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Assessment of Coastal Erosion and Accretion Scenario of an Island using Mauza Maps: a GIS Based Case Study of Sandwip Island of Bangladesh

Irtifa Alam Nabila[1], Nawrid Israd[2] & Nilufa Akhter[3]
[1]Lecturer, Bangladesh University of Professionals
[2]Research fellow, Jahangirnagar University [3]Student, Beihang University, China

Abstract: *The Coast of Sandwip Island shows a mixing trend of land erosion and accretion. In this study, Azimpur and Thak Kuchiamora mauzas have been studied as a representative area of land erosion and accretion accordingly. Azimpur mauza is located in the south-western part of the Island which is more prone to land erosion. On the other side, Thak Kuchiamora mauza is in the eastern part of the Island which has been experiencing newly accreted landmass. Historical Mauza maps are very significant for surveying areas at plot level. With the application of Cadastral Survey and Revisional Settlement mauza maps and Geographic Information System approach it has been tried to identify eroded and accreted landmass of the study area. The erosion and accretion scenarios of the area have been represented by map through analyzing collected data from Directorate of Land Records and Surveys (DLRS) office and satellite image (2016) using Google Earth. Due to tidal influence, direction change of ocean current, devastating action of major cyclones and human interference a vast area of the mauza has been lost. During Cadastral Survey (1913) the area was 2708 acres but in 2016 it has become only 324 acres. During 1970 to 2016 period, about 5857 plots occupying 2386 acres areas have been lost. As a result, the mauza has been losing its lands gradually and a large number of people had already left the area after being displaced from their ancestral home due to erosion. On the other side, Thak Kuchiamora mauza have gained new landmass due to regular sedimentation process. Analyzing accreted database over different period it has been summarized that from Revisional Settlement Operation (1970) to present time the area of the mauza has increased about 1185 m from west to east direction which has brought a ray of happiness for the people of the deltaic Island.*

Keywords: Mauza Map, Sandwip Island, Land erosion, Land accretion, GIS

"1. Introduction"

Coastal area is the place where the waters of the sea meet the land. In most cases the coastal off-shore Islands are situated near the coast and subject to large scale environmental change resulting from an intricate interface of natural and man-made processes [1]. Sandwip, a coastal part of active delta of the three mighty river arrangements of the Ganges, Brahmaputra and Meghna locating in the lower Meghna estuary is one of the main offshore Islands. Being positioned in the lower Meghna estuary, it goes through numerous geomorphological changes. The low-lying land has shaped within and surrounding the river mouth and it is home to more than 4 million people [2]. The landforms of Sandwip Island are primarily controlled by the result of tidal range, salinity level, turbulent water motion, monsoon winds and also human interventions. Erosion and accretion are successively changing the shape, size and configuration of the Island accordingly. Here erosion is much more foremost than accretion. Most particularly the western part of the Island experienced more erosion than the other side. A mentionable part of the western part of Sandwip Island has been lost due to coastal erosion. The reasons of erosion were attributed to wave movement due to vigorous southwest monsoon winds, high currents, regular and hazardous storm surges in the Bay of Bengal [3]. The erosion rate considering both shoreline and area changes is much more intense exceeding accretion in the silty clay sedimentary parts and the sea level rise trend is shocking in comparison with other neighboring coastal zones in Bangladesh [4]. Due to widespread coastal erosion, the area of the Island has been diminished and a number of unions have been already eroded by erosion [5]. On the other hand, accretion of land has been observed in the eastern side of the Island. The present study intends to assess plot level database on land erosion and accretion of the Sandwip Island from micro level using mauza maps in order to get an image of the dynamic nature of the Sandwip and its impact on its' inhabitants.

"2. Study Area"

Sandwip is a deltaic Island where surface water movement is controlled by its surroundings, Meghna estuary and Bay of Bengal. It is also enclosed by Sandwip and Hatiya channel. According to Mukherjee [6] "Sandwip lies in the maximum cyclone prone area of Bangladesh". The shape of Sandwip in satellite imagery shows that erosion is very active in western part. For example: The area of Sandwip was 279 sq. km. and 238.49 sq. km in 1980 and 1986 respectively. Total area of 41.21 sq. km has been washed out in that period [5]. The west part of Kalapania, Harispur, Rahmatpur, Azimpur, Musapur, Maitbhanga and Sarikait, as well as the south part of Sarikait and Mogdhara union, unprotected from erosion and nature's furies. Katgor, Ijjatpur, Hudrakhali, Neamasti and Batajora unions have disappeared over the last few decades due to coastal erosion. On the contrary, the east side is a zone of accretion. So it can be said that the Island has an extremely dynamic coastline which has been undergoing numerous changes overtime.

Table 1: Land Area of Sandwip Island Measured from 1779 to 2014 (km^2), Shows a Continuous Changes in Size Overtime.

Year	Map Source	Area (Km^2)
1779	Delta of Ganges (Rennel)	579
1896	Survey of India	502
1938	Topo Map	518
1945	Survey of India	500
1973	Landsat-1	290
1980	Landsat TM	258
1990	Landsat TM	233
2010	Landsat TM	229
2014	Google Earth	238

(Source: Pramanik, 1983)

Erosion and accretion process isn't same in all side of the Island. The western side of the Island has been selected as zone of erosion and eastern part has been selected as zone of accretion based on satellite image. Azimpur mauza has been selected as sample study area experiencing loss of land to analysis erosion scenario of the Island and Thak Kuchiamora mauza situated in the eastern side of the Island have been selected for analyzing sedimentation scenario of the Island. Both mauzas have been surveyed on plot level using mauza maps to understand from micro level.

Azimpur mauza is located in Azimpur union of Sandwip upazila of Chittagong district. GEO code no. of the area is 048 [7]. The topographic sheet reference of Azimpur mauza is 79 $\frac{N}{7}$ and located in the western side of Sandwip Island.

Thak Kuchiamora mauza is located in Bauria union of Sandwip upazila of Chittagong district. GEO code no. of the area is 918 [7]. The topographic sheet reference of the mauza is 79 N/7 and located in the eastern side of Sandwip Island.

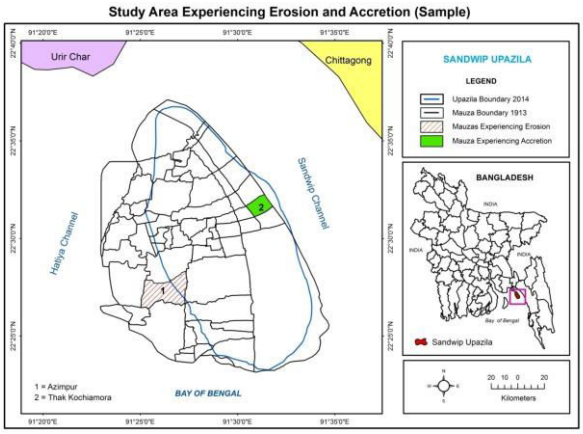

Figure 1: Location of Study Mauzas

"3. Materials and Methods"

The related data and information of this research have been collected from both primary and secondary data sources. Primary data is mainly collected from field observation, photograph taking, note taking, informal interviewing and secondary data is collected from Mauza maps and satellite Imagery from Google archive. Base maps for this study are collected from following sources:

- DLRS (Directorate of Land Records and Surveys) office for CS (Cadastral Survey) and RS (Revisional Settlement) Mauza maps
- Google archives for Satellite image of the study area

Relevant information is also collected by reviewing literature from different sources:

- Published Books, Reports and Journals,
- Census Book and Community series,
- Settlement Manual,
- Newspaper etc.

A geographic information system (GIS) approach has been adopted for mapping the changing nature of the study area.

For conducting this study the following methodology is prepared:

- Cadastral Survey and Revisional Settlement mauza maps of Azimpur (included sheet number 1,2,3,4) and Thak Kuchiamora mauza (maps in 16"=1mile scale) has been collected from (DLRS) Directorate of Land Records and Surveys office. The collected map is scanned in 300 dpi (dot per inch) to produce raster form.
- Based on Cadastral Survey and Revisional Settlement operation the mauza boundary of the study area has been detected by taking referenced point with the help of feature extrapolation method using overlay analysis tool of Google Earth-Win-Plus-5.0.11733.9347.
- Mauza sheets are geo-referenced using align tool of Arcview GIS 3.3 software.
- Plot level database such as number of plots, existing plots, eroded plots, different features are digitized by using digitizing tool of Arcview GIS 3.3 software.
- Plot level information is represented by detecting plot with individual plot number. Occupying plots area and other features area are measured using xtools of Arcview GIS 3.3 software.

Data is represented by table, chart and bar diagrams using Microsoft Excel to assess and analysis the erosion scenario of the area. Final output is represented by map using layout tool of ArcGIS 10.1.

"4. Results and Discussion"

4.1 Analysis of Erosion Scenario Using Mauza Maps

Erosion is the geological process in which earth's surface is worn down by natural forces such as tide, current, wave etc. Erosion process is much vigorous in the south-western part of Sandwip. Erosion scenario of different features can be easily understood from the following analysis of erosion of the study area named Azimpur which was 2708 acres in 1913 but it became 326 acres only in 2013 due to severe erosion.

4.1.1 Erosion scenario of plots

Erosion is eating up the plot area along with its features which is very alarming. From mauza maps of study area it has been seen that the area is divided into so many small plots having individual DAG number. If it is considered about Revisional Settlement mauza then it has seen that there were 7935 plots. But due to coastal erosion maximum of them have been lost (Figure 3).

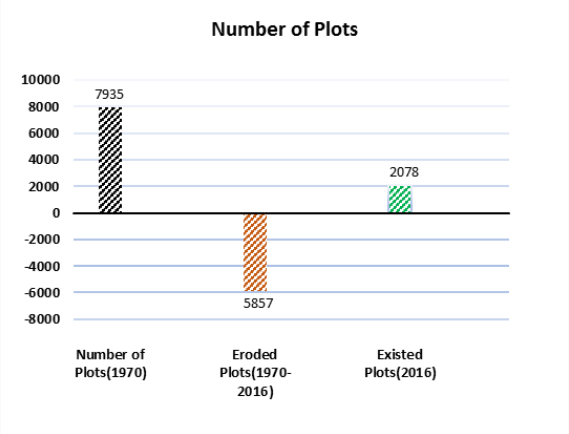

Figure 2: Number of eroded plots from 1970 to 2016
(Source: Mauza Maps; Satellite Image, 2016)

From above bar diagram it is seen that during Revisional Settlement Survey the number of plots were 7935 having area 2708 acres. From 1970 to 2013, about 5857 plots occupying 2386 acres area have been washed away. At present in 2016, the area is recorded only 324 acres and is about to lose its existence in near future and will be washed away forever.

For example, a picture of eroded plots (sheet 4) of studied mauza is given:

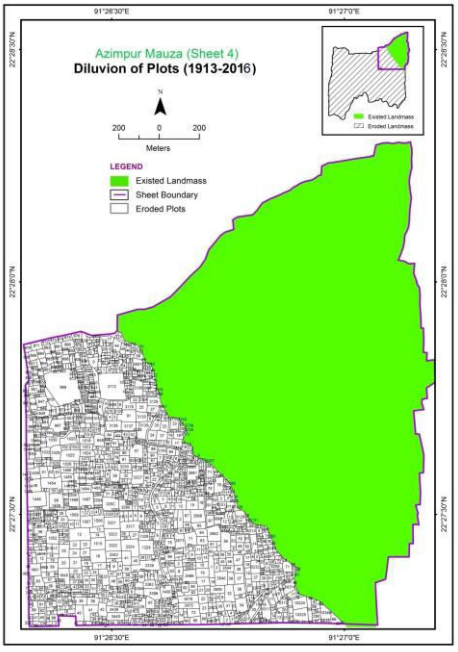

Figure 3: Eroded plots of the area (sheet number 4)

4.1.2 Erosion Scenario of Land Cover Features

By integrating mauza maps with recent satellite image it has been seen that the area covering three sheets of mauza map have been already vanished with various land cover features except the sheet number four. Some portion of it has been also eroded and this process is still being continued.

4.1.3 Settlement Disappearance of the Study Area

The destiny of people living alongside the coastal zone have been playing hide and seek with the natural calamities [8]. Coastal erosion is the common one and every year numerous people became vagrant and settlement disappearance is a regular phenomenon of the area. Here a table showing number of eroded household of the study area Azimpur:

.Table 3: Measurement of Erosion during Different Periods

Period	Erosion (m)	Direction
1913-1970	1465	From Southwest to Northeast
1970-2000	1670	
2000-2005	410	
2005-2016	42	

(Source: CS and RS Mauza map; Satellite Image, 2016)

From above table, it can be said that Azimpur mauza is gradually losing its land direction from southwest to northeast.

4.1.4 Measurement of Land Erosion

Land erosion of study area has been measured through cross-section method for better understanding of the erosion scenario

Table 4: Number of Eroded Settlements and Displaced Population of the Study Area

Number of Settlement (Revisional Settlement survey)	Eroded Settlements (1970 - 2016)	Number of Population (Revisional Settlement Survey)	Displaced Population (1970-2016)
305	**232**	**1460**	**1015**

(Source: Compiled by Authors from Mauza maps and Satellite Imagery, 2016)

During 1970-2013 period, about 232 settlements disappeared from 305 and about 1015 people of the area have been displaced and compel to go other areas due to the massive erosion hazard.

4.2 Newly accreted Land Scenario Analysis

Thak Kuchiamora mauza belongs to one of the accreted area of Sandwip Island. From satellite imagery and mauza map it has been seen that new area has been added with the definite landmass. Those newly accreted areas are used for farming practices.

4.2.1 Land Accretion during Different Period

Land accretion scenario of Thak Kuchiamora mauza has been identified through integrating mauza maps with recent satellite image. In determining land accretion boundary data of different years have been developed from satellite image so that accretion scenario of the mauza can be easily identified.

Table 5: Measurement of Accretion during Different Periods

Period	Accretion (m)	Direction
1970-2000	220	From Southwest to Northeast
2000-2005	41	
2005-2010	631	
2005-2016	293	

4.2.2 Char and Fertile Landmass

By analyzing database of alluviated land in different year it can be said that the natural process of sedimentation is giving rise to new chars in the area of Thak Kuchiamora mauza. Accretion happens due to sedimentation process. So accreted landmass has the quality of fertile soil and this is useful for agricultural practices. It is important to note that the accreted landmass of the area hasn't stable enough for permanent land use yet.

4.2.3 Measurement of Land Alluvion

Accretion of landmass of study area has been measured through cross-section method for understanding the alluvion scenario of study mauza.

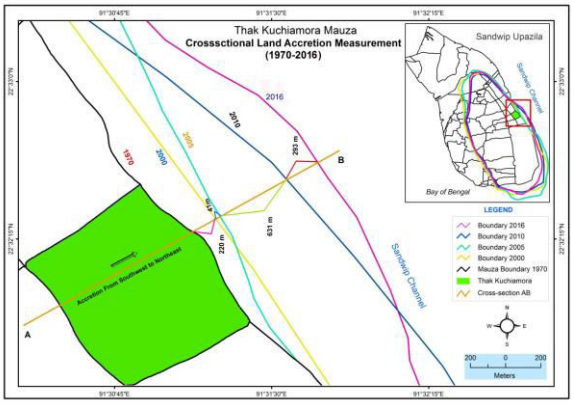

Figure 4: Land Accretion during Different Periods

(Source: Compiled by Author from Mauza maps and Satellite Image, 2016)

From developed database, it has been seen that the land area of Thak Kuchiamora mauza is increasing from southwest to northeast direction. From Revisional Settlement Operation (1970) to present time it has been recorded that the mauza increased about 1185 m from west to east.

"5. Conclusion"

Coastal area encompasses a very explicit characteristic than other land. Newly accreted landmass is considered as a blessing for the coastal inhabitant. Due to newly accreted landmass Sandwip Island has been accreted in its size in the eastern side. On the other side, Erosion has become a name of disaster for the people of Azimpur mauza located in the south-western side of the Island. Because of severe erosion thousands of people of the area have become homeless. By analyzing database, it has been seen that the area became one fourth of its actual size and it will be washed way completely in upcoming days. So effective actions should take to protect other vulnerable areas otherwise like Azimpur mauza those will be disappeared into the sea. Again, management of newly added area is very vital for the wellbeing of the people of coastal zone. Plot level database about land erosion and accretion of selected study mauzas will help the Island dwellers, researcher or policy makers to understand the severity of land erosion and its impact from micro level and take effective steps to lessen the effects of this hazard and take proper management of accreted landmass of study area.

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"7. References"

[1] Emran, A., Rob, M.A. and Kabir, H.M., 'Coastline Change and Erosion-Accretion Evolution of the Sandwip Island, Bangladesh', *International Journal of Applied Geospatial Research (IJAGR)* 8(2). 2017.

[2] Center for Environmental and Geographic Information Services (CEGIS), *Integrated Coastal Zone Management Plan Project: Knowledge Portal on Estuary Development (KPED) Working Paper WP017*, prepared for: Program Development Office Sponsored by the Government of the Netherlands and the United Kingdom Executed by ARCADIS Euro consult, the Netherlands. Dhaka, Bangladesh, 2003.

[3] Hedge, A.V.,'Coastal Erosion and mitigation methods – Global state of art', *Indian Journal of Geomarine Sciences,* 39(4), 521-530, 2010.

[4] Uddin, M.M., *Geomorphological Evolution and Vulnerability of Low- Lying Coasts in Bangladesh: The Case Study of Sandwip Island,* 2015.

[5] Mukta, F. A., *Assessing the impact of coastal erosion on land ownership and land management in Bangladesh: A GIS based study on the Sandwip Island,* Unpublished research work, Jahangirnagar University, 2010.

[6] Mukherjee, R., *The struggle for the Bay: The life and times of Sandwip, an almost unknown Portuguese port in the Bay of Bengal in the Sixteenth and Seventeenth Centuries*, Historia, p67-68, 2008.

[7] Department of land records and surveys (DLRS), *General instruction about land records and map preparation,* Government of Bangladesh, Dhaka.

[8] Islam, M.R. (eds), *Where Land Meets the Sea: A Profile of the Coastal Zone of Bangladesh*, The University Press Limited, Dhaka, 2004, ISBN: 984 05 1719 8.