

# Study focuses on the socio-economic vulnerability of coastal settlements in the context of Kerala

Anakha K, Josin Baby Mathew

<sup>1</sup>Student, T.K.M. College of Engineering, Kollam, Kerala

<sup>2</sup>Assistant Professor, T.K.M. College of Engineering, Kollam, Kerala.

Corresponding Author: Anakha K

Date of Submission: 02-05-2024

Date of Acceptance: 10-05-2024

**ABSTRACT:** The coastal area, acting as a transitional zone between land and sea, plays a crucial role in supporting diverse ecosystems and valuable resources within the biosphere. Human settlements along the coast, established for various purposes such as trade, fishing, and tourism, serve as focal points of activity in these dynamic environments. However, these settlements are susceptible to a range of vulnerabilities, including environmental, economic, socio-cultural, and societal factors, which can undermine their ability to withstand threats. This research focuses specifically on the socio-economic vulnerabilities of coastal settlements within Kerala. By closely examining different coastal characteristics, the study seeks to uncover the complex relationship between socio-economic factors and vulnerability in this region. Through the analysis of multiple case studies, the research explores various methods used to assess vulnerability, offering insights into the nuanced dynamics of coastal vulnerability assessment in the distinctive socio-economic context of Kerala.

**KEYWORDS:** Coastal settlement, Socio-economic vulnerability, Climate change, Coastal Vulnerability Assessment.

## I. INTRODUCTION

[1]. This paper strives to delve deeply into the socio-economic vulnerabilities inherent in Kerala's coastal communities, aiming to unravel the intricacies that define their resilience in the face of adversity. By focusing on the distinctive socio-economic context of Kerala and closely examining the diverse characteristics of its coastal areas, this research seeks to shed light on the nuanced relationship between socio-economic factors and vulnerability in this region. Through the exploration of multiple case studies and the

analysis of various vulnerability assessment methods, we aim to offer valuable insights into the dynamics of coastal vulnerability within the socio-economic fabric of Kerala. By doing so, we aspire not only to deepen our understanding of the challenges confronting these coastal settlements but also to pave the way for informed interventions aimed at enhancing their adaptive capacity and fostering sustainable development

[2]. The coastal zone is a transition zone between the Earth's surface's entirely terrestrial and fully marine components. It is widely acknowledged as an essential component of the biosphere, a location with various ecological systems and resources. (Christopher J. Crossland, 2014). Coastal areas have always been attractive settling grounds for human populations. Coastal locations have distinct natural and socioeconomic features that foster the concentration of human activity. (Costanza, 1999). A coastal settlement refers to a community or human habitation located in close proximity to a coastline or along the shore of a body of water, such as an ocean, sea, lake, or river. These settlements can vary widely in size and complexity, ranging from small fishing villages to large coastal cities. Coastal settlements are often established for a variety of reasons, including access to water for transportation, trade, and fishing, as well as for recreational purposes and tourism. The World Bank reported in 2015 approximately 38% of the world's population lives in coastal areas, which are defined as places within 100 km of the shore (UNEP 2014b). Global coastal populations have expanded from 1.6 billion to over 2.5 billion (see figure 2) during the last three decades. In 2007, about three-quarters (1.9 billion) were in developing countries.

[3]. The Coastal Zone in Kerala unfolds as a low-lying expanse bordering the sea, stretching

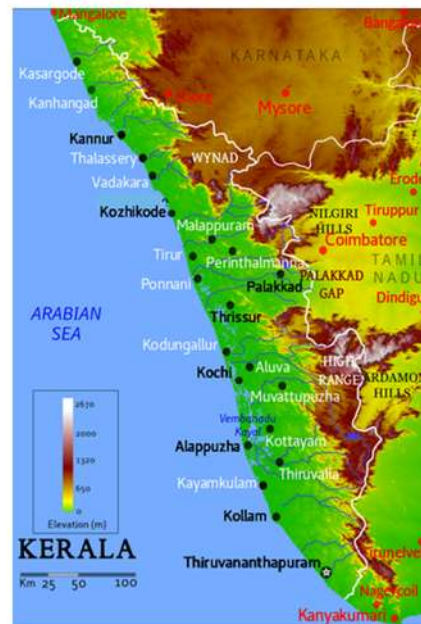
across an extensive 590 kilometers. Situated at an elevation of less than 8 meters from Mean Sea Level (MSL), this region encompasses approximately 15% of the state's total area, which stands at 38,863 square kilometres. This coastal stretch spans nine districts, namely Thiruvananthapuram, Kollam, Alappuzha, Ernakulam, Thrissur, Malappuram, Kozhikode, Kannur, and Kasargod, incorporating a total of 222 coastal villages along its 590-kilometer coastline. Within this geographical domain, there are 27 estuaries and 7 lagoons or kayals, contributing to the diversity of the ecosystem.

[4].The Coastal Zone further comprises various water bodies such as brackish marshes, backwaters, mangroves, and intertidal as well as sub tidal zones. Characterized by sandy beaches, natural rocks, and man-made granite sea walls extending into the sea, the coastal landscape presents a unique blend of natural and engineered features. The soil composition in this region primarily consists of coastal alluvium, ranging from sandy to clayey foam, characterized by excellent drainage properties. Notably, there are a total of 17 ports lining the Kerala coast, comprising one major port, Cochin, three intermediate ports (Kollam, Azheekkal, Beypore), and thirteen minor ports, contributing to the region's economic and maritime significance.

[5].Coastal areas in Kerala are prone to various natural threats due to their geographical

positioning near the Arabian Sea. During monsoon seasons, storm surges and flooding are significant dangers, worsening coastal erosion and flooding low-lying regions. The rising sea level intensifies these risks, making coastal communities more susceptible to flooding and erosion in the long run. Additionally, the region faces the risk of tsunamis, often triggered by seismic events in the Indian Ocean, which can cause widespread damage along the coast. The intrusion of saltwater into freshwater sources also endangers agriculture and access to clean water for coastal residents. Furthermore, ongoing erosion and land loss affect infrastructure, habitats, and livelihoods, aggravated by human activities like sand mining and unsustainable coastal development. It's crucial to implement effective strategies for mitigation and adaptation to ensure the resilience and safety of Kerala's coastal communities amidst these interconnected hazards. Coastal erosion poses a significant threat along Kerala's 370-kilometer coastline, influenced by factors like early monsoons, high waves, and rising sea levels. About 53% of the coast is fortified against erosion, yet 10.3% experiences varying degrees of erosion intensity. Thrissur District has the least erosion at 1.5%, while Thiruvananthapuram faces the highest at 23%, highlighting the localized nature of this challenge within the state.

## II. KERALA COASTAL REGION - SETTLEMENT PATTERN



Coastal district in Kerala and topography of Kerala

[6]. The population of Kerala State, as per the 2011 census, stands at approximately 33,387,677, equivalent to around 3.33 crores. The coastal districts contribute significantly to this demographic composition, housing a population of 9,397,625. The overall population density of Kerala is marked at 859 individuals per square kilometer. Notably, a substantial 40% of the total populace is anticipated to reside within a 25-kilometer radius of the Kerala Coast, encompassing merely 10% of the entire land area. Consequently, this concentration of inhabitant's results in a heightened population density in the Kerala Coastal Plains, reaching 2022 individuals per square kilometer—indicating a notable 2.5 times increase compared to the state's average.

The settlement pattern within the Kerala Coast follows a dispersed model. This distinctive

characteristic is attributed to the relatively flat topography of the coastal belt, which stands in contrast to the elevated terrain in the eastern region. The coastal landscape is intricately laced with an extensive network of interconnected brackish canals, lakes, estuaries, and rivers. This intricate water system has led to the fragmentation of land, thereby fostering a dispersed settlement pattern in the coastal region.

Coastal areas are highly dynamic and undergoing rapid change. The terms "land use" and "land cover" relate to the natural flora, water bodies, rock/soil, artificial cover, and other things that are seen on the land (NRSA, 1989). Land use refers to man's actions and the many uses that are carried out over land. Understanding how land use and land cover change is crucial for managing natural resources, using them, and conserving them.



**Dispersed Settlement Pattern – Kerala Coast**

### III. ASSESSING VULNERABILITY

[7].The IPCC Third Assessment Report (TAR) describes vulnerability as “The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.” (IPCC, 2001, p. 995). Various groups and communities, such as low-income, marginalized, disadvantaged, children, elderly, women, rural, and urban poor, may face differing levels of vulnerability to climate change and other threats. Vulnerability is determined by multiple variables, which can vary based on the specific situation and issue at hand. Different types of vulnerability, including climate vulnerability, environmental vulnerability, economic vulnerability,

physical vulnerability, and socio-economic vulnerability, exist. These vulnerabilities are determined by various factors and can vary depending on the specific context and circumstances. The Coastal Vulnerability Index (CVI) is one of the most commonly used and simple methods to assess coastal vulnerability to sea level rise, in particular due to erosion and/or inundation (Gornitz et al., 1991). The Coastal Vulnerability Index (CVI) comprises the Physical Vulnerability Index (PVI) and the Social Vulnerability Index (SVI). The Vulnerability Index (SEVI) describes the relative socioeconomic characteristics of communities in terms of poverty, unemployment, educational attainment, linguistic isolation, and percent of income spent on housing (Susan L. Cutter, June 2003).

### IV. CASE STUDY ANALYSIS

[8].The first case study examines Bangladesh's vulnerability to disasters, attributed to

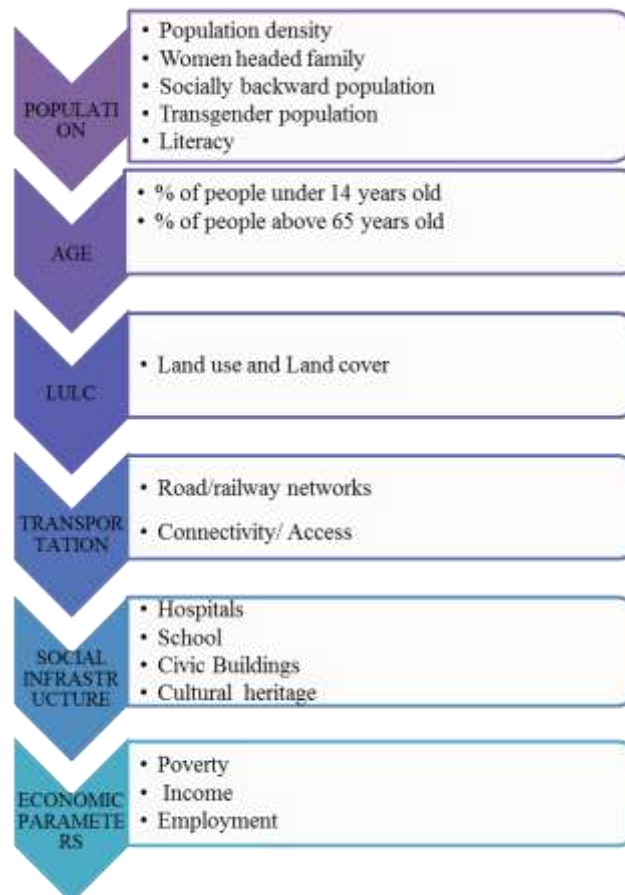
its geographical location and climate issues, making it one of the most disaster-prone countries. Coastal areas face hazards like erosion, cyclones, and floods annually, causing loss of life and property damage. Climate change will exacerbate these issues, particularly coastal erosion, affecting the local economy and environment. The study employs multi-criteria assessment using AHP and GIS methodologies to evaluate erosion vulnerability. Thirteen spatial criteria under physical and socio-economic vulnerability components were weighted via AHP, generating individual vulnerability indices. Six socio-economic criteria, including population density, land use, dependent population, tourist spots, road network, and literacy rate, were assessed.

[9].The study was conducted in Gunjur, a coastal community and major Fish Landing Site (FLS) in the South-Western part of The Gambia, situated within the Kombo-South District in the West Coast Region. It aimed to assess the risks associated with climate change hazards and their impacts on socio-economic development in coastal

communities'. Employing the MOVE (Methods for the Improvement of Vulnerability Assessment in Europe) framework allowed for flexibility and replicability. This framework conceptualizes vulnerability in a multi-faceted manner, considering factors such as exposure, susceptibility, and resilience. It recognizes that hazards result from both natural and human-induced factors, while vulnerability is inherently linked to human aspects.

### V. SOCIO ECONOMIC VULNERABILITY ASSESSMENT

[10].The socio-economic vulnerability of coastal settlements in Kerala is assessed based on six indicators, with 14 sub-indicators identified. These indicators and sub-indicators establish a functional relationship within the context of Kerala, providing a comprehensive understanding of the socio-economic vulnerabilities faced by coastal communities in the region.



Indicator	Sub Indicator	Functional relationship
Population	Population density	Population density (SQ/Km) increase exposure hazard will be more. Kerala's western coastal regions have a <b>population density of 2,022 persons per km<sup>2</sup></b> , 2.5 times the state's overall density of 859 persons per km <sup>2</sup> .
	Women headed Household	women-headed households in Kerala are considered highly vulnerable. Kerala recorded a prevalence of <b>20%</b> households headed by females
	Socially backward population	The Scheduled Caste ( <b>SC</b> ) and Scheduled Tribe ( <b>ST</b> ) populations in Kerala are perceived as highly vulnerable, with approximately <b>9.10%</b> of the state's population identified as socially backward.
	Transgender population	The transgender population in Kerala is viewed as highly vulnerable, comprising approximately <b>3,092 individuals</b> .
	Literacy rate (%)	The literacy rate, standing at 93.91% in Kerala, plays a crucial role in determining the vulnerability of coastal settlements.
Age	% of people under 6 years old	With the growth of the minor population, there is a corresponding increase in vulnerability. In Kerala, children make up <b>19%</b> of the population
	% of people above 65 years old	As the elderly population rises, so does the level of vulnerability. In Kerala, <b>12%</b> of the population is constituted by the elderly.
Land use and Land cover	Change in LULC will highly influence the rate of impact and potential	High vulnerability in coastal settlement, Habitation, urban and industrial area and low vulnerability in open water bodies and barren land
Transportation	Road/railway networks	The condition of transportation network effect vulnerability of people
	Connectivity/ Access	Improved connectivity or access mitigates the vulnerability of coastal settlements, making evacuation routes more accessible.
Social Infrastructure	Hospitals	The presence of essential social infrastructures such as hospitals, schools, and civic bodies is crucial for coastal settlements, as their existence plays a key role in minimizing vulnerability.
	School	
	Civic building	
	Cultural heritage/tourist spot	
Economic parameters	Poverty	Poverty serves as a factor contributing to vulnerability in Kerala, with 59.79% of households classified as Below Poverty Line (BPL).
	Income	Vulnerability in Kerala is influenced by income, signifying that the level of income plays a role in this aspect. Unemployment increases the adaptive capacity decreases
	Employment	The percentage of the population engaged in the informal sector, <b>daily wage labour, local-level economic activities, agriculture, and fisheries</b> in Kerala's coastal settlements represents a vulnerable demographic susceptible to hazards.

**The Indicators, Sub-Indicators, and Their Functional Relationships within the Kerala Context**

## VI. CONCLUSION

In conclusion, this study sheds light on the socio-economic vulnerability of coastal settlements in Kerala, recognizing the intricate interplay between various factors within this unique context. Through an exploration of multiple case studies and a detailed analysis of indicators and sub-indicators, the research provides valuable insights into the complex dynamics of vulnerability assessment in coastal regions. By understanding these relationships, policymakers and stakeholders can develop targeted strategies to enhance resilience and mitigate risks faced by coastal communities in Kerala, ensuring their sustainable development and well-being in the face of evolving challenges.

## REFERENCES

- [1]. Christopher J. Crossland, D. B.-P. (2014). The Coastal Zone – a Domain of Global Interactions.
- [2]. Costanza, R. (1999). The ecological, economic, and social importance of the. *Ecological Economics*, 199-213.
- [3]. <https://dop.lsgkerala.gov.in/en/node/1030>. (n.d.).
- [4]. <https://fisheries.kerala.gov.in/>. (n.d.).
- [5]. IPCC. (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*
- [6]. Muhammad Leroy Albert Gomez, O. J. (2020). Vulnerability to coastal erosion in The Gambia: Empirical experience. *International Journal of Disaster Risk Reduction*.
- [7]. Nakhapakorn, F. D. (2011). Coastal vulnerability assessment: a case study of Samut Sakhon coastal zone. *Songklanakarin Journal of Science and Technology*, 469-476.
- [8]. Nicholls, R. J. and A. Cazenave. 2010. Sea-level rise and its impact on coastal zones. *Science* 328(5985):1517–1520.
- [9]. Naser Ahmed a, N. H.-A. (2020). Coastal erosion vulnerability assessment along the eastern coast of Bangladesh using geospatial techniques. *ScienceDirect*.
- [10]. Sachin Pavithran.A.P, N. K. (2014). An Analysis of Various Coastal Issues In Kerala. *International Journal Of Scientific Research And Education*, 1993-2001.
- [11]. Susan L. Cutter, B. J. (June 2003). Social Vulnerability to Environmental. 242-261.
- [12]. Rani, N. N. V. S., A.N.V. Satyanarayana, and P.K. Bhaskaran. 2015. Coastal vulnerability assessment studies over India: A review. *Natural Hazards* 77(1):405–428.
- [13]. Rozance, M. A. (2019). Recognizing and Addressing Risk Ambiguity in Sea level Rise Adaptation Planning.
- [14]. VaishnaviChandrashekhar, T. (2019, October 31). 7-fold surge in Indians at risk due to sea level. *Times of India*.