IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Assessing The Coastal Based Vulnerability (CBV) Of Alappuzha District Of Kerala By The Application Of DSAS

[1*] Rengith R Pillai

Research Scholar,

Department of Geography,

Sree Sankaracharya University of Sanskrit, Kalady, Ernakulam 683574, rengithrpillai1996@gmail.com

ABSTRACT

Shoreline change is regarded as a severe issue due to the changing nature of the oceans and its impact on people and land. The notion of "shoreline" refers to the rate at which the shore is eroded or accreted as a result of wave action, sea level rise, or any other risks or processes that influence the land. All natural processes are conserved in order to achieve equilibrium; the coast, as a physical feature, is always changing, and nature strives to maintain its balance. India's coastal regions are known for their diverse ecosystems, high production, and dense population, which have enhanced their importance. The present study has been conducted along the coastal areas of southern Kerala, especially Alappuzha district with the help of multi-temporal satellite images of the years 1973, 1988, 2002, 2018 and 2022. Alappuzha district which is located in the southern region of Kerala faces a significant amount of erosion leading to a greater coastal based vulnerability. The decadal changes in the shoreline are evidence that the beaches are eroded at an alarming rate. The Digital Shoreline Analysis System (DSAS) technique is used for calculating the coastal erosion and accretion rates.

Key words: Digital Shoreline Analysis System (DSAS), Coastal Erosion, Accretion

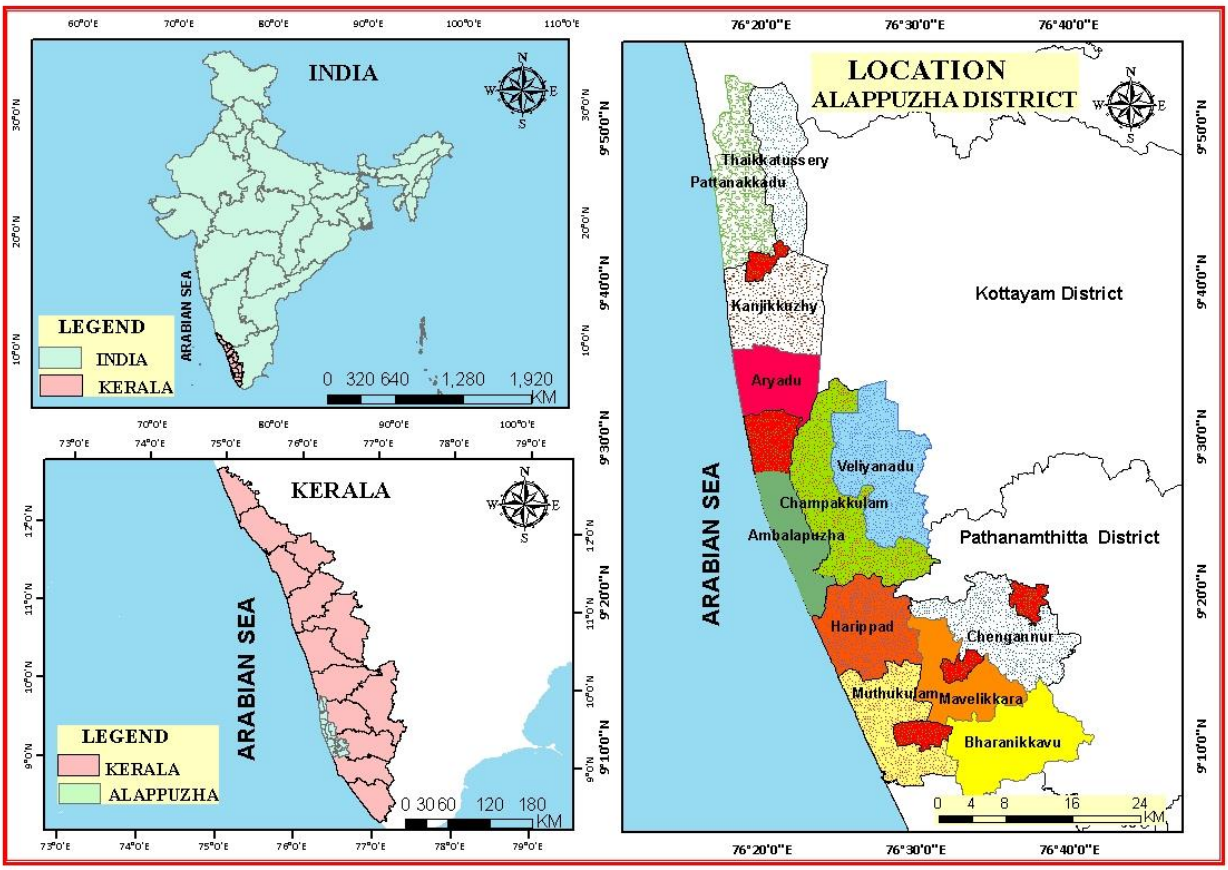
INTRODUCTION

Coastal districts of Kerala is having higher number of built-up regions, highways close to the coastline, low near shore bed slope, low coastal elevation, high rates of erosion, and high population density (saikrishnan et.al, 2023). Shoreline refers to the actual physical boundary between land and water (Dolan et al. 1991). Some of the causes leading to the extremely high Coastal Landform Vulnerability in Alappuzha are primarily due to the higher erosion and unique hydrogeomorphic setting which marks the district as one of the vulnerable regions in the state. Coastal landforms are recognised as one of the most dynamic areas on earth, with physical and human activities being the main drivers of shoreline modifications (Chen et al. 2005). Estimating the level of shoreline dynamics over time marks the level of Coastal Based Vulnerability (CBV). Application of Digital Shoreline Analysis System (DSAS) is utilised for the extraction of the regions having higher rate of erosion and accretion which determines the rate of CBV.

STUDY AREA

Alappuzha district marks the southern portion of the state of Kerala, elucidates most of the region, having low lying characteristics. District shares a boundary with kottayam and Pathanamthitta districts in the East, Lakshadweep Sea in the West, Ernakulam forms the north and Kollam marks the southern portion (Map 1). The geographical coordinates are 9° 05' and 9° 54' latitudes and 76° 17' 30" and 76° 40' longitudes. Districts cover an area of 1414 Sq Km comprising 6 taluks, 12 blocks, 5 municipalities. The predominance of the coastal plain and its allied erosion dynamics is a result of the regional close proximity to coastal hydrologic activities.

Map1 Location map



Source: Prepared by the researcher

RESEARCH METHODOLOGY

The Digital Shoreline Analysis System (DSAS) is an extension tool of Arc Map 10.4 is designed to calculate the rate of shoreline change using statistics from a temporal series of multiple shoreline positions. The software is proposed to assist the shoreline change-calculation process and also give rate-of change of information and the arithmetical data important to set up the consistency of the computed results. The most important application of DSAS is that it can operate multiple layers as representation of a particular shoreline feature at a specific point of time.

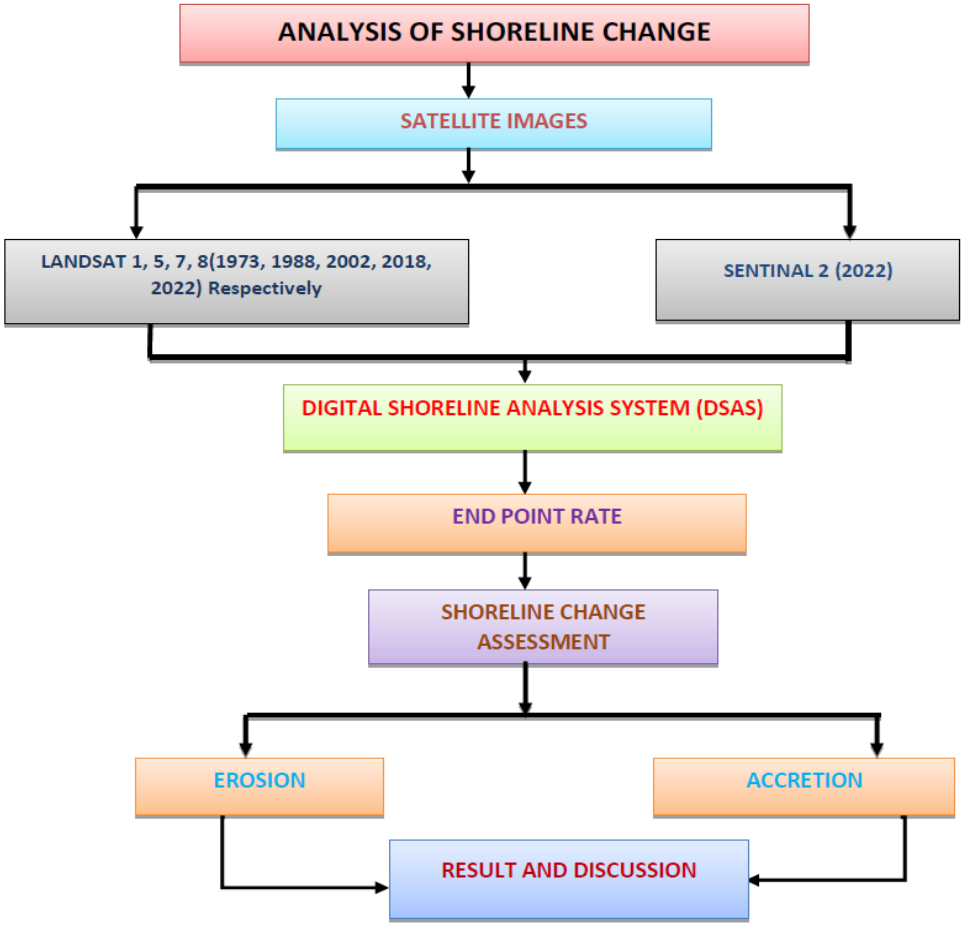
Table 1 Satellite Imageries and Specifications

Satellite	Sensor	Launch Year	Path/Row	Spatial Resolution
Landsat 1	MSS C1	1973/02/09	155/52	80m
Landsat 5	TM C1	1988/01/19	145/52	28m
Landsat 7	ETM+C1	2002/02/18	145/52	30m
Landsat 8	OLI/TRS C1	2018/02/06	145/52	30m
Sentinel 2A	MSI	2022/01/18	T43 PEN	10m

Source: Prepared by the Researcher

Using five-year intervals between the corresponding years 1973, 1988, 2002, 2018, 2022, (Table 1) the study examines the temporal changes in the shorelines and thereby analysed the regions having coastal landform vulnerability.

Figure 1 Methodology Chart



Source: Prepared by the Researcher

RESULTS AND DISCUSSION

The Shoreline Change Envelope (SCE) refers to a metric of the overall change in shoreline movement which takes into account all accessible shoreline positions and reports their distances, without specifying particular timeframes (Oyedotun et.al, 2014).

Table 2 Rate of Shoreline Change Envelope

Colour code	Erosion rate (in meter)
Red	20 – 158
Yellow	158 – 296
Green	296 – 434
Blue	434 – 572

Source: Prepared by the Researcher

The above table 2 states the colour code and rate of erosion. The SCE illustrates the severity of shore line erosion dynamics along the region; most of the regions (red coloration) resulting a widespread of erosion along the coastal region up to 158 meters including the regions (Map.2) of Pallithodu north and south, Arthunkal in the northern region, and regions of Mararikkulam, Punnapra north and Arattupuzha. The regions of the central and southern part are under severe erosion up to 434 meters including the regions of Thumpoly, Kanjiramchira and Thrikkunnapuzha. The regions stretching from Thumpoly to Punnapra exhibits a significant higher rate of erosion. Hence the degree of erosion is dynamic along the entire coastal stretch, which marks a varying level of coastal vulnerability. This indicates the influence of local factors namely the coastal hydrogeomorphic setting, sediment supply and wave velocity dynamics and patterns.

The End Point Rate (EPR) is estimated by taking the difference between the starting and ending shoreline dynamics over specified time periods. It provides an accurate result in the shifting of shoreline towards the coast. The mathematical formula for calculating the EPR can be expressed as:

$$EPR = \frac{(X_{end} - X_{start})}{(T_{end} - T_{start})}$$

Where,

X_{end} – position of shoreline at the end time

X_{start} – Position at the observation stating stage

T_{end} and T_{start} – Corresponding time periods of monitoring.

Table 3 Rate of EPR

Colour Code	Erosion rate (in meter)	Vulnerability Status
Violet	-11.6 to -7.9	Higher erosion
Green	-7.9 to - 4.2	Moderate Erosion
Yellow	-4.2 to -0.5	Low Erosion
Red	-0.5 to 3.3	Stable / Accretion

Source: Prepared by the Researcher

The EPR rate has been calculated for a time period of 49 years (1973 to 2022). Higher erosion rates are identified mostly in the central and southern regions. Table 4 illustrates the regional distribution of erosion and accretion status in the coastal region. The higher erosion trend can be identified in the regions of Thumpoly to Kanjiramchira stretch (Map 3); moderate vulnerability can be identified in the central to northern sections of the region mainly from kattoor to Mararikulam and central to southern regions mainly from vadakkal to purakkad. Less vulnerable regions are from Pallithode North to Arthunkal and some scattered regions in central regions.

Table 4 Regional Distribution of EPR

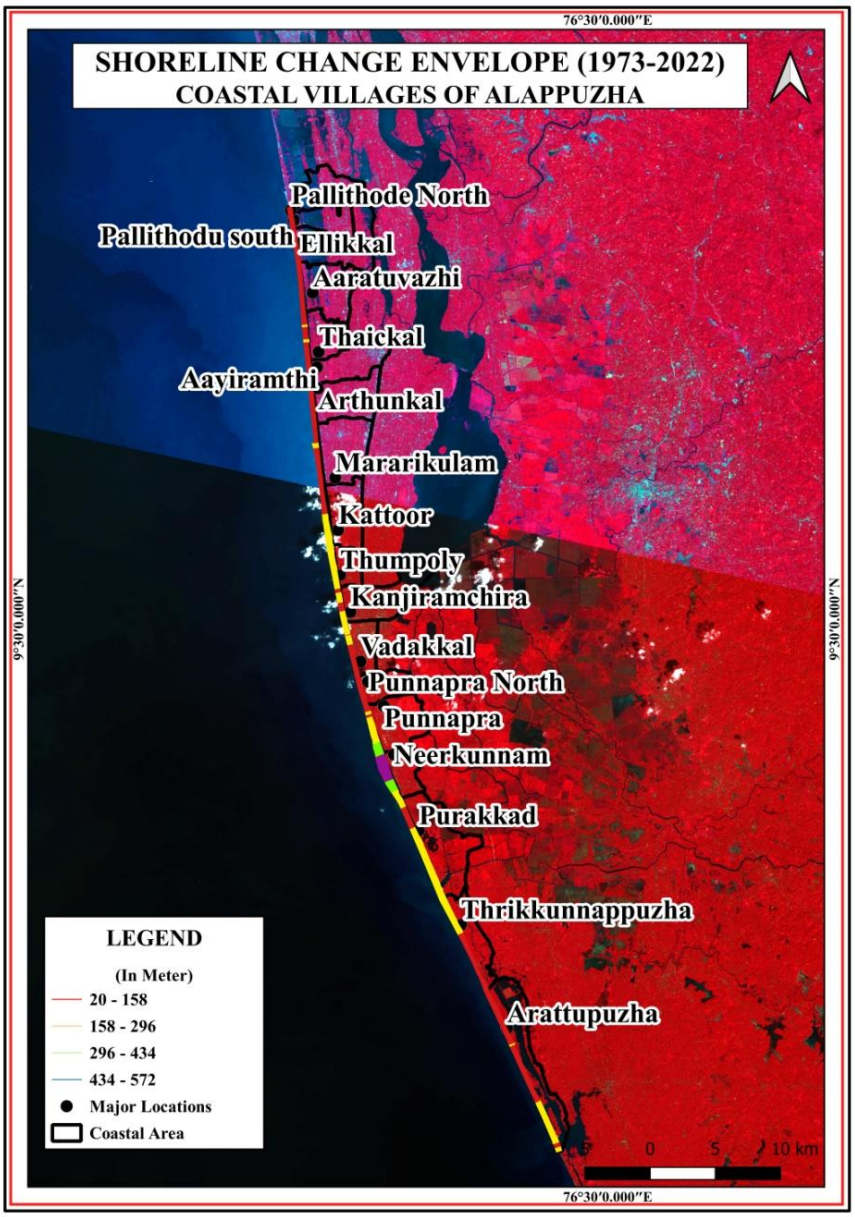
Erosion rate (m/yr)	Vulnerability status	Regions
-11.6 to -7.9	High Erosion	Thumpoly Kanjiramchira Regions of Northern Punnapra Parts of Thrikkunnapuzha Arattupuzha
-7.9 to -4.2	Moderate Erosion	Kattoor Regions of Mararikulam Vadakkal Parts of Punnapra Neerkkunnam Purakkad
-4.2 to -0.5	Low Erosion	Pallithode North Ellikkal Thaickal Aayiramthi Arthunkal Northern regions of Mararikulam
-0.5 to 3.3	Stable / Accretion	Smaller portions near Pallithodu

		South Regions near to Punnapra (Very Smaller Segments)

Source: Prepared by the Researcher

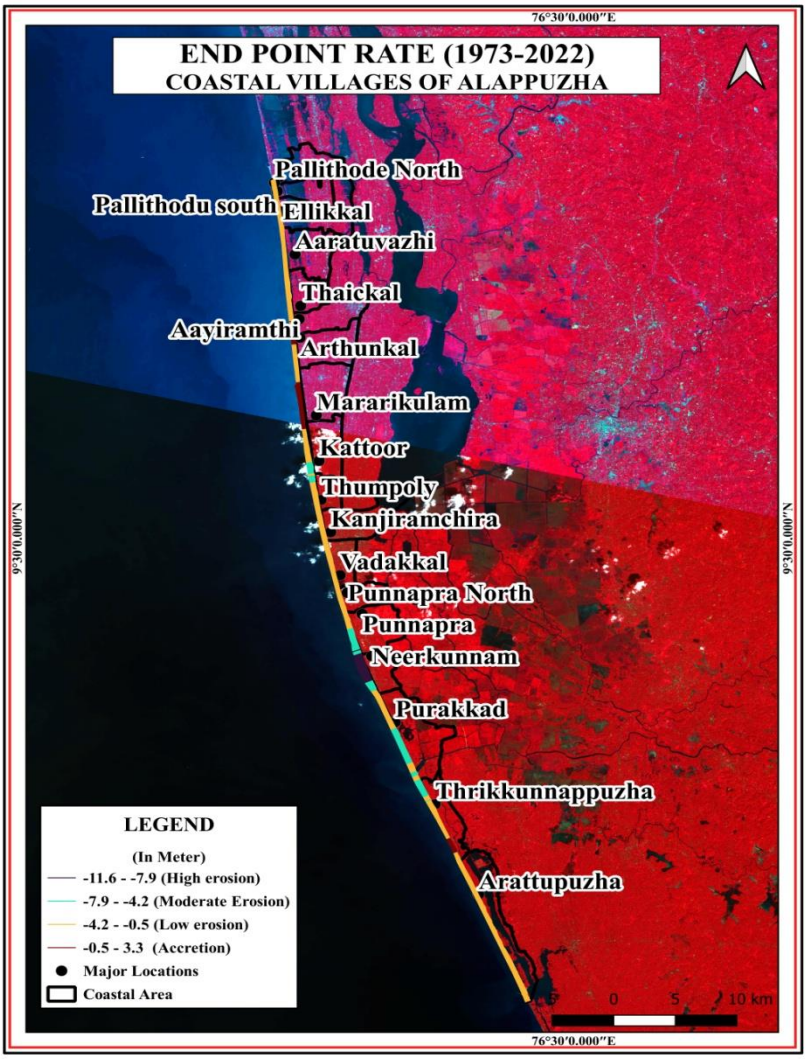
The region of higher erosion rate in the region is due to the Thumpoly fishing harbor which results in erosion on down drift side and occurrence of disrupted sediment transport. The dredging activities in the regions mark the accelerating erosion along the region. The transportation network in the region namely the Alappuzha beach road development, Arthungal to Thumpoly coastal area road network reduced the natural beach width and interference with the coastal landform morphology. The tourism infrastructure in the Alappuzha beach environment results in the removal of vegetative cover over the region and altered the coastal stability. The regions having higher rate of erosion are facing higher groundwater quality issues, mainly the occurrence of salt water intrusion in the coastal phreatic aquifers which results in the unsuitable conditions for domestic purposes.

Map 2 Shoreline Change Envelope



Source: Prepared by the Researcher

Map 4.5 End Point Rate



Source: Prepared by the Researcher

CONCLUSION

The CBV in the region is marked by the coastal landform erosion namely the higher beach erosion. The satellite data and filed visit states higher erosion in most of the regions. The beach ecosystem is highly vulnerable to erosion which shifts the shoreline towards the coastal area which entirely affects the regional ecology. The regional anthropogenic activities namely the dredging enhances the shoreline dynamics in the region. The hydrogeomorphic setting in the region is the main reason which leads to the higher vulnerability.

REFERENCES

- Chen, S., Chen, L., Liu, Q., Li, X., & Tan, Q. (2005). Remote sensing andGIS based integrated analysis of coastal changes and their environmentalimpacts in Lingding Bay, Pearl River Estuary, South China. Ocean &Coastal Management, 48, 65–83.
- Dolan, R., Fenster, M. S., & Holme, S. J. (1991). Temporal analysis of shoreline recession and accretion. Journal of Coastal Research, 7, 723–744.
- Fulani Stefano, Devoto Stefano, Biolchi Sara CucchiFranco.2011. Factors Triggering Sea Cliff Instability Along the Slovenian Coasts. Journal of coast research.
- Jayakumar K (2014) Remote sensing and GIS application in the management of GodavariMangroveWetland, Andhra Pradesh, South India. Dissertation, University of Madras.
- Kaliraj Seenipandi, K.K. Ramachandran, N. Chandrasekar, 2021. Modeling of coastal vulnerability to sea-level rise and shoreline erosion using modified CVI model, Remote Sensing of Ocean and Coastal

Environments, Elsevier. Pp.315-340, ISBN 9780128196045

- Kumar Avinash, Narayana A.C, K.S. Jayappa K.S.2010 “Shoreline changes and morphology of spits along southern Karnataka, west coast of India: A remote sensing and statistics-based approach. Geomorphology article.Elsevier.Pp.133-152.