ISSN: 0974-5823 Vol. 6 No. 3 December, 2021

International Journal of Mechanical Engineering

COASTLINE CHANGES ANALYSIS IN SIR CREEK REGION, GUJARAT COASTLINE BORDERING PAKISTAN

Maaz Allah Khan[1], Dr. Anoop Narain Singh[2]

1Department of Civil Engineering, Research Scholar, Maharishi University of Information Technology, Lucknow, Uttar Pradesh, India

[2]Department of Civil Engineering, Assistant Professor, Rajkiya Engineering College, Azamgarh, Uttar Pradesh, India

KEY WORDS: Coastline extraction, TM & ETM+ sensors, reclassification, band ratios, Sir creek region, coastline changes.

ABSTRACT:

96 kilometres of the Run of Kutch swamplands are claimed by India and Pakistan as the "Sir Creek" waterway. As time went by, Sir Creek's path changed dramatically. It has been argued that Sir Creek's location has been shifted by water erosion by 1.5 kilometres eastward. Sir Creek, which separates India and Pakistan, acts as a natural border. Oil and gas reserves in the area could be significant, thereby improving the country's overall energy security. A total of 20 Landsat-5 pictures spanning the years 1988 to 2017 have been used in this investigation. Before processing these Landsat images, they were radio metrically as well as geometrically corrected to cover the whole study area. Between 1988 and 2017, coastal alterations were evaluated, and the results showed that the shoreline has degraded. Band-5 pictures were classed and a second set of binary images was generated using the band ratio method to analyse the shoreline alterations. Finally, the total land and water area, as well as the changes in the shoreline, were determined. 30.70 percent of the land area has degraded and 28.40 percent of the water area has expanded in the previous 20 years, according to the findings of this study. However, it continues to deteriorate. When contrasted to ground survey as well as many remote sensing approaches, the known pattern of coastline alteration returned by reclassification was almost congruent with these studies.

1. INRODUCTION

In the coastal zone, land and sea, as well as lithosphere, hydrosphere, atmosphere and biotic spheres interact. The meeting point of coastline as well as coastal waters is referred to as the coastline. The coastline is influenced by waves, tides, winds, storms, sea level rise, erosion as well as deposition processes, and human activities. When you look out to sea, you can see the most recent changes to the coastline. Because the loose granular sediments are continually responding to the ever-changing waves and currents, they can alter the coastline's morphology and develop various coastal landforms [3].

From 1927 until 1980, aerial pictures were the only resource of coastal mapping. In order to map the shorelines of a region, a large number of aerial photographs are needed (Lillesand, et al., 2004). As a result of this labor-intensive process, creating a map from pictures is both time-consuming and expensive. Additionally, there are a myriad of other drawbacks of using black and white photos, such as: The difference among land and water in panchromatic pictures is low, especially in murky or muddy water. In order to use them, you'll need to have them digitally converted from their original format.

The low cost and great precision of remote sensing data could be used to monitor changes in the coastal zone, along with the coastline. It has been over 40 years since Landsat and other remote sensing satellites began producing digital imagery in infrared spectral bands with clearly defined land-water interfaces. It is thus possible to utilise remote sensing images and image processing techniques that can help with land and water segmentation and some of the difficulties associated with producing and updating shoreline maps. Images from different bands of Landsat-5 TM and Landsat-7 ETM+ are used to get the coastline changes and present them in this study. A variety of ArcGIS 10.2 software tools were employed in the process of analysing imagery.

2. STUDY AREA

The Sir creek region, Gujarat coast, India, is the focus of this investigation. India and Pakistan are separated by Sir stream, a natural border. At 23°56'45.48"N and 23°40'21.49"N, longitudes of 68° 9'41.69"E and 68°21'3.38"E, the Sir Creek region is located. Located in the Rann of Kutch, Sir Creek is a 96-kilometer tract of water claimed by India and Pakistan. Formerly known as Ban Ganga, the village of Sir Creek was given its current name in honour of a British representative. Near the mouth of the Creek, which roughly divides Gujarat's Kutch region from Pakistan's Sindh Province, the Arabian Sea opens up to the world's largest ocean. Until it reaches India's land borders, Pakistan claims the entire water stream, while India claims half of the channel with a division in the middle, stating that the subject should be addressed in accordance with international riverine system regulations. After numerous discussions, the problem has still to be resolved since neither one is willing to give ground on their viewpoint. As a result of the potential for large quantities of oil and gas to be found in the area, the issue has taken on greater importance. A further breakdown in negotiations is now inevitable. For India's defence, India employs the Thalweg legislation. River boundaries across two states can be divided by the mid-channel when both states agree. The theory that Sir Creek is a tidal estuary does not apply in this circumstance, says Pakistan, notwithstanding its acceptance of the 1925 map [8]. Refuting Pakistan's claims are the fact that Sir Creek is navigable at high waves, that the Thalweg principle is used to delineate some international maritime boundaries, and that fishing boats use Sir Creek to reach the open sea. Additionally, Pakistan is concerned that Sir Creek's trajectory has changed dramatically. Water erosion may have shifted Sir Creek by 1.5 kilometres eastward, according to some estimates. If the present channel is used to determine the boundary line, Pakistan and India will both lose small swaths of wetlands topography that were once part of their respective countries.

Figure 1. Location of Study Area on Google image

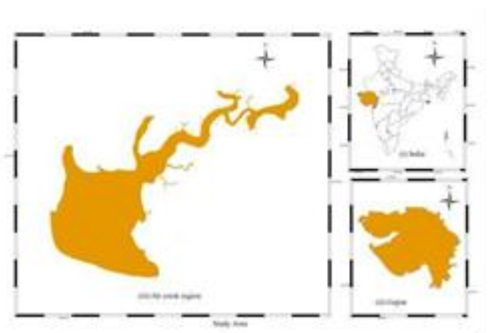

Figure 2. Location map for the Sir creek area

3. MATERIALS USED AND METHODOLOGY

3.1 Data Used

Three Landsat-5 TM images and five Landsat-7 ETM+ images from the years 1988, 1995, 1998, 2004, 2007, 2010, 2014, and 2017 were used in this study's analysis. The pictures containing path-152 row-43 and path-151 row-44 were geometrically corrected and blended using the capability in ArcGIS 10.2 programme to create a final workable image for the study area. Using photos taken at the same time each year (as mentioned above) and under similar tide circumstances, researchers at Sir Creek Regional Center examined the shoreline alterations. Analysis of the data was done using ArcGIS 10.2 software, which was used throughout. Excel was used to create a table and graph to show the findings.

3.2 Methodology

There are a variety of methods for extracting the coastline from optical symbols. Even if you just have a photo of one band, you can still eliminate the coastline. While water's reflectance is nearly identical to that of land's infrared group focus, land's reflectance is more notable than water's. If you change the name of the picture to "land and water divided double picture" on the band-5 of the TM or ETM+ symbolism, this can be done. Of the six intelligent TM groups, band 5 in the mid-infrared is the most effective in separating land and water (Kelley, et al., 1998[2]). As turbid water absorbs mid-infrared radiation, Band 5 is the optimum band for land and water division because the solid reflectance of mid-infrared by flora, soil, rocks and other normal characteristics in this range makes Band 5 ideal for this purpose. The beachfront's remarkable land-water link Sir brook area complicates the separation of land and water, especially since it is not an estuary. The transition zone between land and ocean is where the pinnacles live. When pixels and moisture systems from land and water are merged together, the result is an area of change. Reflectance values can be divided into water (poor quality) and land (high quality) if they are broken into two distinct areas (higher qualities). Since land and water can be divided, the renaming process can produce parallel images. Renaming band-5 qualities with an infrared reflectance of zero to one was done to account for the fact that water has very little infrared reflectance. Another approach is to make use of the ratio of bands 4 and 2, as well as bands 5 and 2. Each percentage may be seen in two ways with this method, which makes it easy to separate water from land. For water, there is no reflection from the TM sensors band-5, which has a frequency range of 1.55 nm-1.75 nm (even sloppy water). Soil is addressed by NIR/R > 1, and water is addressed by NIR/R 1. Renaming and band proportion are just two examples of methods used to get a higher degree of precision with the final double image. Pictures obtained by multiplying band-2 by band-5 (band2/band>1) yield a binary1 image, but pictures obtained by multiplying band-2 by band-4 (band2/band4>1) yield a binary2. Additionally, binary1 picture and binary2 picture are multiplied to generate binary3 image. Last picture from and proportionality strategy is Binary3. [5] After that, each year's renamed image is reproduced using a binary3 image from the same year, which was obtained using band proportions. The final images are used to find out what happened. To begin, a region is selected for each field, such as land or water, and the results are then arranged in a dominant sheet to produce a graphical representation. As a result, the final images of each year are converted to vector (polygon) design, allowing the viewer to see how the land has evolved and grown over the course of the year.

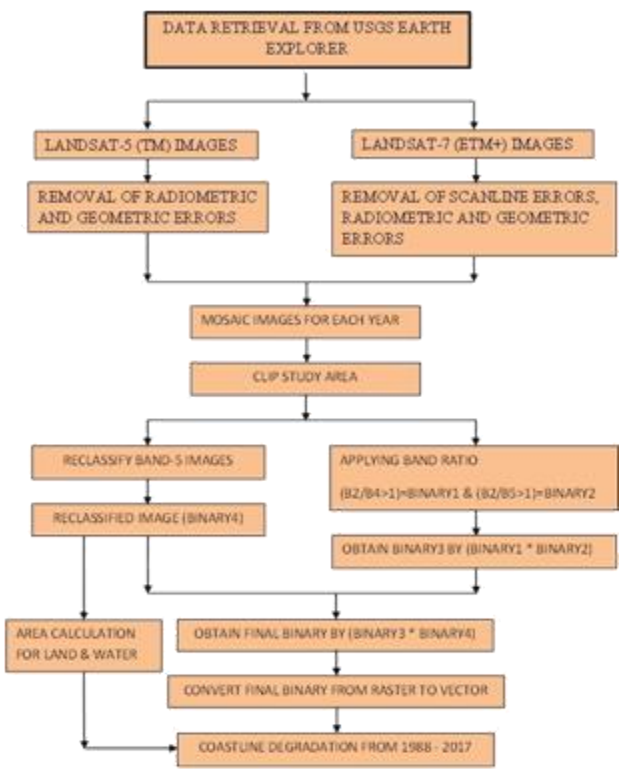

Figure 3. Flowchart for extracting coastline changes from satellite imagery

4. RESULTS

From 1988 to 2017, the coastline saw significant modifications. In the years leading up to and following the year 2014, the deterioration of the coastline was clearly visible and unavoidable.

A modest increase in coastal population in 2014 is possible. In 1988, the land area was found to be approximately 233 km2, which decreased to approximately 181 km2 in 2004 and to approximately 161 km2 in 2017. The results demonstrated that coastal debasement was discovered in the chosen research area. The issue is illustrated in fig (7). Also shown in vector (polygon) design are the results of this study's coastal modifications in fig. (4), fig. (5), and fig (6). Band-2, band-4, and band-5 Landsat images The target of 30m*30m provided clear data concerning land and water when paired structure was implemented. It was easy to distinguish between land and sea. Based on pixel checks, land and sea areas were estimated. A field was added to the property table for each quality, for example, land and water, which gave the region for each. Table 1 shows the calculating method and the resulting data (1). A single pixel with a 30m*30m goal will cover a 900m2 area.For calculation of area:

Land area = (land pixel count * 0.0009) km²:

Year	Land Area km²	Water Area km²	Land Erosion Area	Accretion Area
1988	233.2	319.6	-	-
1995	225.5	327.3	7.7	-
1998	198.4	354.4	27.1	-
2004	181.9	370.9	16.6	-
2007	182.1	370.7	0.3	-
2010	162.8	391.0	19.2	-
2014	182.0	370.8	-	20.4
2017	161.6	391.2	19.3	-

Table 1. Land & water statistics for Sir creek region

5. DISCUSSION AND CONCLUSION

India and Pakistan share a border along the Sir rivulet in Gujarat, which serves as a dividing line between the countries. Imagery acquired by Landsat 5 and 7 throughout the course of 20 years, from 1998 to 2017, for the same season each year, from 1988 to 1995 to 2004 to 2007 to 2010 to 2017. Mathematics and radiometrics were used to correct this data. During the past 20 years, 30.70 percent of the land area was demolished and 22.40 percent of the water area grew. Two different methods were used to examine the coastline's position changes between 1988 and 2017. Renaming band 5 is one option, while mixing renaming with band proportion is another. All the land and water limits for each year were converted from raster data to vector data. According to the results, the Sir Brook district's coastline has shifted closer to the land. Between 1995 and 1998, the land area decreased by around 27 km2 and increased by by 20 km2 between 2010 and 2014. Further studies are clearly needed to identify the progressions in shoreline modifications of this challenged regular border, which is crucial from an economical and business point of view for both domains. However,

REFERENCES

1. Alesheikh A.A., Ghorbanali A., Nouri N. (2007) Coastline change detection using remote sensing of Urmia Lake. *Int. J. Environ. Sci. Tech*., 4 (1): 61-66, 2007.
2. N. Baghdadi, R. Pedreros, N. Lenotre, T. Dewez, M. Paganini. "Impact of polarization and incidence of the ASAR sensor on coastline mapping: example of Gabon", International Journal of Remote Sensing, 2007.
3. Z. Umar, W. A. A. W. M. Akib, A. Ahmad. "Monitoring shoreline change using Remote sensing and GIS: A case study of padang coastal area, Indonesia", 2013 IEEE 9th
4. International Colloquium on Signal Processing and its Applications, 2013.
5. Elkoushy A.A. and Tolba R.A. (2004). Prediction of shoreline change by using satellite aerial imagery.
6. *Proceeding of the XX ISPRS Congress. Istanbul*, Turkey.
7. Kumaravel S., Ramkumar.T, Gurunanam.B, Suresh.M (2012), Quantitative estimation of shoreline changes using remote sensing and GIS A case study in the parts

of Cuddalore district, East coast of Tamil Nadu, India. *International journal of environmental sciences*, Volume 2, No 4, 2012.

8. Masria A., Nadaoka K., Negm A. and Iskander M. (2015) Detection of Shoreline and Land Cover Changes around Rosetta Promontory, Egypt, Based on Remote Sensing Analysis. *Land 2015*, 4, 216-230.

9. Misra A. et al. Department of Civil Engineering, IIT Bombay, Powai,Mumbai 400076 India. A study on the shoreline changes and Land-use/ land-cover along the South Gujarat coastline. *Procedia Engineering* 116 (2015) 381 – 389.

10. Mostafa M.M. and Soussa H.K. (2006), Monitoring of LakeNasser using remote sensing and GIS techniques.