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Morphological Dynamic of Ekakula Spit and Kalam Island in Kendrapara District of Odisha—A Geospatial Approach

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Abstract

Odisha Coast of India is about 480 km long stretching and oriented in a SW-NE direction. The sediment contributions from the rivers are deposited along the coast. The littoral drift deposition builds spits and bars at the river mouths especially at the southern side of the river mouths. The one of the study area is situated between 20°40'57.417"N and 20°45'49.947"N latitude and 87°1'5.576" E and 87°7'4.959"E longitude. Another is the Dr. Abdul Kalam Island, formerly known as Wheeler Island, an island off the coast. The Integrated Test Range missile testing facility is located on the island. In May 2013, increasing concern has been drawn to the change of the island's topography, owing to sand erosion. Since the island is technically a shoal, seawater frequently causes sand-shifting. The situation is being monitored by geological experts from National Institute of Ocean Technology and the DRDO. The study has taken through Remote Sensing and GIS technology with time series satellite imageries during the year 1973 and 2017. The spit has growing gradually but now the erosion process has increased the spit length during the year 2015 and 2017. During the year 2009 and 2017, the Kalam island has stable and some areas are deposited.

Keywords: *Odisha, Ekakula spit, Kalam Island, Geospatial Approach*

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INTRODUCTION AND STUDY AREA

Odisha Coast of India is about 480 km long stretching and oriented in a SW-NE direction. The sediment contributions from the rivers are deposited along the coast. The net littoral drift along the coast is northerly and this drift together with the river-discharged sediments make the river mouths a depositional environment. The littoral drift deposition builds spits and bars at the river mouths especially at the southern side of the river mouths. The Gahiramatha coast lies about 10 km northwest of the Paradip coast on the northern side of Mahanadi river. Dhamara and Maipura rivers are at the northern side of Gahiramatha coast discharge into the sea. Ekakula spit is an extension of the Gahiramatha coast at the Maipura river mouth. The study area is the elongated spit extending towards north from Ekakula owes its origin mainly to the deposition of sediments brought by the northerly long shore sediment transport from south and partly to the sediments deposited by the Maipura-Dhamara river system. Maipura river mouth shifted back and forth. Growth of the spit forces the river to shift its mouth and the river causes fragmentation by breaching the spit during heavy floods and cyclones. The one of the study area is situated between 20°40'57.417"N and 20°45'49.947"N latitude and 87°1'5.576" E and 87°7'4.959"E longitude.

Another study area is the Dr. Abdul Kalam Island, formerly known as Wheeler Island, an island off the coast. The Integrated Test Range missile testing facility is located on the island. The island was originally named after English commandant Lieutenant Wheeler. On 4 September 2015, the island was renamed to honor the late Indian president, Dr. APJ Abdul Kalam. It is located in the eastern side of the river mouth of Maipura river and Ekakula spit in the Bay of Bengal approximately 10 km of the eastern coast.

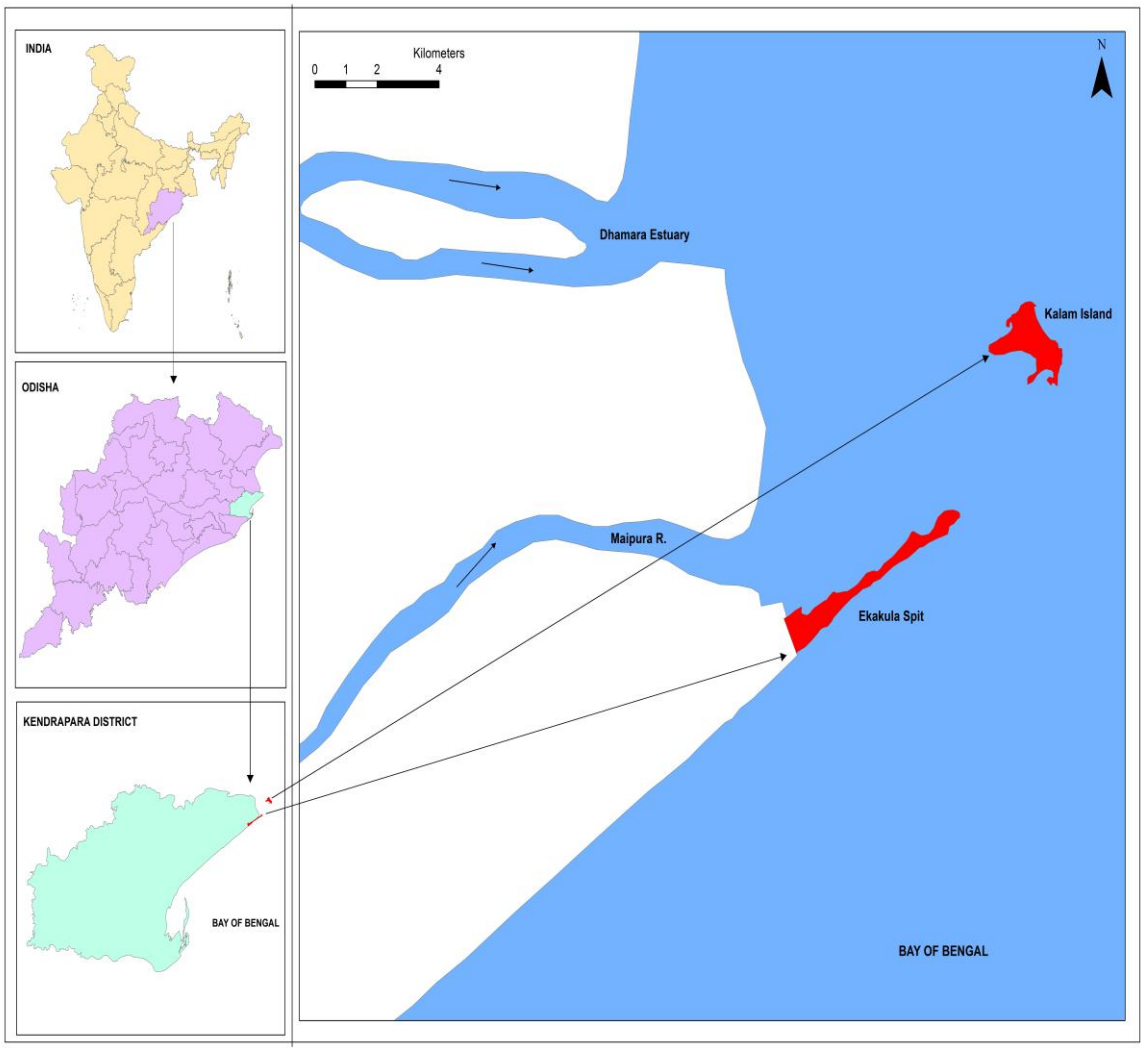

Fig. 1: *Location Map of Study Area.*

In May 2013, increasing concern has been drawn to the change of the island's topography, owing to sand erosion. Since the island is technically a shoal, seawater frequently causes sand-shifting. The situation is being monitored by geological experts from National Institute of Ocean Technology and the DRDO. The study has taken through Remote Sensing and GIS technology with time series satellite imageries.

OBJECTIVE

The objective of the study is to analysis the dynamic of the Ekakula spit and Kalam island.

DATABASE

Time series satellite imageries of during the year 1973 to 2017.

Landsat image of the year 1973, 1990, 2000, 2009, 2015 and 2017.

Base Year 1973.

METHODOLOGY

Flow Chart showing the Methodology of the Study Area

The flowchart showing the methodology which applied for the study purpose (Figure 2).

DISCUSSION

For analyzing the Ekakula spit dynamic, there is a constant location, fixed at 20° 41'12.863" N latitude and 87°1'1.608" E longitude. From this point the Ekakula spit length has calculated during the year 1973 to 2017. The spit has become narrow and growing its length from 4.696 km in the year 1990 to 6.262 km in the 2017. The maximum and minimum width of the spit is 1440 M and 146 M, respectively in the year 1973 but in the year 2017 the maximum and minimum width of the spit is 960 M and 199 M, respectively.

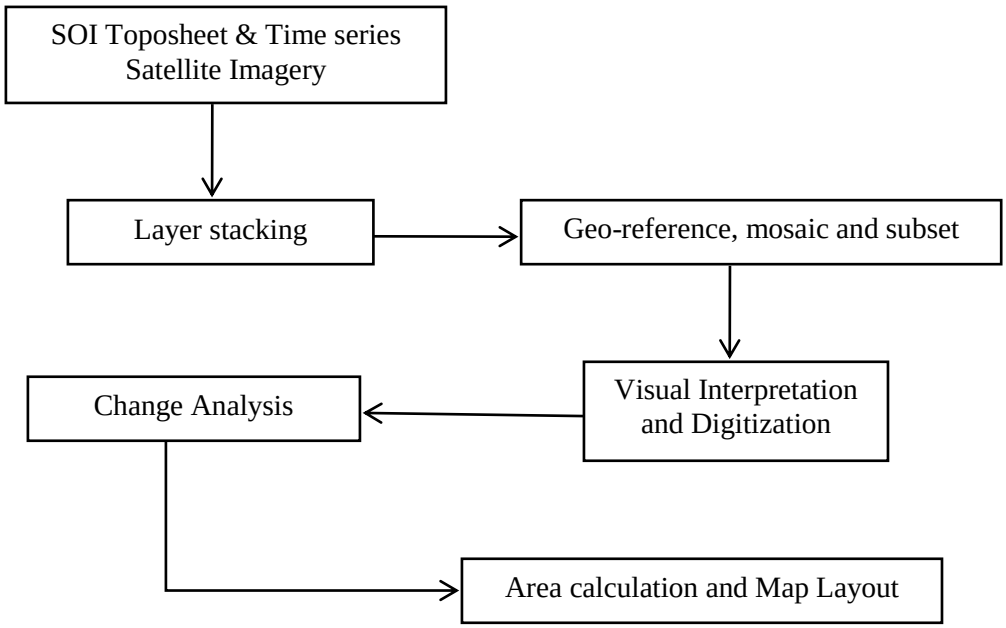

Fig. 2: *Flowchart Showing the Methodology.*

Table 1: *Showing the Length of the Spit from the Fixed Point.*

Distance	In M.	Difference from previous Year (M.)
1973	5671	
1990	4696	-975
2000	5375	679
2009	6456	1081
2015	6992	536
2017	6262	-730

The maximum erosion is made during the year 2015 and 2017 and the net erosion rate is 365 M. The minimum net erosion is during the year 1973 and 1990 is 57.35 M. The maximum net deposition is during the year 2000 and 2009 i.e.,120.11 M and the minimum is during the year 1990 and 2000 i.e., 67.90 M.

Table 1 showing that the spit has reduced during the year 1973 and 1990 but after that during the year 1990 and 2015, it is growing towards northeast direction. This spit grew towards northeast and reached closer to the outer Wheeler Island (Present Kalam Island) by 1988. The spit has breached and fragmented at its Ekakula end in the south during a cyclone in 1989 and the Maipura river mouth shifted back towards south [1].

The detached portion of the spit stay behind as a barrier offshore bar known as Nasi bar towards south of Maipura river Mouth. The Nasi bar got again fragmented into two parts in May 1997 during cyclone. Accelertaed long shore transport of sands helps building and prolongation of this spit system. The continued prolongation of the spit may lead to the withdrawal of material from the proximal end of the spit causing thinning and deposition at the distal end causing widening. During high floods and storm surges associated with cyclones, the river tends to breach the spit [2].

The spit length has increased during the year 1990 and 2015 (Table 1) which estimated using time series satellite images from the common base point. The total spit length has increased since 1990 by 2296 M towards northeast direction (Figure 1). The spit is increasing by deposition of sediment flow from south direction by the littoral drift except during the year 1973 and 1990, 2015 and 2017.

Table 2: *Showing the Area of the Spit and the Island.*

Area (in ha.)				
Year	Kalam Island	Difference from previous Year (M.)	Ekakula Spit	Difference from previous Year (M.)
1973	203.14		306.18	
1990	161.8	-41.34	277.27	28.91
2000	218.39	56.59	246.17	-31.1
2009	187.57	-30.82	318.37	72.2
2015	195.56	7.99	346.38	28.01
2017	207.39	11.83	259.58	-86.8

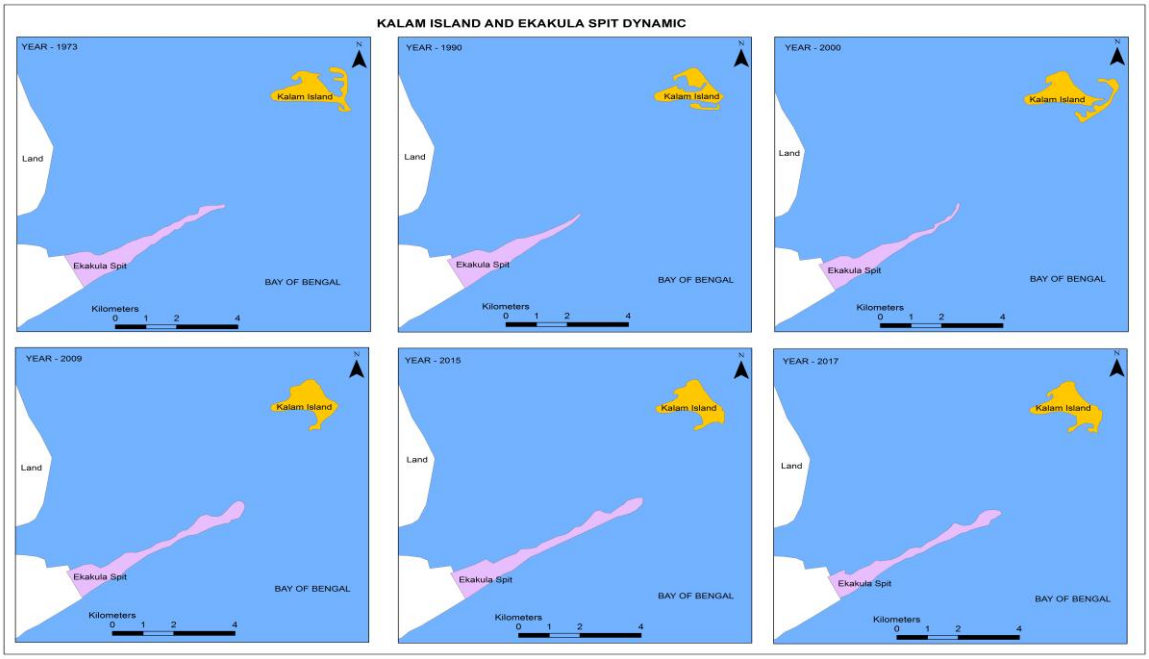

Fig. 3: *Showing the Dynamic of the Ekakula spit and Kalam Island.*

Table 2 and Figure 3 showing the erosional and depositional area of the Ekakula spit and the Kalam island. The table indicates that during the year 1973 and 1990 the spit has deposited and the island has eroded. Then during the year 1990 and 2000, the spit has eroded and the island has deposited. During the year 2000 and 2009, the spit has deposited and the island has eroded. Only during the year 2009 and 2015, the spit and the island both have deposited and after that the spit has eroded.

Ekakula spit and the Nasi bars are known for providing mass nesting sites for Olive Ridley Turtles. Satellite Images of the area revealed that spit underwent marked temporal changes. In general, the spit grows towards northeast but were fragmented during the heavy flood and cyclones. The build up and subsequent fragmentation processes of the spit created different landforms in the offshore. The reasons for the erosion may be due to natural processes and manmade intervention. This coast is prone to cyclones, storm surges and floods, which cause changes in the morphology of the coast [2–11].

CONCLUSION

It is analyzed that, the Remote Sensing and GIS technology is very useful for better appreciative of the seasonal and annual cycles of the coastal geomorphologic changes. The spit is growing gradually but now the erosion

process has increased the spit length during the year 2015 and 2017. When the sediment load is reduced from the catchment area through the river, the depositional process also reducing. The sea level rises due to global warming, local subsidence/tectonic causes and occurrence of more frequent cyclones are controlling the significant changes. During the year 2009 and 2017, the Kalam island has stable and some areas are deposited.

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