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Reviewing Literatures, Recognizing Knowledge Gaps And Refining Potential Research Focus For Fluvio-Coastal Khejuri Blocks Of Purba Medinipur District In West Bengal

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Abstract:

The fluvio-coastal Khejuri Blocks of Purba Medinipur district in West Bengal is a dynamic landscapes shaped by riverine and marine interactions. Having the influences from river Hooghly, river Rasulpur, Talpati channel and Bay of Bengal, the region is highly vulnerable to fluvio-coastal erosion, tidal surges, sea cyclones, saline intrusion, and socio-economic stressors, necessitating comprehensive research for sustainable management. This study aims to systematically review existing literatures on the geomorphological, hydrological, ecological, and socio-economic aspects of the region to identify knowledge gaps and refine potential research directions.

A critical analysis of past studies reveals gaps in long-term morphodynamic assessments, the socio-ecological impacts of climate change, and the effectiveness of existing coastal management strategies. Additionally, inconsistencies in data availability and methodological approaches limit a holistic understanding of the region's evolving dynamics. By synthesizing insights from interdisciplinary research, this study seeks to highlight underexplored areas such as community resilience, nature-based adaptation strategies, and the integration of remote sensing and GIS for spatiotemporal analysis.

Addressing these research gaps is crucial for developing evidence-based policies and sustainable management strategies for the Khejuri Blocks. This review will contribute to a more focused and impactful research agenda, ensuring a scientific foundation for mitigating the environmental and socio-economic challenges of this vulnerable coastal region.

Keywords: Fluvio-coastal dynamics, Khejuri Blocks, literature review, knowledge gaps, potential research focus, coastal management, climate resilience.

1. Introduction:

The interaction between population dynamics and land use patterns plays a critical role in shaping environmental and socio-economic transformations, particularly in ecologically sensitive coastal zones. The fluvio-coastal region of **Khejuri, situated within the Rasulpur Basin of West Bengal**, is a highly dynamic landscape where population growth, land use transitions, and climate-induced factors have collectively influenced its environmental and socio-economic conditions. Over the past century, Khejuri has experienced a dramatic increase in population—from **60,416 in 1921 to 348,743 in 2021**, and from **36,003 in 1872 to**

359,640 in 2023—triggering rapid environmental and socio-economic shifts. This population surge has significantly altered land use patterns, intensifying human-induced changes in the local environment.

The fragile fluvio-coastal landscape of Khejuri has undergone profound **land use transformations**, driven by **economic expansion and unsustainable resource exploitation**. Institution-backed **aquaculture growth, unregulated brick manufacturing, and intensive irrigation-based agriculture** have generated significant environmental and socio-economic costs, outweighing short-term economic benefits. Sensitive river-fed habitats and ecosystems are increasingly facing **fragmentation, degradation, and instability**, affecting both their structural integrity and functional resilience. Additionally, weak governance, **gaps in policy planning, and inadequate strategic interventions** have further exacerbated the challenges of sustainable development in the region.

Given the mounting environmental and social pressures, there is an urgent need for **comprehensive environmental and social impact assessments** to guide policy formulation and adaptation strategies. However, **empirical research integrating these dimensions remains limited**, hindering effective decision-making for long-term sustainability. This study aims to **critically evaluate the environmental and social consequences of ongoing transitions**, identify key research gaps, and propose **sustainable solutions to enhance resilience and adaptive capacity** in the fluvio-coastal region of Khejuri.

2. Statement of Problem:

The fluvio-coastal Khejuri Blocks in Purba Medinipur, West Bengal, are highly dynamic environments shaped by riverine and marine processes. These regions face significant challenges, including coastal erosion, saline water intrusion, tidal flooding, and socio-economic vulnerabilities. Despite numerous studies on coastal dynamics and management, a comprehensive synthesis of existing literature is lacking. The absence of a consolidated review has resulted in fragmented knowledge, limiting the formulation of effective strategies for sustainable development and climate resilience. Identifying critical research gaps is essential to refine potential research directions and inform future studies. This study, therefore, aims to systematically review existing literature, recognize gaps, and propose a focused research agenda for the region.

☯ Major Aspects regarding Research Problem:

- **Land Use Dynamics and Landscape Transformations:**
  - Conflict between agricultural expansion and ecosystem sustainability.
  - Depletion of coastal vegetation and biodiversity loss.
  - Intensifying coastal erosion and increasing flood vulnerabilities.
- **Climate Change and Hydro-Geochemical Alterations:**
  - Rising sea levels, saline intrusion, and groundwater contamination.
  - Shifts in coastal hydrology affecting agricultural and freshwater resources.
- **Socio-Economic Challenges in Changing Livelihoods:**
  - Occupational transitions and growing livelihood insecurities.
  - Socio-cultural disruptions due to environmental and economic shifts.
- **Gaps in Policy, Planning, and Sustainable Management:**
  - Lack of Ecosystem-Based Adaptation (EBA): Absence of nature-based solutions for mitigating environmental changes.
  - Deficiencies in Sustainable Land Use Planning: Limited integration of agro-aqua-ecological farming and Integrated Coastal Zone Management (ICZM) for balancing development and conservation.
  - Limited Livelihood Diversification: Inadequate promotion of eco-tourism, aquaculture, and sustainable fisheries as alternative income sources.
  - Weak Community Participation in Resource Management: Insufficient local engagement in decision-making processes.

- Inadequate Disaster Preparedness and Climate Resilience: Lack of early warning systems, resilient infrastructure, and adaptive housing strategies to mitigate climate risks.

3. Geo-environmental Context of the Study Area:

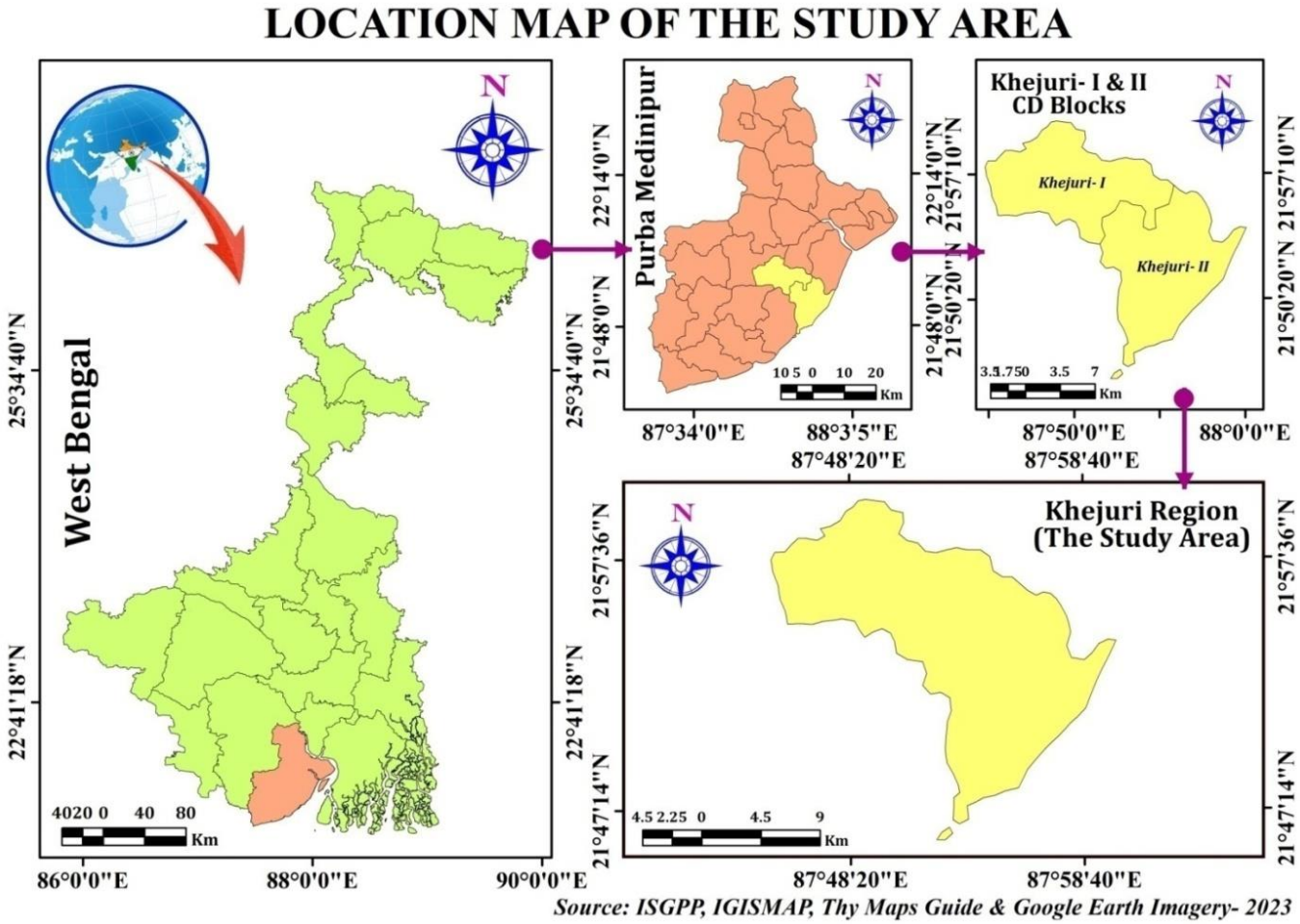

Figure 3: Location Map of the Study Area

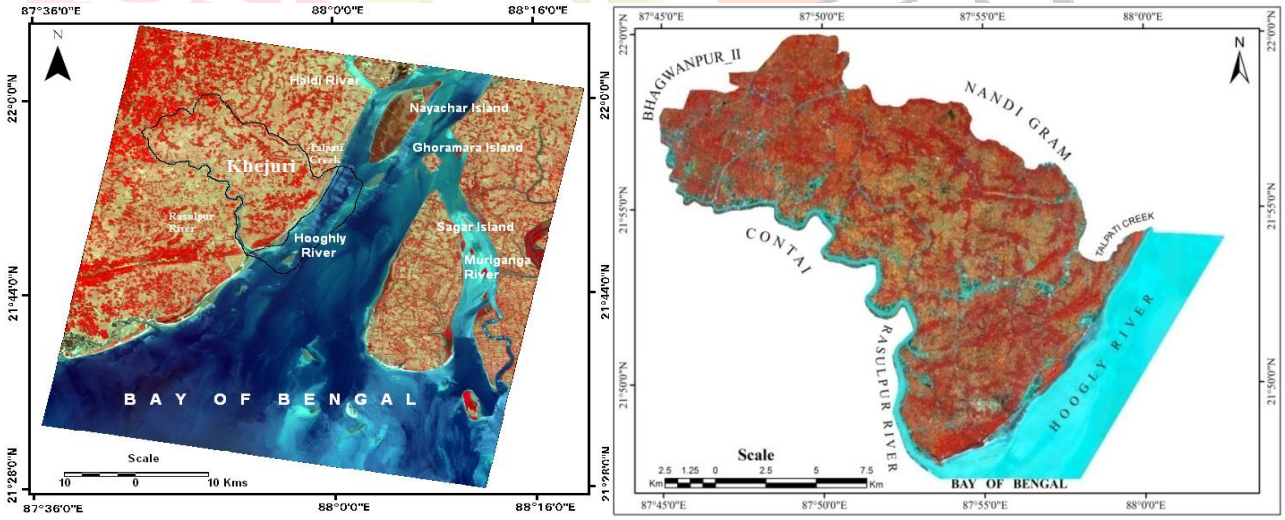

Figure 1 & 2: Layout Maps on Satellite Image

Khejuri is a dynamic fluvio-coastal landscape along the Midnapore coast in West Bengal, characterized by diverse coastal features, habitats, and ecosystems. Geomorphologically, it is located at the confluence of the Hooghly River, the Rasulpur River, and the Bay of Bengal, marking the terminal section of the Lower Ganga Course within the Rasulpur-Pichhaboni Basin. The study area spans approximately **265 sq. km**, positioned between **21°45´N - 22°00´N latitudes and 87°45´E - 88°05´E longitudes**.

Climatically, Khejuri experiences a **sub-tropical monsoonal climate**, influencing its wet deciduous vegetation, along with distinct coastal and mangrove ecosystems found in the Indian subcontinent.

Geologically, the region primarily consists of **Quaternary sedimentary formations**, reflecting recent lithological characteristics.

Administratively, Khejuri functions as a coastal police station and is bordered by **Nandigram to the north, Bhagwanpur to the northwest and west, Uttar Kanthi to the south (separated by the Rasulpur River), and the Hooghly River and Bay of Bengal to the east and southeast**. It is divided into **two Community Development (CD) Blocks**:

- **Khejuri-I CD Block** includes Gram Panchayats: Haria, Tikashi, Lakshi, Birbandar, Kamarda, and Kalagachhia.
- **Khejuri-II CD Block** comprises Gram Panchayats: Baratala, Haludbari, Khejuri, Janka, and Nij Kasaba.

Politically, Khejuri falls under **Khejuri Assembly Constituency (215)** and is part of the **Kanthi Lok Sabha Constituency (216)** in the Purba Medinipur district, West Bengal, India.

4. Key Questions for Review Research Work:

Q1. What are the key themes and findings in the existing literature on the fluvio-coastal dynamics of the Khejuri Blocks?

Q2. What are the major knowledge gaps in the current research related to geomorphology, hydrology, ecology, and socio-economic aspects of the region?

Q3. How can a refined research focus contribute to better understanding and management of the fluvio-coastal challenges in Khejuri?

Q4. What methodological approaches can be adopted to address the identified research gaps effectively?

5. Aim and Objectives:

5.1 Aim:

This study aims to systematically review existing literature on the fluvio-coastal environment of the Khejuri Blocks in Purba Medinipur, West Bengal, to identify knowledge gaps and refine potential research directions. By synthesizing interdisciplinary studies, the research seeks to contribute to a more comprehensive understanding of the region's environmental, socio-economic, and policy challenges while proposing a structured research agenda for sustainable development.

5.2 Objectives:

- ❖ To conduct a systematic review of existing literature on the geomorphological, hydrological, ecological, and socio-economic aspects of the Khejuri Blocks.
- ❖ To identify critical knowledge gaps in previous studies concerning land use changes, climate resilience, coastal management, and socio-economic transitions.
- ❖ To assess the limitations of existing policies and governance frameworks in addressing environmental and livelihood challenges in the region.
- ❖ To propose a refined research agenda that aligns with sustainable coastal management and resilience-building strategies.
- ❖ To recommend appropriate methodologies for future research, integrating geospatial analysis, socio-economic surveys, and climate impact assessments for a holistic understanding of the study area.

6. Methodology for Review Work:

Below is a step-by-step methodology for my review work on the selected topic:

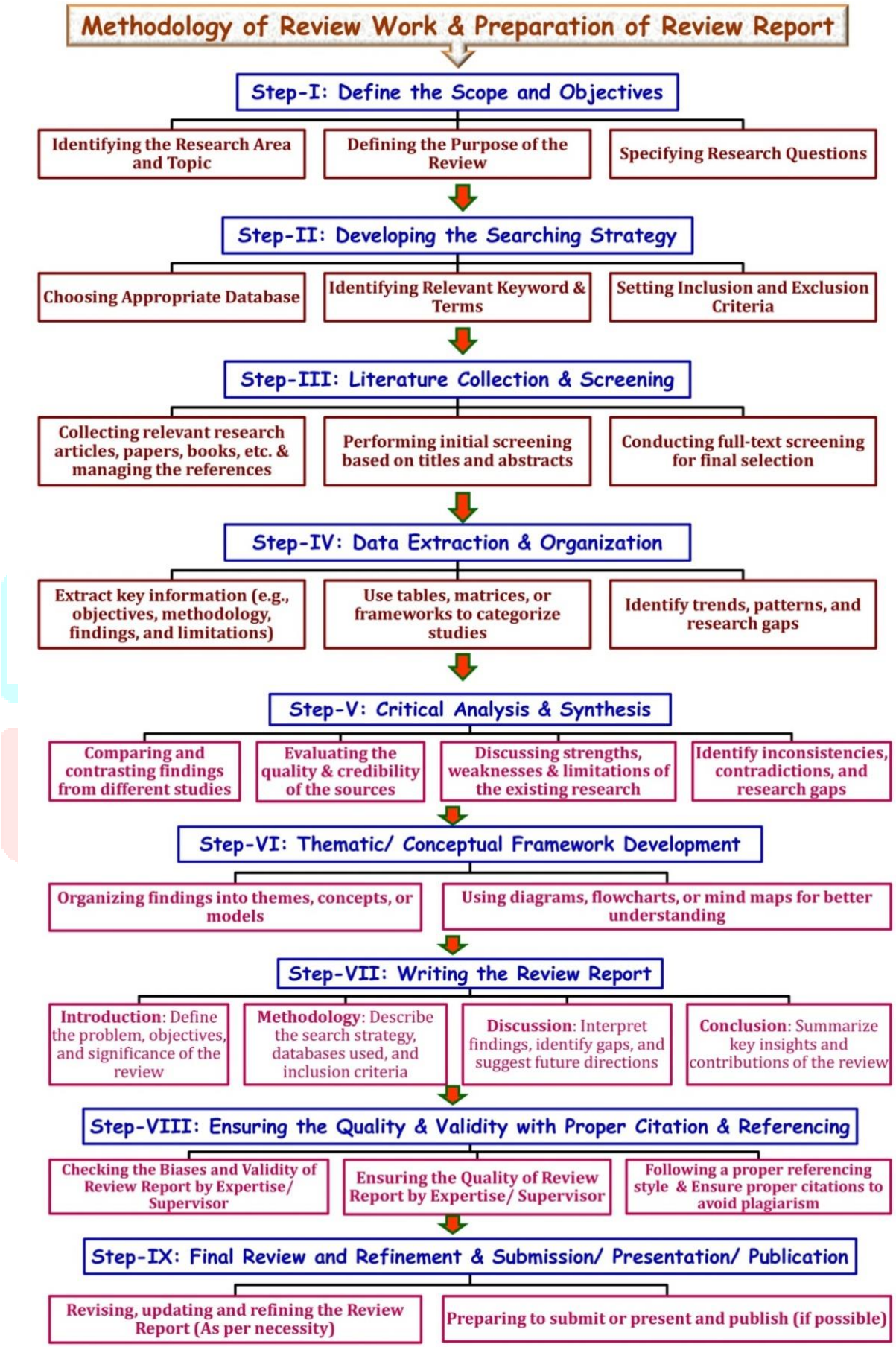

Figure 4: Flowchart of the Methodology for the Review Work

7. Result and Discussion of the Literature Review:

7.1 Discussion on the Review Summary of the Existing Literatures:

7.1.1 Geo-environmental and Administrative Overview of Khejuri:

Table 1: Geo-environmental and Administrative Overview of the Study Area

Particulars	Khejuri-I CD Block	Khejuri-II CD Block	Khejuri Fluvio-coastal CD Blocks
Location:	21°51′08″N & 87°47′07″E	21°51′27″N & 87°54′42″E	21°45´N - 22°00´N and 87°45´E - 88°05´E
Geological Set Up:	Most Recent Quarternery Formation		
Geomorphological Perspectives:	Situated at the junction of River Hoogly, River Rasulpur and Bay of Bengal at the western edge of Rasulpur-Pichhaboni Basin with the end of Lower Ganga Course		
Climatic Influence:	Sub-tropical Monsoonal Climatic Sway with Bay of Bengal Maritime Climatic Influence		
Soil:	Typical coastal sandy, loamy, loamy sand and clay soils throughout the region and saline tidal clay soil along the tidal channels and creeks.		
Vegetation Perspectives:	Wet Deciduous type of vegetation alongwith identical coastal and mangrove vegetation		
Head Quarter:	Kamarda	Janka	Janka
Parliamentary/ Lokh Sabha Constituency	Kanthi	Kanthi	Kanthi
Assembly/ Bidhan Sabha Constituency	Khejuri	Khejuri	Khejuri
PIN	721430 (Haria) 721432 (Kalagachia)	721431 (Janka)	721430 (Haria), 721432 (Kalagachia) & 721431 (Janka)
Area Code	03224	03210	03224 & 03210
Neighbouhood Administrative Units	Nandigram-II & Bhagwanpur-II CD Blocks (North), Contai-III, Khejuri-II & Deshapran CD Blocks (South), Nandigram-I & Khejuri-II CD Blocks (East) Bhagwanpur-II CD Block (West)	Nandigram-I & Khejuri-I CD Blocks (North), Bay of Deshapran CD Block & Bay of Bengal (South), River Hooghly & South 24-Parganas District (East) and Deshapran & Khejuri-I CD Blocks (West)	Bhagwanpur-II, Nandigram-II & Nandigram-I CD Blocks (North), Bay of Bengal, Dehapran & Contai-III CD Blocks (South), River Hooghly & South 24-Parganas District (East) and Bhagwanpur-II CD Block (West)
Number of Gram Panchayat:	6	5	11
Number of Panchayat Samity:	1	1	2
Gram Sansads (Village Councils):	93	90	183
Mouzas:	42	99	141
Inhabited Villages:	42	97	139
Name of Gram Panchayat:	Kalagachhia GP, Kamarda GP, Lakhi GP, Birbandar GP, Tikashi GP & Heria GP	Baratala GP, Khejuri GP, Janka GP, Haludbari GP & Nij Kasba GP	Kalagachhia, Kamarda, Lakhi, Birbandar, Tikashi, Heria, Baratala, Khejuri, Janka, Haludbari & Nij Kasba
Police Station:	Khejuri PS: Heria Branch	Khejuri PS: Janka Main, Baratala Branch, Talpati Coastal PS & Hijli Coastal PS	Main: Janka Branch: Heria, Baratala, Talpati & Hijli

Sub-division:		Contai Sub-division	Contai Sub-division	Contai Sub-division
District:		Purba Medinipur District	Purba Medinipur District	Purba Medinipur District
State:		West Bengal	West Bengal	West Bengal
Country:		India	India	India
Geographical Area (Hectare):		130.51 km^2 (50.39 sq mi/ 13,051.29)	137.46 km^2 (53.07 sq mi/ 13,745.93 hectares)	267.97 km^2 (103.46 sq mi/ 26797.22 hectares)
Elevation		5 m (16 ft)	4 m (13 ft)	4.5 m (14.5 ft)
Population (2011):		132,992	139,463	272,455
Density		1,019/km^2 (2,639/sq mi)	1,015/km^2 (2,628/sq mi)	1,017/km^2 (2,633/sq mi)
Decadal Population Growth (1991-2001)		14.94%	17.82%	16.38%
Households (2011):		27,554	27,260	54,814
Male Population (2011):		68,494 (52%)	71,294 (51%)	139,788 (51.31%)
Female Population (2011):		64,498 (48%)	68,169 (49%)	132,667 (48.69%)
Literacy Rate (2011):		104,075 (78.26%)	103,149 (73.96%)	207,224 (76.06%)
Male Literacy (2011):		56,122 (81.94%)	56,101 (78.69%)	112,223 (80.28%)
Female Literacy (2011):		47,953 (74.35%)	47,048 (69.02%)	95,031 (71.67%)
Illiteracy Rate (2011):		28,917 (21.74%)	36,314 (26.04%)	65,231 (23.94%)
Male Illiteracy (2011):		12,372 (18.06%)	15,193 (21.31%)	27,565 (19.72%)
Female Illiteracy (2011):		16,545 (25.65%)	21,121 (30.98%)	37,666 (28.39%)
Child Population (0-6)/ (2011):		15,925 (M=8,273 & F=7,652)	18,537 (M=9,429 & F=9,208)	33,862 (M=17,702 & F=16,860)
Religion	Hindu	121,175 (91.11%)	128,714 (92.29%)	249,889 (91.72%)
	Muslim	11,614 (8.73%)	10,521 (7.55%)	22,135 (8.12%)
	Others	203 (0.16%)	228 (0.16%)	431 (0.16%)
Schedule Tribe Population (2011):		169 (0.13%)	900 (0.65%)/ (M=443 & F=457)	1069 (0.39%)
Schedule Caste Population (2011):		17,744 (13.34%)	79,149 (56.95%)/ (M=40,415 & F=38,734)	96,893 (35.56%)
Sex Ratio (2011):		942	956	949
Child (0-6) Sex Ratio (2011):		925	977	952
Total Workers (2011):		50,939 (38.30%)/ (M=39,133 & F=11,806)	47,186 (33.83%)/ (M=38,707 & F=8,479)	98,125 (36.01%)/ (M=77,840 & F=20,285)
Main Workers (2011):		20,416 (M=18,187 & F=2,229)	27,511 (M=24,758 & F=2,753)	47,927 (48.84%)/ (M=42945 & F=4982)
Marginal Workers (2011):		30,523 (M=20,946 & F=9,577)	19,675 (M=13,949 & F=5,726)	50,198 (51.16%)/ (M=34895 & F=15303)
Non-workers (2011):		82,053 (M=29,361 & F=52,692)	92,277 (M=32,587 & F=59,690)	174,330 (63.99%)/ (M=61948 & F=112382)
Agricultural Worker (2011):		5,636 (27.61%)/ (M=5,106 & F=530)	7,236 (26.30%)/ (M=6,635 & F=601)	12,872 (26.86%)/ (M=11741 & F=1131)
Cultivator (2011)		3,282 (16.08%)/ (M=3,034 & F=248)	6,478 (23.55%)/ (M=6,039 & F=439)	9,760 (20.36%)/ (M=9073 & F=687)
Household		839 (4.11%)/ (M=689 &	790 (2.87%)/ (M=675 &	1,629 (3.40%)/ (M=1364 &

Industry Workers (2011)	F=150)	F=115)	F=265)
Other Workers (2011)	10,659 (52.21%)/ (M=9,358 & F=1,301)	13,007 (47.28%)/ (M=11,409 & F=1,598)	23,666 (49.38%)/ (M=20,767 & F=2,899)
Pisciculture Land (2013-14)	720.15 hectares	705.38 hectares	1,425.53 hectares
Pisciculture Worker (2013-14)	3,615 (17.71% w.r.t. MW)	3,730 (13.56% w.r.t. MW)	7,345 (15.33% w.r.t. MW)
Pisciculture Production (2013-14)	27,438 quintals	26,875 quintals	54,313 quintals
Working Participation (2011):	1:2.61 (38.30%)	1:2.96 (33.83%)	1:2.78 (36.02%)
Banking (2013-14):	4-Commercial Banks and 2-Gramin Banks	5-Commercial Banks	9-Commercial Banks and 2-Gramin Banks
Modified Human Poverty Index (MHPI)	24.78	24.78	24.78
Nearest Town:	Contai (19 km)	Contai (19 km)	Contai (19 km)
Vehicle Registration:	WB-29, WB-30, WB-31, WB-32, WB-33	WB-29, WB-30, WB-31, WB-32, WB-33	WB-29, WB-30, WB-31, WB-32, WB-33
Health Care:	1 block primary health centre, 1 primary health centre and 1 private nursing home	1 block primary health centre, 1 primary health centre and 1 private nursing home	2 block primary health centre, 2 primary health centre and 2 private nursing home
Source: Census of India, 2011 & Database from Two CD Block Offices			

7.1.2 Literature Review on Khejuri, the Study Area:

i) **Relevant Background**: Khejuri, located in Purba Medinipur, is a fluvio-coastal region that has undergone significant transformations over the years. Once a thriving center of trade and commerce, the area now faces challenges arising from rapid population growth, land-use changes, and environmental threats. Coastal erosion, salinity intrusion, and shifting livelihoods have reshaped the socio-economic fabric of Khejuri, making resilience and adaptation critical for its future sustainability**.** [15] [67]

ii) **General Geology and Geomorphology:** A few studies relating the geological set up, geomorphological existence and changing river and coastal face of Bengal shows the general geology, geomorphological evolution and changing river geometry of Khejuri as well as Rasulpur Basin. Some of studies reveals that coastal Khejuri has been evolved from its twin islands formation situation during 15^{th} – 16^{th} Century and later on all those have been adjoined to the main landmass and existed as today's Khejuri. [1] [8] [16….20] [22] [61] [67] [71] [73] [76] [78] [85] [88] [90] [91] [97] [99]

iii) **Historical and Evolutionary Journey of Khejuri**: During the British colonial period, Khejuri was a prominent port town facilitating the trade of salt, textiles, and agricultural products. However, shifts in river courses and economic transformations led to its decline. Once bustling with commercial activity, the town gradually lost its prominence, leading to economic downturns and reduced opportunities for its residents. [22….25] [41] [57] [58] [67] [70] [71] [77] [78] [79]

iv) **Historical Significance and Environmental Changes in Khejuri-Hijli:** The study highlights the historical evolution of Khejuri-Hijli as a trading hub, its colonial influence under different rulling powers like Das Dynasty, Mughal, Portuguese, Spanish and British, and subsequent decline due to environmental and socio-economic factors. Major environmental concerns include estuarine changes, loss of navigability, and the degradation of local resources. [67] [77] [78] [79] [80] [81]

v) **Land-Use Change and Environmental Degradation**: Rapid expansions of agricultural lands, deforestation, and urbanization have drastically altered Khejuri's landscape. These changes have resulted

in significant environmental degradation, including increased soil salinity, loss of mangrove cover, and heightened coastal erosion. Such ecological shifts have placed additional stress on traditional livelihoods, necessitating adaptive strategies for environmental conservation and sustainable development. [15] [49] [60] [69]

vi) **Agricultural Expansion and Soil Salinity**: The adoption of high-yielding variety (HYV) crops has intensified agricultural activities in Khejuri. However, this shift has also led to soil degradation, reducing its fertility. Additionally, the intrusion of saline water has made paddy cultivation increasingly difficult, forcing farmers to explore alternative agricultural practices. [5] [49]

vii) **Sand Dune Destruction, Mangrove Loss and Coastal Erosion**: The extensive deforestation of mangrove forests and destruction of dune ridge on and along the coast has resulted in reduced natural barriers against cyclones and tidal surges. This loss has exacerbated land erosion and increased displacement risks for local communities. The absence of mangroves has further weakened the region's resilience to climate-induced calamities, necessitating urgent reforestation efforts. [31] [60] [61] [66] [67]

viii) **Impact of Cyclones and Climate Change**: Khejuri has been severely affected by extreme weather events such as Cyclone Amphan (2020) and Cyclone Yaas (2021). These natural disasters have caused widespread flooding, extensive damage to infrastructure, and large-scale displacement of residents. Such climate-induced adversities have intensified migration trends, with many seeking refuge in urban centers. [50] [57] [72] [80]

ix) **Socio-Economic Conditions and Livelihood Challenges**: The region's traditional livelihoods, particularly agriculture and fisheries, have been significantly impacted by climate variability and environmental degradation. As a result, many residents have been compelled to migrate in search of better economic opportunities. This shift has led to socio-economic imbalances, with increasing dependency on remittances and declining local employment opportunities. [4] [5] [7] [10…12] [27] [35] [51…..57] [58] [62…64]

x) **Migration and Urbanization**: Due to the deteriorating rural economy, a significant portion of Khejuri's population has migrated to urban centers such as Kolkata and Haldia. This migration trend has resulted in the feminization of agriculture, as women are left behind to manage farms and household responsibilities. Such demographic shifts have altered traditional gender roles and increased the burden on women. [29] [89]

xi) **Education and Healthcare Challenges**: Limited access to quality education and inadequate healthcare facilities continue to pose major challenges for the residents of Khejuri. Poor educational infrastructure restricts skill development, thereby limiting employment opportunities for the younger generation. Moreover, the prevalence of waterborne diseases due to poor sanitation and inadequate medical facilities further exacerbates the community's health vulnerabilities. [60] [72]

xii) **Sustainable Development and Adaptation Strategies**: To combat environmental and socio-economic challenges, several adaptation strategies have been proposed and implemented in Khejuri. These include mangrove restoration projects, the introduction of salt-resistant crop varieties, and the promotion of organic farming. These measures aim to enhance climate resilience and ensure sustainable agricultural practices. [49] [72]

xiii) **Disaster Preparedness and Resilience Building**: Community-based disaster management initiatives, along with the Integrated Coastal Zone Management Project (ICZMP), have been instrumental in strengthening Khejuri's resilience against cyclones and flooding. These programs emphasize early warning systems, emergency response training, and infrastructural reinforcements to mitigate disaster impacts. [31] [58]

xiv) **Alternative Livelihood Promotion**: To diversify income sources and reduce dependency on traditional agriculture, various alternative livelihood options have been introduced. These include aquaculture, eco-tourism, and the promotion of women-led enterprises through Self-Help Groups (SHGs). Such initiatives provide economic stability and empower marginalized communities, fostering long-term sustainable development. [29] [89]

xv) **Women Empowerment and SHGs:** SHGs have played a crucial role in improving economic conditions and self-sufficiency among rural women in Khejuri. The studies indicate an increase in social mobility, decision-making ability, and financial independence of women through SHG participation. [43]

xvi) **Impact of Shrimp Farming on Society and Environment:** Shrimp farming and industrial expansion have led to ecological degradation. Conflicts between land-use planning and environmental conservation strategies are evident in the reviewed studies. Rapid and unregulated shrimp cultivation has led to significant ecological degradation, including land-use changes, pollution, and economic displacement of marginal farmers. The economic benefits of shrimp farming are unevenly distributed, with large-scale farmers benefiting at the expense of local communities. [46] [47]

xvii) **Indigenous Fish Species and Aquatic Ecosystem Degradation:** Overfishing, pollution, and habitat destruction due to shrimp farming and urbanization have led to the decline of native fish species wetlands and increased competition from exotic species are contributing to the ecological imbalance. [38]

xviii) **Land and Social Degradation Due to Brick Kilns:** Rapid expansion of brick kilns in Khejuri has led to extensive environmental damage, including deforestation, soil erosion, and air pollution. Agricultural land conversion for brick-making has resulted in declining soil fertility and ecosystem imbalance. Brick manufacturing in the Khejuri region has resulted in deforestation, soil erosion, and loss of agricultural productivity. Air pollution from brick kilns has negatively impacted both human health and local biodiversity. [36] [42] [44] Child labor in brick kilns is a major social issue in the region, leading to poor health outcomes and disruption of education of strict regulations and enforcement has perpetuated hazardous working conditions for children. [39] [45] Socioeconomic factors force women into labour, especially in hazardous brick-making industries. The lack of proper regulations, unsafe working conditions, and educational deprivation are highlighted as major concerns. [40]

xix) **Database and Databank:** Different gazetteers, census reports and institutional record books reflect the historical database relating mainly socio-economic perspectives of Khejuri under the accounting of British ruled Bengal and undivided and divided Midnapore. [2…7] [9….12] [23] [25] [27] [51-56] [59] [61….64] [74-75] [86-87] [98] [100]

7.1.3 Review Summary on Khejuri related Rasulpur River Basin and Bengal Coast:

i) **Relevant Background of Rasulpur Basin:** The Rasulpur River Basin, located in Purba Medinipur, is a dynamic fluvio-coastal system influenced by various natural and anthropogenic factors. Climate change, human activities, and coastal dynamics have significantly impacted the basin's hydrology, agriculture, and local livelihoods. These challenges necessitate a comprehensive understanding of environmental and socio-economic interactions to develop effective adaptation strategies.[31]

ii) **Geomorphology and Hydrological Characteristics:** The Rasulpur River is tidally influenced, with its hydrology primarily shaped by monsoonal rainfall, estuarine processes, and changes in sea level. These factors lead to seasonal variations in water availability, affecting both agriculture and freshwater ecosystems. [48] [72]

iii) **River Morphology and Sediment Transport:** The river experiences high sediment deposition, leading to channel shifting and siltation. This process alters the wetland ecosystems and affects local hydrodynamics, thereby impacting agricultural and fisheries-dependent communities. [48] [49] [60]

iv) **Water Quality and Salinity Intrusion:** The basin faces a growing challenge of salinity intrusion due to coastal backflows and excessive groundwater extraction. This phenomenon deteriorates water quality, affecting aquatic biodiversity, agriculture, and human health. [15] [27]

v) **Environmental Challenges:** Coastal erosion, habitat degradation, and climate hazards pose significant threats to the Rasulpur River Basin. Land degradation and deforestation further exacerbate these environmental issues, requiring immediate intervention. [31] [48] [60]

vi) **Impact of Cyclones and Climate Change:** Recent cyclones, including Amphan (2020) and Yaas (2021), have caused severe agricultural losses, infrastructure damage, and increased salinity intrusion. These extreme weather events underscore the vulnerability of the region to climate-induced disasters. [50] [72]

vii) **Erosion and Siltation:** Continuous riverbank erosion has led to displacement of local communities, while excessive siltation has reduced the efficiency of irrigation systems. This dual challenge threatens agricultural productivity and calls for better land and water management practices. [31] [60]

viii) **Degradation of Wetlands and Biodiversity:** The expansion of agricultural land and industrial activities has led to significant wetland loss, which in turn has diminished biodiversity and reduced natural flood protection mechanisms. Conservation efforts are critical to restoring ecological balance in the region. [46] [47] [48] [89]

ix) **Land Use and Socio-Economic Implications:** Due to soil salinization and erratic rainfall, agricultural practices in the basin are transitioning towards salt-resistant crops and aquaculture. This shift reflects the region's adaptive strategies to mitigate environmental stressors while ensuring food security. [15] [46] [47] [48] [58] [60] [69].

x) **Fisheries and Aquaculture:** Traditional fishing communities are facing economic stress due to declining fish stocks, while shrimp farming has emerged as an alternative livelihood option. However, concerns about the sustainability of shrimp farming practices highlight the need for environmentally responsible aquaculture techniques. [29] [46] [47] [48] [72] [89]

xi) **Urbanization and Infrastructure Development:** Rapid urban expansion and unplanned infrastructure projects have significantly altered the region's drainage patterns, exacerbating seasonal floods. Sustainable urban planning is necessary to prevent further disruption to the hydrological system. [31] [89]

xii) **Sustainable Development and Policy Interventions:** Ecosystem-based adaptation, wetland conservation, and disaster preparedness programs have been introduced to enhance resilience. These strategies aim to balance economic development with environmental sustainability. [47] [48] [58]

xiii) **Climate-Resilient Agriculture and Water Management:** Efforts are being made to promote salt-resistant crops and rainwater harvesting to improve food security in the region. Such adaptive agricultural techniques are essential for long-term sustainability. [26] [27] [71] [72]

xiv) **Disaster Preparedness and Community Resilience:** Community-based disaster management programs and government initiatives, such as the Integrated Coastal Zone Management Project (ICZMP), aim to mitigate disaster risks and enhance the resilience of vulnerable populations. [31] [89]

7.2 Knowledge Gaps identified in the Literatures on Khejuri:

7.2.1 Knowledge Gaps identified in the Literatures on Khejuri:

Table 2: Knowledge Gaps identified in the Literatures on Khejuri

Research Area	Identified Research Gaps
Historical Significance	Limited archaeological and historical documentation on the port's decline and its socio-economic impacts.
Land-Use Change and Environmental Degradation	Lack of long-term satellite-based land-use analysis to track environmental changes over time.
Agricultural Expansion and Soil Salinity	Insufficient research on the economic viability and long-term effectiveness of salt-resistant crop varieties.
Sustainable Agriculture	Lack of empirical research on the economic feasibility, scalability, and sustainability of alternative agricultural practices like salt-resistant crops and aquaculture.
Infrastructure Development	Limited studies on the role of unplanned urbanization and road construction in altering drainage, sediment transport, and seasonal flooding.
Hydrological Changes	Lack of long-term hydrological monitoring to assess seasonal and inter-annual variations in sediment transport and channel shifts.
Water Quality and Salinity Intrusion	Limited comprehensive, time-series data on water quality trends, including heavy metal contamination and micro-plastic pollution.
Mangrove Loss and Coastal Erosion	Need for comprehensive studies on the effectiveness of mangrove restoration in mitigating erosion and cyclone impacts.
Wetland and Biodiversity	Minimal research on ecosystem restoration, habitat connectivity, and the role

Conservation	of estuarine vegetation in fluvio-coastal resilience.
Impact of Cyclones and Climate Change	Limited predictive modeling on future climate change scenarios and their specific impacts on Khejuri's coastal ecosystem.
Socio-Economic Livelihood Challenges	Lack of studies on the socio-economic resilience of farmers and fishers in adapting to climate variability.
Migration and Urbanization	Limited research on the long-term socio-economic consequences of migration from Khejuri to urban centers.
Education and Healthcare Challenges	Insufficient studies on the impact of inadequate education and healthcare on long-term human capital development in Khejuri.
Sustainable Development and Adaptation Strategies	Need for empirical evaluation of ongoing ecosystem-based adaptation initiatives and their socio-economic benefits.
Disaster Preparedness and Resilience Building	Lack of community-based assessments on the effectiveness of disaster risk reduction programs and early warning systems.
Alternative Livelihood Promotion	Limited research on the feasibility and market potential of eco-tourism and aquaculture as sustainable livelihoods.
Integrated Water Resource Management	Lack of research on sustainable aquifer management, groundwater recharge, and community-led water conservation strategies.
Policy and Governance	Gaps in evaluating the effectiveness of policies like CRZ, ICZMP, governance frameworks, and institutional coordination in managing land-use conflicts and environmental sustainability.
Source: Author's Own Composition based on Literature Review, 2025	

7.2.2 Identified Knowledge Gaps regarding Environmental Impact Assessment (EIA) on the Study Area:

Table 3: Identified Literature Gaps on Environmental Impact Assessment (EIA)

Research Area	Identified Research Gaps
Historical Development of EIA	Limited comparative studies on the evolution of EIA across different countries and its effectiveness in diverse governance frameworks.
EIA Methodologies	Need for research on the integration of emerging technologies such as AI, big data analytics, and machine learning in impact assessments.
Effectiveness of EIA	Lack of empirical evidence evaluating the long-term success of mitigation measures and their enforcement in large-scale projects.
Public Participation	Limited studies on the role of digital platforms and social media in enhancing stakeholder engagement and transparency in EIA processes.
Challenges in EIA Implementation	Need for more research on the influence of political and economic factors in decision-making and approval of EIA reports.
Strategic Environmental Assessment (SEA) and Cumulative Effects Assessment (CEA)	Insufficient studies on the integration of SEA and CEA with EIA to better address long-term and large-scale environmental impacts.
Case Studies of EIA in Practice	Lack of comprehensive cross-sectoral analyses comparing the effectiveness of EIA in different industries such as mining, infrastructure, and energy.
EIA and Climate Change	Need for research on how EIA frameworks can better integrate climate change adaptation and mitigation strategies.
EIA and Sustainable Development	Limited research on how EIA can be strengthened to align with the UN Sustainable Development Goals (SDGs).
Future Directions for EIA	Need for interdisciplinary approaches that integrate social, economic, and environmental dimensions within EIA frameworks.
Source: Author's Own Composition based on Literature Review, 2025	

7.2.3 Identified Knowledge Gaps regarding Social Impact Assessment (SIA) on the Study Area:

Table 4: Identified Literature Gaps on Social Impact Assessment (SIA)

Research Area	Identified Research Gaps
Historical Development of SIA	Limited comparative studies on how SIA has evolved across different cultural, legal, and economic contexts.
SIA Methodologies	Need for research on integrating quantitative and qualitative methods to improve accuracy in predicting social impacts.
Public Participation in SIA	Lack of studies on the role of digital technologies and social media in enhancing public engagement in SIA processes.
Social Impact Management Plans (SIMPs)	Insufficient research on long-term effectiveness and monitoring of SIMPs in large-scale infrastructure projects.
Challenges in SIA Implementation	Limited empirical studies evaluating the integration of SIA with other impact assessment frameworks like EIA and HIA (Health Impact Assessment).
SIA in Indigenous and Marginalized Communities	Need for more culturally sensitive and participatory approaches tailored to indigenous knowledge systems.
SIA in Resource Development and Large-Scale Projects	Lack of research on balancing economic development with social equity in extractive industries such as mining and energy.
Emerging Trends and Innovations in SIA	Limited studies on the application of AI, big data, and GIS in enhancing the efficiency and predictive capacity of SIA.
SIA and Sustainable Development	Need for research on aligning SIA practices with the UN Sustainable Development Goals (SDGs) for long-term social resilience.
Future Directions for SIA	Gaps in interdisciplinary research integrating social, environmental, and economic assessments for a holistic impact evaluation.
	Source: Author's Own Composition based on Literature Review, 2025

7.2.4 Identified Knowledge Gaps regarding Land Use Dynamics on the Study Area:

Table 5: Identified Literature Gaps on Land Use Dynamics

Research Area	Identified Research Gaps
Drivers of Land Use Change	Need for interdisciplinary studies integrating socio-economic, environmental, and political factors influencing land use change.
Methods for Analyzing Land Use Dynamics	Limited research on the integration of AI, big data analytics, and advanced GIS techniques in land use modeling.
Impacts of Land Use Change	Lack of longitudinal studies assessing cumulative effects of land use change on biodiversity and ecosystem services.
Urban Expansion and Agricultural Land Conversion	Need for research on balancing urban growth with sustainable agricultural land preservation.
Climate Change and Land Use Interactions	Insufficient studies on feedback mechanisms between land use change and climate variability.
Policy and Governance	Gaps in evaluating the effectiveness of existing land use policies and community engagement strategies.
Sustainability of Land Management Practices	Limited research on innovative land conservation techniques that integrate local knowledge and technology.
Economic and Social Implications	Need for more empirical research on the socio-economic consequences of rapid land use change.
Future Research Directions	Lack of integrated frameworks for predicting future land use scenarios under different socio-environmental conditions.
	Source: Author's Own Composition based on Literature Review, 2025

7.2.5 Identified Knowledge Gaps regarding Population Dynamics on the Study Area:

Table 6: Identified Literature Gaps on Population Dynamics

Research Area	Identified Research Gaps
Drivers of Population Change	Need for research on the impact of emerging socio-economic trends, such as remote work and digital economies, on population distribution and migration.
Models of Population Dynamics	Limited studies on integrating AI and machine learning in population forecasting and demographic modeling.
Impacts of Population Dynamics	Lack of comprehensive studies on the combined effects of urbanization, climate change, and technological advancements on population structures.
Aging Populations	Insufficient research on the economic and healthcare impacts of aging populations in low- and middle-income countries.
Urbanization and Migration	Need for empirical studies on internal migration trends in response to environmental changes and economic shifts.
Policy and Management Implications	Gaps in policy research addressing population pressures on urban infrastructure, housing, and resource management.
Population and Climate Change	Limited research on feedback loops between climate change adaptation policies and population movements.
Future Research Directions	Lack of interdisciplinary approaches combining demography, environmental science, and urban planning to address global population challenges.
	Source: Author's Own Composition based on Literature Review, 2025

7.2.6 Identified Knowledge Gaps regarding Methodology to Measure Population Dynamics:

Table 7: Identified Knowledge Gaps regarding Methodology to Measure Population Dynamics

Section	Research Gap
1. Materials for Measuring Human Population Dynamics	Limited integration of various data sources (e.g., census, surveys, GIS) for comprehensive population analysis.
2. Methods for Measuring Human Population Dynamics	Lack of standardized methods for measuring migration patterns in both short- and long-term contexts.
3. Life Table Analysis	Inconsistent application of life tables across different populations with varied demographic and health characteristics.
4. Mathematical Models	Inadequate incorporation of external factors (e.g., climate change, economic shifts) in population growth models.
5. Sampling Methods	Limited research on the effectiveness of various sampling techniques for specific populations or regions in large-scale surveys.
6. Population Growth Models	Lack of application of non-linear models (e.g., logistic growth) in contemporary population dynamics studies.
7. Methodology - Population Projections	Insufficient integration of social and economic factors in cohort-component methods for population projections.
8. Demographic Transition Theory	Limited application of demographic transition theory to specific contexts, such as low-income countries or rapidly changing societies.
9. Stable Population Theory	Lack of studies on stable population theory in relation to contemporary global challenges such as migration and climate change.
10. Human Capital Models	Insufficient empirical evidence on the interplay between population changes, education, and labor market outcomes.
11. Migration Studies	Gaps in understanding how global environmental changes influence migration patterns and population dynamics.
12. Epidemiological Models	Limited integration of disease dynamics into broader population modeling approaches, especially with emerging diseases.
	Source: Author's Own Composition based on Literature Review, 2025

7.2.7 Identified Knowledge Gaps regarding Methodology to Measure Land Use Dynamics:

Table 8: Identified Knowledge Gaps regarding Methodology to Measure Land Use Dynamics

Section	Research Gap
1. Materials for Measuring Land Use Dynamics	Lack of comprehensive integration of diverse data sources (remote sensing, field surveys, GIS) for holistic land use analysis.
2. Remote Sensing Techniques	Inadequate accuracy and consistency in change detection across different types of land use categories (e.g., urban, agricultural, forest).
3. Land Use Classification	Inconsistent classification accuracy in land use types due to varying quality of satellite imagery and classification algorithms.
4. GIS-Based Spatial Analysis	Limited research on optimizing spatial analysis techniques for capturing small-scale land use changes in remote or inaccessible areas.
5. Modeling Land Use Dynamics	Current models (Markov Chain, Cellular Automata) may not capture complex interactions in land use transitions involving multiple variables.
6. Statistical and Econometric Methods	Insufficient application of spatial econometrics to account for spatial autocorrelation in land use changes.
7. Agent-Based Models (ABM)	Lack of real-world validation of agent-based models in land use dynamics and the incorporation of more diverse agent types (e.g., government, industries).
8. Methodology - Land Use/Land Cover Change (LUCC) Analysis	Limited focus on integrating LUCC analysis with socio-economic and policy data for comprehensive impact assessments.
9. Landscape Ecology Approaches	Insufficient study on the impact of land use change on ecological processes like biodiversity and ecosystem services.
10. Integrated Assessment Models (IAMs)	Limited integration of real-time data into IAMs for dynamic land use change analysis.
11. Participatory Approaches	Lack of detailed studies on the effectiveness of participatory rural appraisal (PRA) in different cultural and political contexts.
12. Scenario Analysis	Insufficient focus on integrating future socio-economic and climate scenarios into land use projections.
13. Sustainability and Impact Assessment	Limited methodologies for comprehensive sustainability assessments that combine environmental, social, and economic impacts of land use changes.
Source: Author's Own Composition based on Literature Review, 2025	

7.3 Comprehensive Knowledge Gaps from the Reviewed Literatures:

A thorough literature review might reveal the following gaps:

- **G1.** **Limited Integrated Studies**: Most studies either focus on environmental or social aspects separately, but comprehensive assessments integrating population dynamics, land use changes, and their socio-economic effects are scarce.
- **G2.** **Lack of Fine-Scale Spatial and Temporal Analysis**: Existing studies may not provide detailed multi-temporal assessments of land use change and population shifts in Khejuri blocks.
- **G3.** **Insufficient Consideration of Climate-Induced Changes**: There is a lack of research linking fluvio-coastal processes with socio-economic adaptations and livelihood resilience in Khejuri.
- **G4.** **Policy and Governance Gaps**: Studies rarely explore governance mechanisms, policy effectiveness, and sustainable management strategies for balancing development with ecological conservation.
- **G5.** **Limited Community-Centric Research**: Few studies incorporate participatory approaches or local perceptions regarding land use change, displacement, and livelihood challenges.

G6. Inadequate Use of Advanced Analytical Tools: GIS-based spatial analysis, remote sensing, and socio-economic modelling are underutilized in existing research on the region.

7.4 Statistics of Reviewed Literatures:

Table 9: Spatial Level of Reviewed Literatures

Level of Reviewed Literatures	Area Coverage (Spatial Extension)	Number of Reviewed Literatures	% of Reviewed Literatures
Local Level	Two CD Blocks of Fluvio-coastal Khejuri	23	22.55
Regional (District) Level	Bengal Coast, Rasulpur Basin & Both Medinipur Districts	47	46.08
State Level	Throughout West Bengal rather than local/ regional extension	27	26.47
National Level	Outside Bengal, but inside India	3	2.94
International Level	Outside India	2	1.96
Total		102	100.00
Source: Scholar's Own Composition based on Literature Review, 2025			

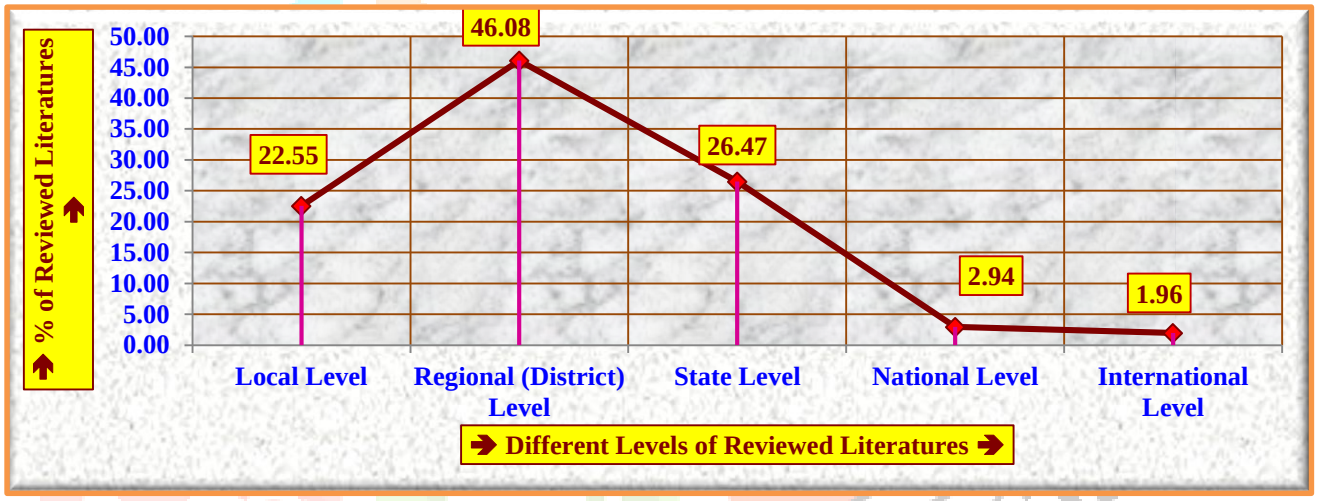

Figure 5: Types of Sources of Reviewed Literatures

Table 10: Types of Sources of Reviewed Literatures

Types of Sources of Reviewed Literatures	Number of Reviewed Literatures	% of Reviewed Literatures
Individual Source	5	4.90
Institutional Source	23	22.55
Organizational Source	24	23.53
Web Source	49	48.04
Unpublished	1	0.98
Total	**102**	**100.00**
Source: Scholar's Own Composition based on Literature Review, 2025		

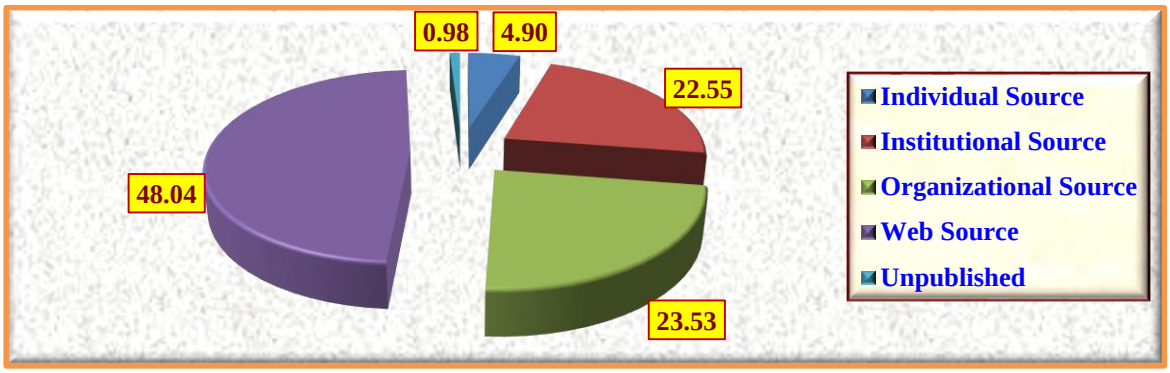

Figure 6: Source Availability of Reviewed Literatures

Table 11: Source Availability of Reviewed Literatures

Types of Source Availability of Reviewed Literatures	Number of Reviewed Literatures	% of Reviewed Literatures
Published Offline: Open Availability	22	21.57
Published Offline: Restricted Availability	36	35.29
Published Online: Availability (Open Access)	33	32.35
Published Online: Availability (Restricted Access)	10	9.80
Unpublished Unavailability with Individual Privacy & Restriction	1	0.98
Total	**102**	**100.00**
Source: Scholar's Own Composition based on Literature Review, 2025		

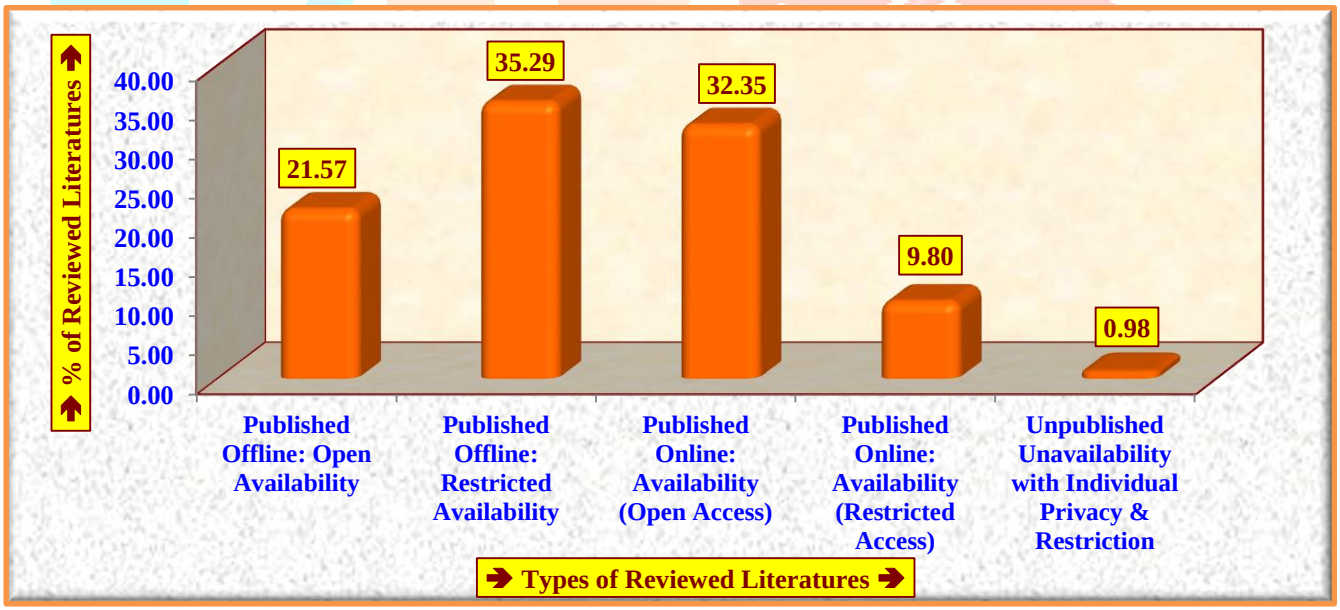

Figure 7: Statistics of the Source Types of Reviewed Literatures

Table 12: Statistics of the Forms of Reviewed Literatures		
Forms of Reviewed Literatures	**Number of Reviewed Literatures**	**% of Reviewed Literatures**
Books	26	25.49
Research Papers & Articles	40	39.22
Synopsis & Thesis	1	0.98
Institutional Reports, Handbooks & Gazetteers	25	24.51
Writings in Local/ Regional Magazines/ Periodicals	2	1.96
Atlas, Monographs & likely	6	5.88
Others	2	1.96
Total	102	100.00

Source: Scholar's Own Composition based on Literature Review, 2025

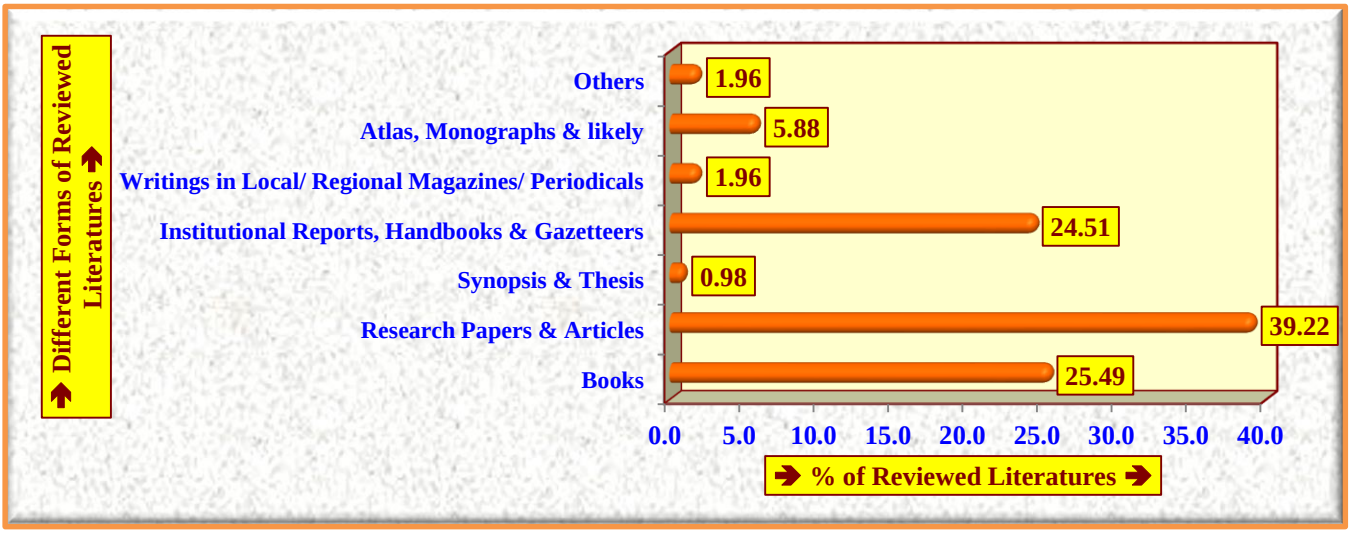

Figure 8: Statistics of Different Forms of Reviewed Literatures

7.5 Potential Research Focus on Khejuri as per Literature Review and Identified Knowledge Gaps:

7.5.1 Historical Significance and Socio-Economic Transformations:

- Conducting archaeological and historical investigations to document the rise and decline of Khejuri as a port town.
- Assessing the socio-economic impact of Khejuri's decline on local communities and their adaptive strategies.

7.5.2 Land-Use Change and Environmental Degradation:

- Employing long-term satellite-based analysis to examine land-use change and its correlation with environmental degradation.
- Investigating the impact of human-induced changes such as deforestation, urbanization, and agricultural expansion on local ecosystems.

7.5.3 Agricultural Expansion, Soil Salinity, and Sustainable Practices:

- Evaluating the economic viability and long-term sustainability of salt-resistant crop varieties and alternative agricultural practices.
- Studying the impact of aquaculture expansion on soil and water salinity levels.
- Examining community-led sustainable agriculture initiatives and their scalability.

7.5.4 Infrastructure Development and Hydrological Changes:

- Analyzing the role of unplanned urbanization, road construction, and land-use practices on local drainage systems and sediment transport.
- Conducting long-term hydrological monitoring to assess seasonal and inter-annual variations in water flow and channel shifts.

7.5.5 Water Quality, Salinity Intrusion, and Coastal Resilience:

- Developing a comprehensive time-series dataset on water quality, including parameters such as heavy metal contamination and microplastic pollution.
- Investigating the effectiveness of mangrove restoration and other nature-based solutions in mitigating coastal erosion and cyclone impacts.
- Examining wetland conservation and its role in fluvio-coastal resilience.

7.5.6 Climate Change, Disaster Preparedness, and Socio-Economic Adaptation:

- Developing predictive models to assess the impacts of climate change on Khejuri's coastal ecosystem.
- Evaluating disaster preparedness programs and early warning systems to improve community resilience.
- Studying the socio-economic resilience of farmers and fishers in adapting to climate variability.

7.5.7 Migration, Urbanization, and Livelihood Transitions:

- Assessing the long-term socio-economic consequences of migration from Khejuri to urban centers.
- Exploring the feasibility of alternative livelihoods such as eco-tourism and aquaculture as sustainable economic models.

7.5.8 Education, Healthcare, and Human Capital Development:

- Investigating the impact of inadequate education and healthcare on long-term human capital development.
- Evaluating policy interventions to improve educational and healthcare access in rural and coastal communities.

7.5.9 Integrated Water Resource Management and Policy Evaluation:

- Examining sustainable groundwater management, aquifer recharge, and community-led water conservation strategies.
- Assessing the effectiveness of policy frameworks such as CRZ and ICZMP in balancing land-use conflicts and environmental sustainability.

7.5.10 Advancing Environmental and Social Impact Assessments:

- Integrating AI, big data, and machine learning in EIA methodologies for improved predictive accuracy.
- Conducting cross-sectoral comparative analyses to evaluate EIA effectiveness in infrastructure, agriculture, and energy sectors.
- Exploring digital platforms and social media's role in enhancing public participation in EIA and SIA processes.
- Assessing the long-term success of mitigation measures and enforcement mechanisms in large-scale projects.

7.5.11 Land Use Dynamics and Sustainable Development:

- Developing interdisciplinary models that integrate socio-economic, environmental, and political factors influencing land use change.
- Employing remote sensing and GIS-based spatial analysis for small-scale land-use change detection.
- Assessing the cumulative effects of land-use change on biodiversity, ecosystem services, and climate resilience.

7.5.12 Population Dynamics and Policy Implications:

- Investigating emerging socio-economic trends such as digital economies and their influence on population distribution and migration.
- Integrating AI and machine learning models for improved demographic forecasting and policy planning.
- Evaluating the feedback loops between climate change adaptation policies and population movements.

8. Expected Materials, Methods and Methodology based on Literature Review:

Table 13: Expected major database, software and sampling techniques for proposed research

Major Database	Major Software	Major Survey Techniques	Major Sample Techniques	Major Indices & Approaches to be analysed
• Satellite Images: LANDSAT and IRS Series • Different Base Maps collected from various institutions/ organization/ departments • ISGPP, IGISMAP and Google Earth Imagery • Bhuvan: Indian Geo-platform of ISRO • Database of Different Govt./ Administrative Offices/ Departments • Census Records, District Gazettes, Documents, etc.	• ARC GIS 10.8.1 & QGIS • GPS • MS Excel, SPSS IBM, Matlab, R and Python • Photoshop 7.0.1, etc.	❖ Literature Survey ❖ Traversing & GPS Tracking ❖ Perception Survey on Target Group (Structured Questionnaire Method) ❖ Landscape Survey ❖ Livelihood Survey ❖ Ecological Survey ❖ Economy specific Survey/ Interviews ❖ Institutional Survey (Structured Questionnaire Method) ❖ Individual Interview (Formal Method), ❖ Photo Documentation & DVD Recording, etc.	❖ Systematic Random Sampling ❖ Stratified Random Sampling ❖ Judgemental Sampling ❖ Purposive Sampling, ❖ Chunk Sampling, etc.	❖ LULC Change Transition Matrix & Markov Chain Transition Matrix ❖ Changing Landscape Ecology Analysis ❖ Change Detection Analysis ❖ Comprehensive Ecological Sensitivity Index (CESI) Analysis ❖ Measure of Ecological Vulnerability ❖ Environmental Vulnerability Index ❖ Socio-ecological Theory/ Model ❖ Gravity Model Analysis ❖ Profit Budget, Productivity Index & Labour Weighted Production Index Analysis ❖ Livelihoods-Landscapes Strategy (IUCN) ❖ CESI, ESI, ERI & EVI Analysis ❖ SDGs (UNO) ❖ PAR Approach ❖ SWOT Matrix ❖ SPACE Matrix ❖ QSPM Matrix ❖ 4-C strategy framework and applying 4-R policy model, etc.

Source: Scholar's Own Composition based on Literature Review, 2025

9. Expected Findings and Probable Challenges of the Research as per the Literature Review:

9.1 Expected Findings as per the Literature Review:

Table 14: Expected Findings as per the Literature Review

Category	Expected Findings
Environmental Findings	• **Land Use Change and Degradation:** Rapid urbanization, deforestation, and agricultural expansion have led to soil salinity, mangrove loss, and coastal erosion.
	• **Coastal Erosion and Cyclone Impacts:** Frequent cyclones (Amphan 2020, Yaas 2021) have intensified coastal erosion and flooding, exacerbating land loss.
	• **Salinity Intrusion and Water Quality Issues:** Rising sea levels and unregulated groundwater extraction have increased soil and water salinity, affecting agriculture and human health.
	• **Wetland and Biodiversity Decline:** The loss of wetlands due to urbanization and industrialization is reducing biodiversity and ecosystem resilience.
	• **Climate Change and Hydro-meteorological Variability:** Increased rainfall variability, temperature rise, and extreme weather events are reshaping the region's land and water systems.
Livelihood Findings	• **Declining Traditional Livelihoods:** Agriculture and fisheries, once the backbone of the

	region, are in decline due to climate variability and environmental stress.
	• **Migration and Urbanization:** The decline in local livelihood options is driving migration to Kolkata and Haldia, leading to a feminization of agricultural labor.
	• **Socio-Economic Vulnerability:** Marginalized communities, particularly small-scale farmers and fishers, face economic distress due to environmental unpredictability.
	• **Education and Healthcare Deficiencies:** Inadequate educational facilities limit skill development, while poor healthcare infrastructure results in persistent waterborne diseases.
	• **Alternative Livelihood Strategies**: Initiatives like aquaculture, eco-tourism, and women-led enterprises (SHGs) are being explored to diversify income sources.
Governance and Policy Insights	• **Ineffectiveness of Disaster Management Programs:** Despite policies like ICZMP, disaster preparedness and early warning systems remain insufficient in minimizing damage.
	• **Limited Policy Integration:** There is a lack of coordinated policies that integrate environmental sustainability with socio-economic development.
	• **Need for Sustainable Land Use Planning:** Existing land use planning lacks an adaptive framework to cope with climate-induced changes and human settlement patterns.
Source: Scholar's Own Composition based on Literature Review, 2025	

9.2 Probable Challenges in the Research as per Literature Review:

Table 15: Probable Challenges in the Research as per Literature Review

Category	Probable Challenges
Data Limitations	• **Lack of High-Resolution Temporal Data:** Long-term satellite-based land use data and socio-economic time-series data are scarce.
	• **Inconsistent Demographic Data:** Migration and informal labor trends are difficult to quantify due to the lack of comprehensive government records.
	• **Limited Historical Documentation:** Historical records on land-use changes and socio-economic transitions are fragmented and not well-documented.
Environmental and Geographic Challenges	• **Dynamic Coastal Changes:** Frequent erosion and shifting river courses may make spatial analysis complex and less predictive.
	• **Unpredictable Climate Events:** Unexpected cyclones, floods, and sea-level rise may alter research findings during field studies.
	• **Access to Remote Areas:** Some affected regions might be difficult to access, restricting primary data collection.
Social and Political Barriers	• **Resistance from Local Communities:** Communities may be hesitant to participate due to concerns over displacement or inadequate policy responses.
	• **Policy and Governance Constraints:** Bureaucratic hurdles and lack of policy enforcement might delay data collection and implementation of research recommendations.
	• **Political Influence on Land Use Policies:** Economic and political pressures may influence land use decisions, making policy recommendations harder to implement.
Technical and Methodological Challenges	• **Integration of Multi-Disciplinary Approaches:** Combining GIS, remote sensing, socio-economic modelling, and policy analysis in a single framework is complex.
	• **Validation of Remote Sensing Data:** Ground-truthing data for land use and coastal changes requires significant time and resources.
	• **Effectiveness of Alternative Livelihood Strategies:** Assessing the sustainability and market potential of eco-tourism and aquaculture as alternative livelihoods needs further empirical research.
Source: Scholar's Own Composition based on Literature Review, 2025	

10. Concluding Remarks:

The fluvio-coastal Khejuri blocks of Purba Medinipur district in West Bengal represent a dynamic and ecologically sensitive region facing significant socio-environmental challenges. Through an extensive review of existing literature, this study has identified critical knowledge gaps across multiple domains, including land-use dynamics, environmental degradation, climate resilience, socio-economic adaptation, and governance frameworks. The findings highlight the urgent need for interdisciplinary research to understand and mitigate the complex interactions between human activities and environmental sustainability.

To bridge these gaps, future research should focus on **integrating advanced analytical tools** such as GIS, remote sensing, and predictive modeling to track long-term environmental and demographic changes. **Enhancing community participation** will be essential in formulating effective adaptation strategies that align with local needs. Furthermore, **strengthening policy frameworks** by incorporating evidence-based insights will ensure a balanced approach to sustainable development, disaster resilience, and socio-economic progress in the region.

By refining the research focus based on identified gaps, this study lays the groundwork for holistic, data-driven, and policy-oriented investigations. Such an approach will contribute to sustainable land and water management, enhance climate adaptation strategies, and improve socio-economic resilience in Khejuri and similar fluvio-coastal regions.

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