and placement of flora over the area are

also responsible in making morphologic changes over the region.⁴⁻⁶ It seems from the shape and location of the island that it is a triangular shape island. Western site consists of sandy material, that has been deposited over the island by accretion process of wave action while eastern site is just moist coast that is facing phitti creek. The third side is located on the north and is covered by mangroves trees. The Bhandal island location is also responsible for development of the island from the eastern side. Wave action especially in the pre-monsoon period plays an important role. Its direction is always northeast that strikes the island at 90°. Bhandal Island is the first feature after the coast of Karachi that is hit by waves. Extension of coastal land in Karachi (Defense Housing Authority, Phase 8) is also indirectly taking part in this evolutionary process. This newly extended portion is strait and has aligned the coast line of Karachi and Bhandal Island. Both coasts are now hit by sea waves at the same (90°) angle therefore shaping the same feature like on both coast that can be seen from latest satellite images and google earth. Sea level rise also plays an important role in the context. This is the gateway feature of the delta from the west. The features developed on the delta over millions of years consist of sandy or silty material. Fluvial process has deposited silt over the deltaic region in Holocene period while sandy material that is more prominent at the shoreline has been built by accretion process of sea waves. Varying climate after the long period of five decades, has also effected the coastal inundation. Karachi and the delta has been experiencing climate shift over half a century.⁷ This phenomenon is not ignorable in the evolutionary changing of the island.⁸

Conclusion

Bhandal Island over the past three decades is continuously under the evolutionary process of formation/deformation. The archive landsat image of 1988 and latest image of 2018 was used for analysis. Satellite image has provided the testament and confirmed how the island has changed over the period. About 1240 acre land has been developed from southwest and northern site of the island in last 30 years. It is evaluated that wave action and its alignment along the coast and direction of wave play an important role in the development of the island. While the tidal waves and sea level rise also play its role in the morphologic change of the delta.

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None.

Conflict of interest

The author declares there is no conflict of interest.

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