SJSW 2026 10(1): 75-94

Sri Lanka Journal of Social Work (SJSW)
Volume 10– Issue 01
DOI: https://doi.org/10.4038/sljsw.v10i1.51

05

GEOSPATIAL ASSESSMENT OF SHORELINE DYNAMICS FOR SUSTAINABLE POLICY SHIFTS: EVIDENCE FROM RAPIDLY DEVELOPING COASTAL ZONES

Isuru Udakara Yakandawala*[1], B.A.O.R. Perera[2]
[1]University of Sri Jayewardenepura, Sri Lanka.
[2]University of Kelaniya, Sri Lanka.
***Correspondence E-mail:** 22isuru22@gmail.com

ABSTRACT

Coastal zones are dynamic environments. It undergo continuous morphological change due to natural processes and human activities. It is posing significant risks to ecosystems, tourism, and coastal communities. This study investigates shoreline dynamics and coastal morphological changes at Calido Beach, Kalutara, along Sri Lanka's southwestern coastal belt. The primary objective of the research is to identify and visualize shoreline changes and coastal morphological variations using geospatial techniques. The study examines erosion and accretion patterns and their implications for sustainable coastal management and disaster risk reduction. The study employed a quantitative geospatial analysis of historical satellite imagery from Google Earth Pro for 2015, 2017, 2020, and 2022. The results indicate notable shoreline fluctuations over the study period. Moderate erosion was recorded between 2015 and 2017 with an estimated land loss of approximately 68,519 m². A substantial increase in erosion occurred between 2017 and 2020, reaching approximately 425,419 m². It is primarily associated with the artificial cutting of the sandbar during the 2017 flood event, and further factors of sea level rise, monsoon impact, and sand mining were examined with secondary scholarly works. The period between 2020 and 2022 shows partial recovery with an accretion gain of approximately 66,128 m². The findings highlight the importance of geospatial monitoring in understanding coastal dynamics for sustainable decision-making. It emphasizes the need for integrated coastal management strategies with environmental impact assessments and utilizes them in policy decision-making in Sri Lanka. The findings call for improved flood mitigation measures to enhance coastal resilience and sustainable environmental management with informed geospatial techniques.

Keywords: *Coastal Erosion, Coastal Morphology, Disaster Risk Reduction, GIS and Remote Sensing, Shoreline Change*

Introduction

Sri Lanka has 1,790 kilometers of coastline with plentiful natural resources (Department of Census and Statistics, 2021). Sri Lanka's territorial sea extends 12 nautical miles from its coastline. Specifically, the marine economic zone comprises 230,000 km^2, which is larger than the land surface of Sri Lanka (Department of Census and Statistics, 2021). Lagoons, rivers, bays, dunes, mangroves, estuaries, rocky coasts, salt marshes, tidal flats, beaches, and spits are a few of the key habitats found along Sri Lanka's coastline (Veettil et al., 2024). The coastline supports the livelihoods of millions of people. Due to the abundance of natural resources and ensuing social and economic benefits, the coastal region has seen substantial development and urbanization throughout the years (Ashraff, 2021). Approximately 33 percent of the global population resides in coastal zones, with their livelihoods heavily dependent on coastal ecosystem services (World Bank, 2017). Coastal morphology is the study of the form and structure of coastal systems and their subsystems. These systems are subject to continuous change as a result of both natural and anthropogenic processes, including coastal erosion, sediment transportation, storage, and deposition.

The coastal area is subject to increasing pressure from both regional environmental changes and global-scale processes (Pang et al., 2023). The coast is the transitional zone where land and sea converge. The coastal areas are composed of masses of loose sediment and are subject to the forces of wind and wave action. Small ridges or hills of sand are found at the upper beach, above the usual maximum reach of wave action (Schwämmle & Herrmann, 2003). The coastline is also called the shoreline. It can be defined as the region where the water bodies, such as lakes, seas, and oceans, meet the land (Boak & Turner, 2005). It can also be considered the boundary between the land surface and water bodies (Cabana et al., 2023). Shorelines can be changed by human and natural factors. A salient feature of these coastal ecosystems is their capacity to migrate towards or away from the sea in response to sediment accumulation or loss. Moreover, coastal areas provide vital ecosystem services: they act as a natural barrier against coastal erosion and protect life and property within the coastal zone (Barbier et al., 2011; Perricone et al., 2023). Coastal areas are of particular importance to central to environmental sustainability, social wellbeing, and economic development (Neumann et al., 2017).

The accretion or loss of land in the near-shore area due to wave action is what defines coastal morphological changes, which are a natural process that shapes and reorganizes the coastal zone throughout time and space. Rainfall, sea level rise, ocean waves, erosion, sedimentation, wind, and tides all directly interact with materials to create coastal islands in this natural process (Brammer, 2014). These changes are driven by a combination of natural processes and anthropogenic activities (Mentaschi et al., 2018).

For a variety of studies conducted by coastal scientists, coastal engineers, and coastal managers, analysis of shoreline variability and shoreline erosion-accretion trends is essential. Thus, coastal morphological change is an urgent global concern (Burningham & Fernandez-Nunez, 2020). Existing evidence indicates that more than one-third of Sri Lanka's coastline is subject to coastal erosion, with the causes and intensity of erosion varying considerably from one location to another (Jayathilaka et al., 2023). Under prevailing dynamic environmental conditions, the coastline in Sri Lanka is in a state of continuous change in both its position and morphological character. Ratnayakage et al. (2020) specifically examine the status and mechanisms of coastal erosion in Sri Lanka, noting that erosion is a long-standing national problem with spatially varying causes. Therefore, the present study focuses on coastal morphological and shoreline changes at Calido Beach, Kalutara. It can be demonstrated among the most prominent beach destinations along the south-western coast of Sri Lanka.

The coastal zone is of considerable significance and an integral part of local communities and the broader economy. Particularly, the tourism sector has long attracted international visitors to this coastal belt in Sri Lanka (Jayathilaka et al., 2023; Ratnayakage et al., 2020; World Bank, 2017). However, ongoing coastal degradation has substantially diminished the economic and social benefits that were previously derived from this area. Understanding and mitigating coastal erosion is therefore of critical importance. On top of those, it is empirically important to identify the coastal morphological changes in the growing coastal line, work as economical active entity. The present study focuses on analyzing coastal morphological and shoreline changes at Calido Beach, Kalutara. The study area was selected to identify as a growing and active area in economic development. The study employs Geographic Information Systems (GIS) and Google Earth Pro to identify and quantify these changes over time.

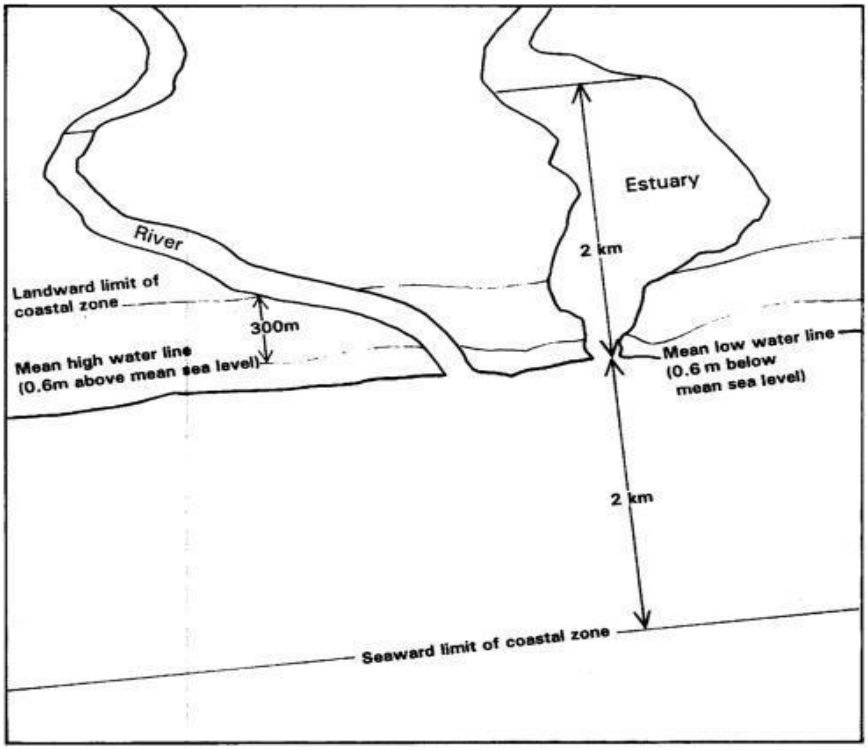
Objectives

This study mainly focuses on identifying coastal morphological and shoreline changes in the context of a highly active economic area. Coastal morphological change is a globally recognized concern. It alters the physical configuration and extent of coastal areas. The present study focuses on Calido Beach, Kalutara, as the most visited coastal destination in Sri Lanka. It empowers the visualization of shoreline changes within the study area for the policy mechanisms. This identification would support distinguishing the greatest erosion and accretion within the study area in past years. ArcGIS and its collection of spatial analysis capabilities are used to identify shoreline alterations. This study uses Google Earth Pro imagery to methodically map coastline changes between 2015 and 2022. Lastly, it would make it possible to evaluate the socioeconomic effects of human habitation near Calido Beach. As a result, the study's numerous domains of investigation, each of which contributes to a more comprehensive understanding of coastal dynamics and its consequences, demonstrate its value.

Methodology

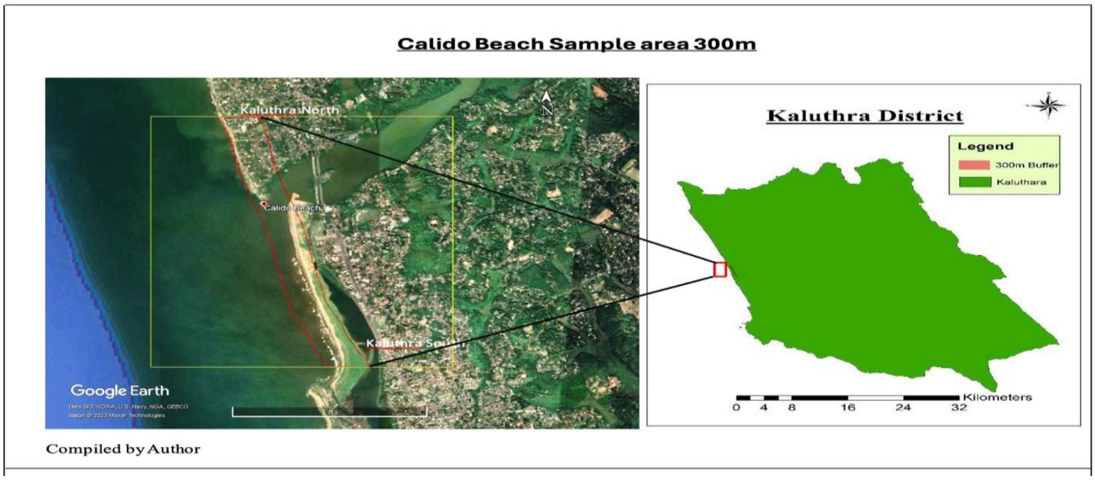
The coastal legal boundary is the mandate of the Costal Conversation Department (CCD). The conservation and management of the coastal environment lie within the coastal zone. It is defined in the Coast Conservation Act of 1981 as the area lying within a limit of 300m landward of the Mean High-Water Line (MHWL) and a limit of 2km seaward of the Mean Low Water Line (MLWL) as a coastal legal boundary (Parliament of Sri Lanka, 1981). In the case of a river, streams, lagoons or any other body of water connected to the sea, the landward boundary extends to a limit of 2km measured perpendicular to the straight baseline which drawn between the natural entrance points thereof and includes the water of such rivers, streams, and lagoons or any other body of water connected to the sea (Parliament of Sri Lanka, 1981). Figure 1 shows an illustration of the legal boundary of the coastal belt in Sri Lanka.

Figure 1: The Legal boundary of the coastal belt in Sri Lanka



In accordance with this legislative provision, the present study delineates a 300-metre buffer zone as the spatial boundary of the sample area. Figure 2 illustrates the delineated sample area that was used for the present study.

Figure 2 : Calido Beach – Sample Area



The study is based primarily on secondary data, mainly the geospatial data. Given the importance of data reliability, all secondary sources were carefully selected and validated according to the selected study area. The primary data sources employed in this study comprise Google Earth Pro satellite imagery and other relevant background information gathered from published literature. Accordingly, historical Google Earth Pro images were acquired for the study period spanning 2015 to 2022. The secondary sources for the secondary reviews in the study were journal papers, government reports, and other online available materials.

Table 1:Google Earth Images collection years

Year	Google Earth Image
2015	1/30/2015
2017	1/30/2017
2020	11/13/2020
2022	12/17/2022

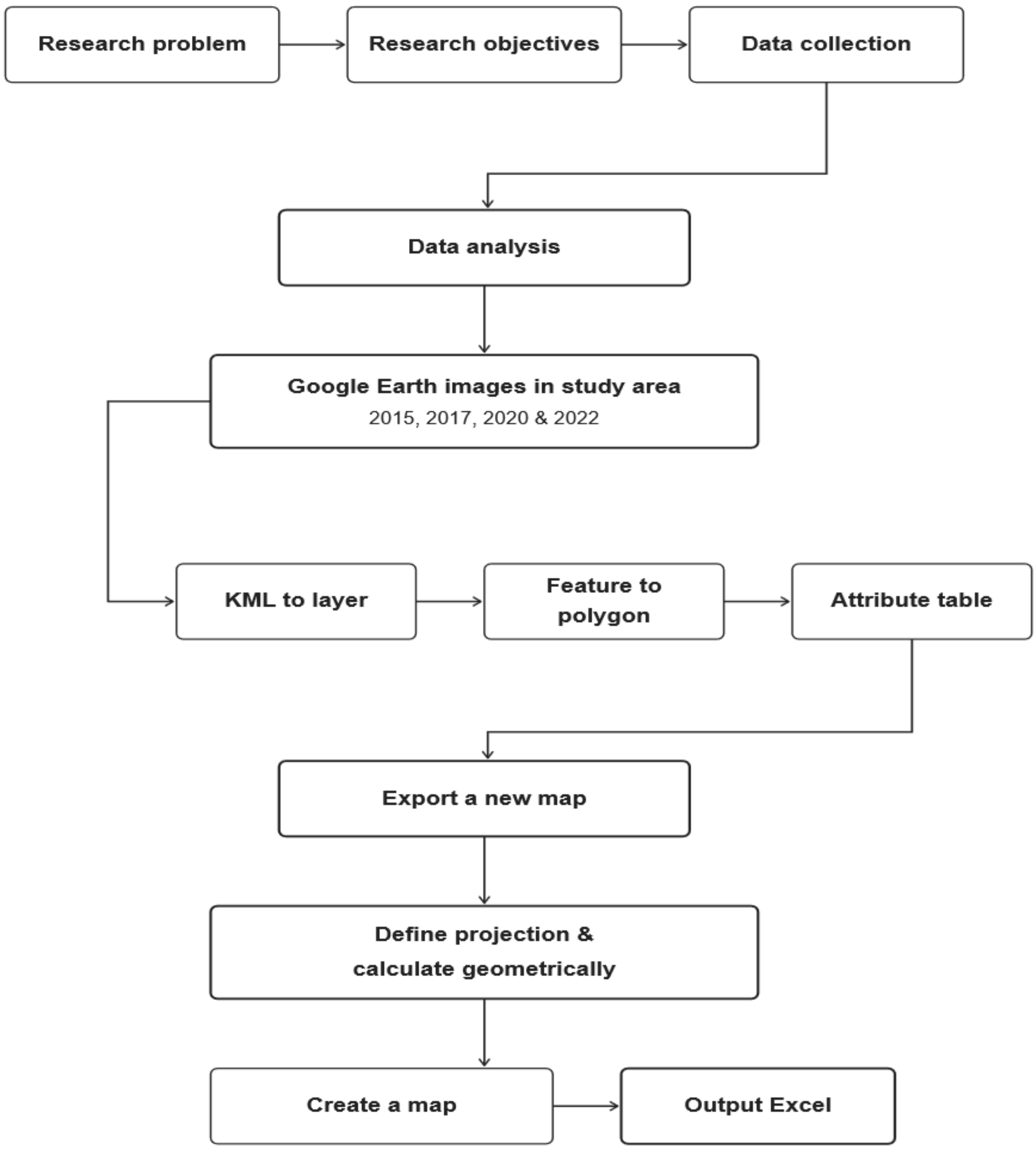
This study employs a quantitative analytical approach to major calculations. Shoreline detection from satellite imagery is used to quantitatively examine temporal variations in erosion and accretion. It was utilized as a component of coastal morphological change, utilizing ArcGIS software. Accordingly, Google Earth images from 2015, 2017, 2020, and 2022 were used to identify shoreline changes. Then, an assessment was conducted by classifying eroded and accreted coastal areas by magnitude. The magnitude was defined as high, medium, and low using ArcGIS software. Within ArcGIS, attribute data were joined to the shoreline change map. Geometric calculations were applied to derive coastal area changes in square meters (sqm).

For data visualization and the mapping process, ArcGIS software and Microsoft Excel were utilized as the primary tools. ArcGIS was used to create all of the maps. The study used the Google Earth imagery that was available for each year and digitized it using coordinate reference systems. Two coordinate reference systems, such as WGS 1984 and the Kandawala Sri Lanka Grid system, serve as the foundation for the maps. Google Earth Pro was used to depict coastline alterations using the WGS 1984 coordinate system. The WGS 1984 coordinate system was used to create shoreline change polygons. A variety of ArcGIS tools, such as KML to Layer, Feature to Polygon, Clip, Buffer, Projection, and Symbology tools, were used to generate the results. The projection for geometric computations used to the coastline polygons was defined using the Kandawala Sri

Lanka coordinate system. Microsoft Excel is used to present the final results, and tables and charts are used to show the classifications of coastal morphology.

Figure *3* presents a schematic overview of the study methodology. Figure was included all the analytical techniques employed throughout the research process.

Figure 3 : Methodology Summary



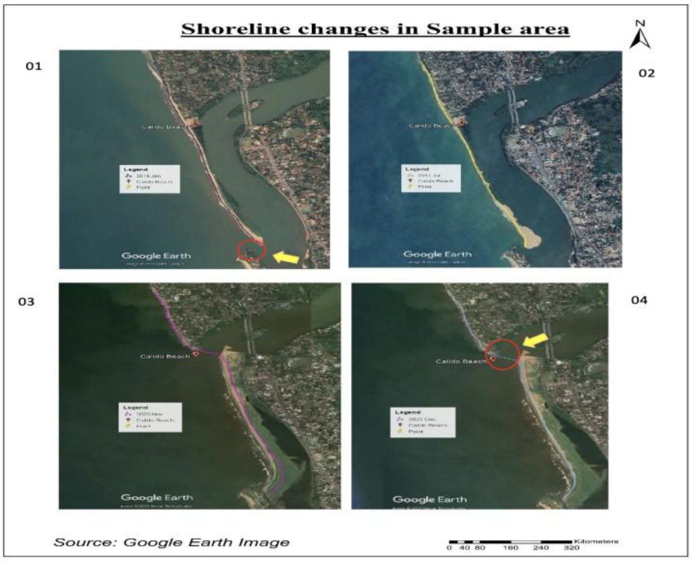
Results

The results show the remarkable shoreline changes over time durations. It insists on the significant coastal transformation within the studied short period of time. Shoreline position changes have notable implications for coastal currents, and it can be noticed mainly during monsoon periods. Even though, if there is a significant catastrophic shoreline change can be observed more from human interaction than the natural process. Prior to 2017, shoreline changes were relatively minor and consistent with natural variability. However, from 2017 onwards, significant shoreline change was recorded on an annual basis. Figure 4 illustrates the observed shoreline changes at Calido Beach.

Figure 4 : Shoreline changes in Calido Beach, Kaluthara

Figure 5 clearly illustrates the directional movement of shoreline changes over time. These images also demonstrate that the position of the river mouth. The river mouth was altered following the cutting of the sand bar during the 2017 flood event. The first image depicts the original river mouth position. The fourth image, marked with a red circle, shows the current river mouth location. The removal of the sand bar can be seen in the last two images, and the yellow line on the sand bar in 2017 has been erased in the 2020 map. Within the time period, it is clear that the river mouth has changed.

Figure 5 : Shoreline Changes in Sample Area



Shoreline change analysis enables the calculation of coastal geomorphological change through geometrical calculation. As a preliminary step, the sample area and shoreline polygons were demarcated. Figure 6 presents the resulting shoreline polygons within the 300-metre buffer zone of the sample area as a visual representation of the Calido coastline.

Figure 6 :Shoreline changes in the Sample area (300m Buffer-Zone)

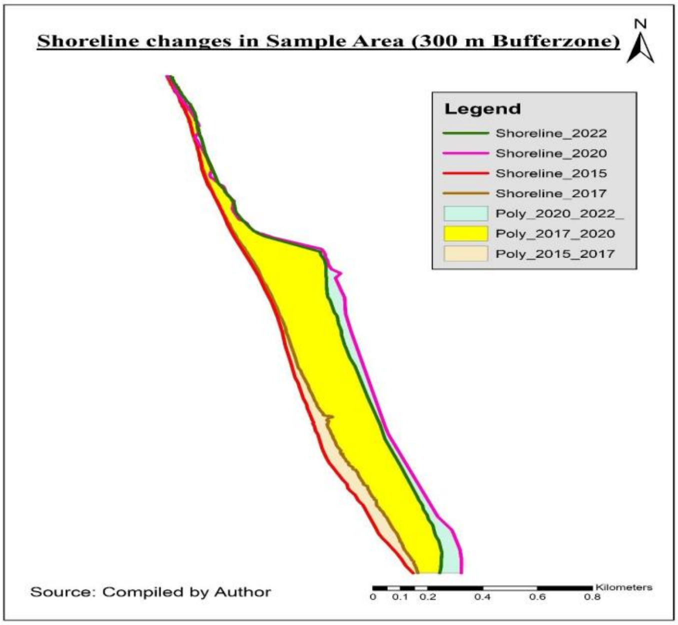


Figure 6 presents shoreline changes within the sample area across the defined time intervals, as represented by 300-metre polygons. In 2015, the red colour line indicates the shoreline with a large area to the ocean. It has changed in 2017. When it comes to 2020, the map indicates drastic land erosion morphologically. In 2022, the erosion has recovered to some extent, and the green line shows the land accretion compared to 2017-2020. Based on these polygonal extents, coastal morphological changes, specifically erosion and accretion, were calculated. Table 2 shows the aggregated result of the polygon area in sq.m.

Table 2 : Coastal Morphological Changes in the Sample Area

Year Duration	Land Change (sq.m)	
	Erosion	Accretion
2015-2017	68519.28795	611.41694
2017-2020	425418.98891	1.73248
2020-2022	5737.91574	66128.15178

Figure 7 : Shoreline change in Calido Beach -2017

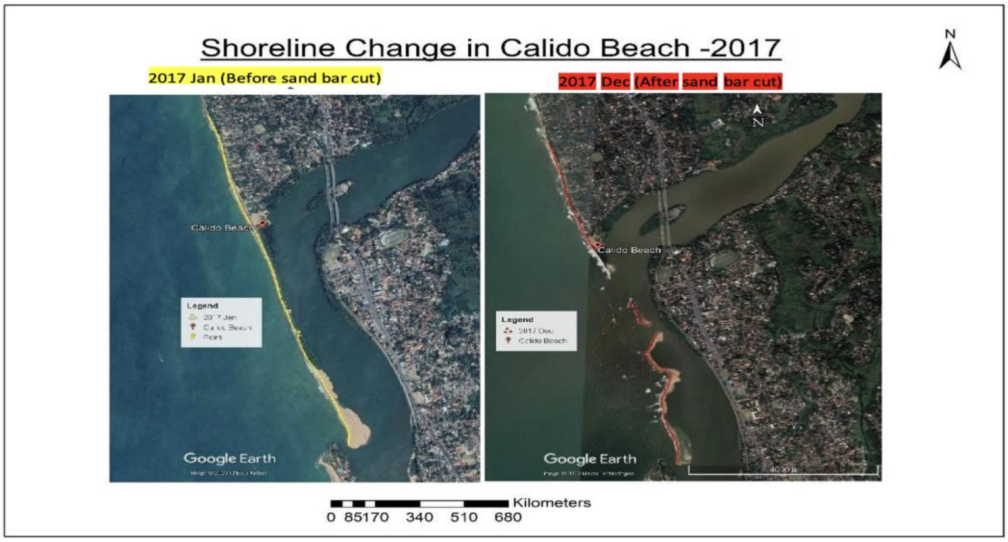


Figure 7 illustrates the manner in which shoreline changes have affected the current position of the shoreline in the study area. The pattern is further corroborated by

Figure 5. The shoreline changes are associated with both positive and negative coastal morphological transformations. Positive changes are classified as accretion (A). Negative changes are classified as erosion (E). Three shoreline polygons were delineated based on the 300-metre sample area (Figure 6), and the resulting land change types are presented in the tables below.

Table 3 :Land Change Pattern in Calido Beach 2015 -2017

Land Change Pattern in Calido Beach 2015 -2017		
OBJECTID	Shape_Area(Sq.m)	Type
2	67358.48725	E
3	2.045179	A
4	108.95029	E
5	14.68031	A
6	618.77759	E
7	281.88750	A
8	35.30453	A
9	68.93676	A
10	0.24769	E
11	11.30762	A
12	402.78669	E
13	3.97561	A
14	15.20946	E
15	193.27945	A
17	14.82898	E
	69131	

Table 4 :Land Change Pattern in Calido Beach 2017-2020

Land Change Pattern in Calido Beach 2017-2020		
OBJECTID	Shape_Area (sq.m)	Type
1	425418.98891	E
2	1.73248	A

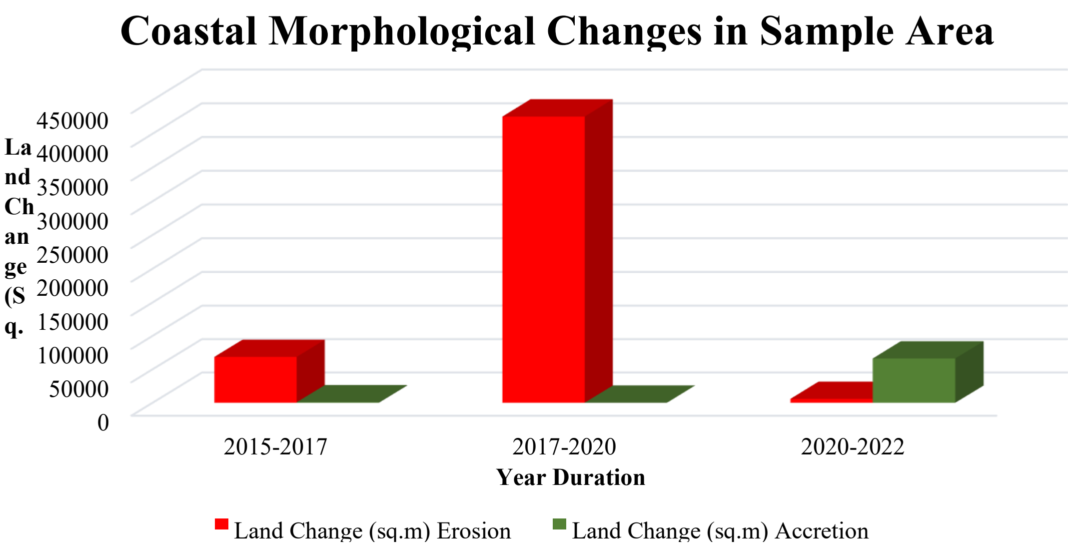
	425420.72139	

Table 5 : Land Change Pattern in Calido Beach 2020-2022

Land Change Pattern in Calido Beach 2020-2022		
OBJECTID	Shape_Area(Sq.m)	Type
1	65618.09727	A
2	21.53894	E
3	89.03626	A
4	698.49254	E
5	62.60530	A
6	1.11796	E
7	38.73605	A
8	0.017355	E
9	187.26867	A
10	765.53341	E
11	0.00084	A
12	1584.15864	E
13	132.40739	A
15	2667.05690	E
	71866.06752	

During the period from 2015 to 2017, a net negative coastal morphological change of approximately 69,131 sq.m was recorded within the sample area. During the period from 2017 to 2020, a substantially larger net negative coastal morphological change of approximately 425,420 sq.m was recorded within the sample area. During the period from 2020 to 2022, a net positive coastal morphological change of approximately 71,866 sq.m was recorded within the sample area.

Figure 8 : Coastal Morphological Changes in the Sample Area



A distinct three-phase pattern of coastal morphological change is revealed by the quantitative geospatial analysis. Between 2015 and 2017, there was modest net erosion of about 68,519 square meters. The limited accretion of 611 sq.m. shows that shoreline degradation started before the sandbar seen in the first satellite photos was removed. The most significant morphological degradation found in this study occurred between 2017 and 2020. A geometric computation can be performed with a net erosion of about 425,419 sq.m. and a negligible accretion of 1.73 sq.m.

In summary, the results show that the deliberate cutting of the sandbar in 2017 directly caused a change. According to the results, it significantly altered the dynamics of sediment transport and moved the mouth of the Kalu River. There was a partial recovery in the 2020–2022 period that followed. It is noteworthy. In comparison to decreased erosion of 5,738 square meters, the recovery involved accretion of almost 66,128 square meters. Through the alteration of the coastline, it may indicate an early restoration of sediment equilibrium within the sample region. All of these results show that the primary cause of the coastal instability at this site was human activity, specifically the removal of sandbars. It continues to produce a series of morphological changes that cascade.

Discussion

The coastal zone plays an integral role in the country's sustainable development. Coastal morphological and shoreline changes have long been recognized as significant natural hazards in the region. The cutting of the sandbar in 2017 is identified as the primary driver of shoreline position changes at Calido Beach (Gunasinghe et al., 2022). Wave and current dynamics, sediment supply, coastal geology and morphology, and anthropogenic intervention are among the principal factors influencing shoreline position (Chand & Acharya, 2010). According to the analysis, the cutting of the sand bar in May 2017 was the principal cause of accelerated coastal erosion at Calido Beach. Prior to this intervention, no comparable scale of erosion was recorded. A comparative analysis of Google Earth imagery from before and after the 2017 flood event clearly demonstrates the magnitude of the resulting coastal morphological change.

The data presented in these tables provide a systematic understanding of how coastal morphological features have changed over time within the 300-metre sample area. As discussed above, the primary driver of these changes was the intervention carried out for flood hazard mitigation. In addition, some factors may have influenced these erosions. As an island, sea level is an important factor for coastal erosion. Palamakumbure et al. (2020) state that the southwestern coast is vulnerable to coastal erosion. It is mainly due to the sea level and the sea current around the coastline. Furthermore, they mention that the significance of sea level rise has been underway in the past from 2006 to 2017 and indicate increased with a rate of 0.288 ± 0.118. Weerakkody (1996) forecasted the same scenario and stated the impact of the sea-level for south-western coastline from 1996 to the upcoming years.

Gunasinghe et al. (2022) explain the monsoon-driven geomorphological changes along the west coast of Sri Lanka, and most of the southwestern coastline of Sri Lanka shows considerable erosion during the monsoon period. Samarasekara et al. (2023) confirm the same argument, and they also assess the climate and monsoon effect for the Kalutara and Kalpitiya beaches in Sri Lanka. Saengsupavanich et al. identify that offshore sand mining is a significant factor for the coastal erosion in Sri Lanka. Unplanned and without a feasible approach, sand mining is an influence for higher level coastal erosion. This general argument was employed for reviewing coastal erosion mitigation measures on Sri Lanka's Western Coast by Jayathilaka et al. (2023b). They suggest that the sand-mining make negative consequences for the coastline as an anthropogenic effect.

The land accretion that can be observed through the years was rooted in the beach nourishment on shoreline dynamics. Karunarathna (2026) and Lakshitha et al. (2025) have systematically assessed the artificial beach nourishment systematically and the coastal protection programs, employing Calido beach and the Kaluthara area as the target point. Therefore, the main factor for both the coastal erosion and the coastal accretion is human anthropogenic activities has impacted.

However, driven by short-sighted political decision-making and other human and natural phenomena, it has generated a range of adverse consequences. The first is the displacement of the Kalu River mouth, as illustrated in

Figure 5, where the changed river mouth position is indicated by a red circle. Before the cutting of the sandbar, the river mouth was located adjacent to the Avani Kalutara Resort. However, its current position has been substantially altered, and it has direct implications for the nearest island.

The second consequence is the deterioration of water quality within the affected area. Before the intervention, the natural tidal circulation facilitated water purification. Seaward was discharged from the lagoon. Following the cutting of the sand bar, reduced circulation has led to the accumulation of waste discharged by local residents. It was resulting in poor water quality and associated public health concerns. Furthermore, the lagoon supports established marine habitats. Those are adversely affected by these changed hydrological conditions. On balance, the negative environmental consequences of the sand bar removal substantially outweigh any short-term flood mitigation benefits.

The findings of this study collectively demonstrate that the 2017 sand bar removal at Calido Beach as significant finding. It represents a critical case study in the unintended consequences of reactive, short-term coastal engineering interventions. The magnitude of erosion recorded between 2017 and 2020, exceeding 425,000 sq.m, far surpasses any comparable change attributable to natural variability in the study period. This underscored the disproportionate impact of this single anthropogenic event on the coastal system compared to other natural phenomena like sand mining, monsoon effect, etc. The compounding effects, displacement of the Kalu River mouth, deterioration of lagoon water quality, disruption of tidal circulation, and degradation of established marine habitats reveal the interconnected nature of estuarine and coastal systems. The interference with one component produces cascading consequences across the broader environment for next few years. These results are consistent with the wider body of literature on anthropogenically induced coastal change. Scholars repeatedly demonstrate that poorly planned interventions can accelerate erosion and ecological degradation at rates that far exceed natural processes (Jayathilaka et al., 2023; Mentaschi et al., 2018; Ratnayakage et al., 2020). The findings, therefore, carry significant implications for coastal governance and management practice in Sri Lana. Particularly in relation to solutions, the study suggests the long-term indicators for sustainable coastal conservation. The need for rigorous environmental impact assessment, multi-stakeholder consultation, and research grounded decision are important as adherence to evidence-based decision-making frameworks prior to any future interventions in sensitive estuarine and coastal environments.

Conclusion

In conclusion, this study provides a valuable contribution to the understanding of coastal morphological and shoreline changes at Calido Beach, Kalutara. The findings and insights aim to inform appropriate protection and mitigation measures for coastal erosion in the area. The study further recommends that future research undertake a comprehensive Environmental Impact Assessment and Feasibility Analysis, which can guide the implementation of an appropriate flood control system for the Kalu River.

This study has established that the coastal morphological and shoreline dynamics at Calido Beach, Kalutara. The shoreline dynamics are overwhelmingly shaped by anthropogenic intervention rather than natural coastal processes, with the artificial cutting of the Kalu River sand bar in May 2017 identified from the past studies as the primary causal event. Through systematic geospatial analysis of Google Earth Pro satellite imagery across four temporal reference points (2015, 2017, 2020, and 2022) and the application of ArcGIS-based polygon analysis within a 300-metre coastal buffer zone. This study has quantified the progression from moderate preintervention erosion, through catastrophic post-intervention land loss, to partial morphological recovery. The socio-environmental consequences of this intervention can include river mouth displacement, degradation of lagoon water quality, and loss of marine habitat. Moreover, it can be illustrated that the broad and enduring costs of reactive, insufficiently assessed coastal management decisions are. This study demonstrates the indispensable value of geospatial monitoring as a tool for coastal governance, beyond its contribution to the understanding of shoreline dynamics at this specific Calido coastal site. The findings force the integration of the use of geospatial data and morphological dynamics for policy decision-making. The study provides the empirical foundation necessary to support evidence-based policy development and disaster risk reduction planning. In addition to that, coastal geospatial analysis supports the formulation of integrated coastal zone management strategies in Sri Lanka and analogous coastal environments across the region.

Limitations of the study

Given the size of the study area, the analysis is limited to a 300-meter buffer zone. A buffer zone of more than 300 meters may have a significant impact on the empirical contribution and despite the fact that it is crucial to identify the most affected coastal boundary at Calido Beach from a legal standpoint, the study area is small and limited. The study only uses secondary data, and Google Earth Pro was used to acquire the imagery. Future research using primary data, such as field observations, locals' opinions, and government insights, may increase the field's worth. Variations in image quality across different acquisition dates represent a limitation that may affect the precision of shoreline delineation. The technical limitations can be corrected or verified through the primary data integration into the study. The temporal scope of the shoreline change analysis is constrained to three intervals: 2015 to 2017, 2017 to 2020, and 2020 to 2022. All area calculations focused on quantifying erosion and accretion as the primary indicators of coastal morphological change. A multi-model or multi-factor study would be insightful, beyond quantifying only erosion and accretion. This supports the scholars to identify the study area deeply and empirically, and to ensure practical soundness.

Reference

Ashraff, S. H. A. (2021). Analysis of Causes and Effects on Social and Economic Conditions in Southeastern Coastal Belt of Sri Lanka. (Special Reference to

Proposed Project on Mining of Heavy Mineral Sands along the Akkaraipattu-Komari Coastal Stretch). *Scientific Research Journal (SCIRJ)*, *1*, 52. https://doi.org/10.31364/SCIRJ/v9.i06.2021.P0521866

Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*, *81*(2), 169–193. https://doi.org/10.1890/10-1510.1;ISSUE:ISSUE:DOI

Boak, E. H., & Turner, I. L. (2005). Shoreline definition and detection: A review. *Journal of Coastal Research*, *21*(4), 688–703. https://doi.org/10.2112/03-0071.1

Brammer, H. (2014). Bangladesh's dynamic coastal regions and sea-level rise. *Climate Risk Management*, *1*, 51–62. https://doi.org/10.1016/J.CRM.2013.10.001

Burningham, H., & Fernandez-Nunez, M. (2020). Shoreline change analysis. *Sandy Beach Morphodynamics*, 439–460. https://doi.org/10.1016/B978-0-08-102927-5.00019-9

Cabana, D., Rölfer, L., Evadzi, P., & Celliers, L. (2023). Enabling Climate Change Adaptation in Coastal Systems: A Systematic Literature Review. *Earth's Future*, *11*(8), e2023EF003713. https://doi.org/10.1029/2023EF003713;WGROUP:STRING:PUBLICATION

Chand, P., & Acharya, P. (2010). Shoreline change and sea level rise along coast of Bhitarkanika wildlife sanctuary, Orissa: An analytical approach of remote sensing and statistical techniques. *INTERNATIONAL JOURNAL OF GEOMATICS AND GEOSCIENCES*, *1*(30), 436–455. https://www.researchgate.net/publication/301772465_Shoreline_change_and_sea_level_rise_along_coast_of_Bhitarkanika_wildlife_sanctuary_Orissa_An_analytical_approach_of_remote_sensing_and_statistical_techniques

Department of Census and Statistics. (2021). *Department of Census and Statistics*. Department of Census and Statistics. https://www.statistics.gov.lk/abstract2021/CHAP1

Gunasinghe, G. P., Ratnayake, N. P., Ratnayake, A. S., Samaradivakara, G. V. I., Dushyantha, N. P., Jayaratne, R., Dinusha, K. A., & Silva, A. (2022). Monsoon-Driven Geomorphological Changes Along the West Coast of Sri Lanka: A

Combined Approach Utilizing ‘CoastSat’ and Google Earth Engine. *Ocean Science Journal 2022 57:3*, *57*(3), 475–492. https://doi.org/10.1007/S12601-022-00081-Z

Jayathilaka, R. M. R. M., Ratnayake, N. P., Wijayaratna, T. M. N., Silva, K. B. A., & Arulananthan, K. (2023a). A Review of coastal erosion mitigation measures on Sri Lanka’s Western Coast, an Island Nation in the Indian Ocean: Current gaps and future directions. *Ocean & Coastal Management*, *242*, 106653. https://doi.org/10.1016/J.OCECOAMAN.2023.106653

Jayathilaka, R. M. R. M., Ratnayake, N. P., Wijayaratna, T. M. N., Silva, K. B. A., & Arulananthan, K. (2023b). A Review of coastal erosion mitigation measures on Sri Lanka’s Western Coast, an Island Nation in the Indian Ocean: Current gaps and future directions. *Ocean & Coastal Management*, *242*, 106653. https://doi.org/10.1016/J.OCECOAMAN.2023.106653

Karunarathna, P. (2026). Analyzing the Impact of Artificial Beach Nourishment on Shoreline Dynamics: A Case Study of Calido Beach-Kaluthara. *International Journal of Innovative Science and Research Technology*, *11*(4), 632. https://doi.org/10.38124/ijisrt/26apr128

Lakshitha, N., Samarasekara, R., & Siriwardana, H. (2025). Environmental Science Optimizing beach nourishment composition for coastal protection in Sri Lanka: Insights from flume experiments. *J.Natn.Sci.Foundation Sri Lanka*, *53*(2), 125–138. https://doi.org/10.4038/jnsfsr.v53i2.12301

Mentaschi, L., Vousdoukas, M. I., Pekel, J. F., Voukouvalas, E., & Feyen, L. (2018). Global long-term observations of coastal erosion and accretion. *Scientific Reports 2018 8:1*, *8*(1), 12876-. https://doi.org/10.1038/s41598-018-30904-w

Neumann, B., Ott, K., & Kenchington, R. (2017). Strong sustainability in coastal areas: a conceptual interpretation of SDG 14. *Sustainability Science 2017 12:6*, *12*(6), 1019–1035. https://doi.org/10.1007/S11625-017-0472-Y

Palamakumbure, L., Ratnayake, A. S., Premasiri, H. M. R., Ratnayake, N. P., Katupotha, J., Dushyantha, N., Weththasinghe, S., & Weerakoon, W. A. P. (2020). Sea-level inundation and risk assessment along the south and southwest coasts of

Sri Lanka. *Geoenvironmental Disasters 2020 7:1*, *7*(1), 17-. https://doi.org/10.1186/S40677-020-00154-Y

Pang, T., Wang, X., Nawaz, R. A., Keefe, G., & Adekanmbi, T. (2023). Coastal erosion and climate change: A review on coastal-change process and modeling. *Ambio*, *52*(12), 2034. https://doi.org/10.1007/S13280-023-01901-9

Parliament of Sri Lanka. (1981). *Coast Conversation Act No. 57 of 1981*. 1981

Perricone, V., Mutalipassi, M., Mele, A., Buono, M., Vicinanza, D., & Contestabile, P. (2023). Nature-based and bioinspired solutions for coastal protection: an overview among key ecosystems and a promising pathway for new functional and sustainable designs. *ICES Journal of Marine Science*, *80*(5), 1218–1239. https://doi.org/10.1093/ICESJMS/FSAD080

Ratnayakage, S. M. S., Sasaki, J., Suzuki, T., Jayaratne, R., Ranawaka, R. A. S., & Pathmasiri, S. D. (2020). On the status and mechanisms of coastal erosion in Marawila Beach, Sri Lanka. *Natural Hazards 2020 103:1*, *103*(1), 1261–1289. https://doi.org/10.1007/S11069-020-04034-4

Saengsupavanich, C., Ratnayake, A. S., Yun, L. S., & Ariffin, E. H. (2023). Current challenges in coastal erosion management for southern Asian regions: examples from Thailand, Malaysia, and Sri Lanka. *Anthropocene Coasts 2023 6:1*, *6*(1), 15-. https://doi.org/10.1007/S44218-023-00030-W

Samarasekara, R. S. M., Sahthy, M. M., Siriwardana, A. H. M. S., & Siriwardana, H. P. A. M. (2023). Assessment of wave climate change and its impact on littoral drift along the Kalutara and Kalpitiya beaches in Sri Lanka. *Journal of the National Science Foundation of Sri Lanka*, *50*(4), 813–826. https://doi.org/10.4038/JNSFSR.V50I4.10823

Schwämmle, V., & Herrmann, H. J. (2003). Solitary wave behaviour of sand dunes. *Nature 2003 426:6967*, *426*(6967), 619–620. https://doi.org/10.1038/426619a

Veettil, B. K., Puri, V., Wickramasinghe, D., Ward, R. D., Stankovic, M., Udagedara, S., & Madawala, Y. (2024). Blue carbon ecosystems in Sri Lanka: A review. *Estuarine, Coastal and Shelf Science*, *306*, 108907. https://doi.org/10.1016/J.ECSS.2024.108907

Weerakkody, U. (1996). *Vulnerability and Adaptation Assessments for Sri Lanka*. 207–224. https://doi.org/10.1007/978-94-017-3653-4_10

World Bank. (2017). Sri Lanka: Managing Coastal Natural Wealth. *The World Bank Group*. https://doi.org/10.1596/30860