Developed By

STS Global

In Collaboration With

SELCO FOUNDATION

ASSESSMENT OF CLIMATE VULNERABILITY OF COASTAL COMMUINITIES IN THE CITY OF

PURI, ODISHA

Acknowledgement

At SELCO Foundation, we extend our sincere gratitude to our consulting partner, Seeds Technical Services (STS), an organisation working since past 15 years towards building resilience from the ground up by informing, thinking and changing minds, for providing their expertise and services in conducting the in-depth study in Puri, Odisha and preparing the report.

We are also grateful to SPANDAN, an NGO working with marginalised communities in Odisha for the past 16 years, for their continued collaboration and field support to our consulting partner, which enabled deeper engagement at the grassroots level. Their expertise has been instrumental in shaping the direction and depth of this work.

We are especially thankful to all the community member respondents who generously shared their time, insights, and experiences. Their on-ground knowledge significantly enriched the findings of this study report.

This report is the result of collective effort, collaboration, and commitment. We deeply appreciate the contributions of each individual and institution involved. This report is intended for policymakers, development practitioners, and ecosystem enablers working to develop sustainable and resilient urban programs in Puri. It also serves as a valuable resource for NGOs, financial institutions, and researchers seeking insights into urban gaps and opportunities within the Climate-Livelihood Nexus.

Executive Summary

The study presents a comprehensive assessment of climate vulnerabilities and livelihood risks faced by the urban poor in Puri city, Odisha. The study focuses on understanding the intersection of climate-induced hazards and stresses, socio-economic vulnerabilities, and the coping capacities of informal communities across key settlements such as Penthakata, Matitota, Talabania, Dandimala Sahi, and Baliapanda. By combining household surveys, focus group discussions, interviews, and secondary research, the assessment aims to provide actionable insights that inform inclusive, gender-sensitive, and climate-resilient programming for the city's most marginalised groups, particularly low-income workers, women, persons with disabilities, and other vulnerable identities.

The urban poor in Puri are at the frontlines of escalating climate risks. Coastal erosion, intense cyclones, sea-level rise, heatwaves, and flooding pose serious threats to their lives, housing, incomes, and access to basic services. Informal settlements, often located in low-lying, unplanned, or hazard-prone areas, are poorly constructed, lack ventilation, and offer no protection from wind or extreme heat. These neighbourhoods face recurring disruptions to power, water supply, mobility, health, and education following major disasters every year. For example, the widespread failure of electricity and network connectivity during cyclones cuts off early warnings and emergency communication. Schools, anganwadis, and primary health centres are among the first services to shut down and the last to recover, compromising both education continuity and child nutrition. Climate shocks also deepen livelihood insecurity, particularly for workers in tourism, fishing, and informal labour sectors, which are highly sensitive to disruption. Women and men in these communities, especially those dependent on informal or seasonal livelihoods such as dry fish processing, are left without income or protection in the aftermath of disasters. Despite their recurring exposure to such hazards, these communities remain underserved by formal institutions and excluded from planning due to the absence of disaggregated urban data and limited capacities of local bodies.

Key findings of the study reveal a lack of resilient infrastructure across critical services, weak institutional linkages for informal workers, and poor access to social protection schemes. There is inadequate data on urban informal livelihoods, and no targeted programme design for at-risk populations like women-headed households or persons with disabilities. Community responses from FGDs and interviews highlighted the absence of decentralised renewable energy solutions, especially for maintaining power and communication during and after extreme events[1]. There are also strong demands for improved housing, accessible healthcare, child services, water supply, and skill-building interventions to diversify livelihoods and reduce economic vulnerability.

To address these challenges, the report recommends an integrated and localised climate adaptation strategy. Key suggestions include deploying decentralised renewable energy (DRE) systems in pump houses, health centres, and education institutions; upgrading housing infrastructure for cyclone and heat resilience; and promoting women-led, climate-smart livelihood options through schemes like *Mission Shakti*. Strengthening early warning dissemination systems with solar-powered hubs and satellite phones is also advised, along with establishing resilient shelters and continuity plans for public services. Policy recommendations emphasise the need for better inter-departmental convergence, improved urban data systems, and ward-level action plans developed through participatory processes. Capacity building of frontline workers and local institutions must be prioritised to ensure anticipatory and responsive governance in climate-sensitive areas.

This study identifies and evaluates climate vulnerabilities in the city of Puri to assess its impact on urban poor livelihoods leading to a roadmap and set of recommendations to design a program that solves the issues. It makes a case for moving beyond top-down disaster responses and climate stress to long-term, community-anchored planning that protects livelihoods, enhances institutional preparedness, and safeguards the rights and dignity of the city's most vulnerable residents.

[1] In high-risk wards of Puri, communities repeatedly highlighted that power loss during disasters paralyses access to water, early warning, and health services, making decentralised renewable energy not just a demand, but a foundational enabler for essential services which further can help them to prepare better and reduce the losses greatly. They believed that DRE would help them in multiple ways as compared to solving just one issue individually.

Climate Vulnerability and Urban

1

Puri's urban poor at climate risk

Population in Puri faces rising threats from cyclones, flooding, coastal erosion and heatwaves etc- especially in informal settlements near the coast and low lying zones, affecting the urban poor population the most.

The study presents a comprehensive assessment of climate vulnerabilities and livelihood risks faced by the urban poor in Puri city, Odisha.

"We eat only if we catch fish that day"
Koviri Nagamani.

Climate induces hazards and stresses across key vulnerable settlements such as Penthakata, Matitota, Talabania, Dandimala Sahi and Baliapanda.

2

Livelihoods in danger

Fishing, tourism, and informal sectors are climate-sensitive. Women and informal workers are hardest hit, often left without income or protection post-disaster.

3

Weak infrastruc & service disrupt

Basic services like power, water, schools, and health centres shut down during disasters, slowing recovery and deepening vulnerabilities.

Poor Livelihood Study

"Last cyclone ruined my tea shop; took 3 months to rebuild"
Sukantha Pradhan

4

Gaps in planning and data

Lack of urban data on livelihoods and vulnerable groups leads to exclusion from formal planning and protection systems.

5

Key Recommendations for resilence and inclusive climate action

a)

Shelter

Resilient Housing

Cyclone- and heat-resistant shelter upgrades

b)

Energy

Decentralised Renewable Energy
Solar power for schools, pump houses, health posts

c)

Livelihoods

Women-Led Livelihoods

Dry fish, solar microenterprises, Mission Shakti

d)

Policy

Urban Data & Local Planning
Ward-level plans, community-driven decisions

e)

Early Warning

Early Warning Systems

CIS(Climate nformation Services),AWS(Automated Weather Stations),Solar hubs, loudspeakers, satellite phones

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1 Introduction

1.1 Background and Context

Puri, a coastal city in Odisha, spans approximately **16.5 square kilometres** and serves as a significant cultural and tourism hub. With a population of around **200,000**, the city experiences considerable fluctuations due to the seasonal influx of pilgrims and tourists, particularly during major festivals such as the Ratha Yatra. Puri's coastal location exposes it to multiple climate-related hazards, including storm surges, cyclonic storms, coastal erosion, and flooding, particularly during the monsoon season. Additionally, the city faces the long-term threat of sea-level rise, which endangers infrastructure and livelihoods, particularly in vulnerable communities.

Puri has **46 notified slums**, many of which are situated in low-lying areas with inadequate access to essential infrastructure such as sanitation, clean water, and resilient housing. These informal settlements are particularly susceptible to climate risks, with **coastal erosion and saline water intrusion** further deteriorating living conditions. The effects are especially pronounced for communities dependent on agriculture and fishing, whose livelihoods are directly impacted by environmental changes.

The urban poor in Puri primarily rely on the tourism sector, fishing, and informal labour for their livelihoods. However, climate change has intensified challenges for these communities, as extreme weather events disrupt both the tourism industry and traditional fishing practices. While government initiatives and various disaster preparedness programs offer some support, significant gaps remain in integrating climate resilience measures and addressing the specific needs of marginalised groups.

Given Puri's high exposure to climate risks, conducting a **climate vulnerability and urban poor livelihood study** was essential. Such

an assessment provided critical insights into the impact of climate change on vulnerable populations, evaluate the resilience of their livelihoods, and inform the changemakers mindfully.

1.2 Vision and Objectives

1.2.1 Vision

The aim of the assessment is to identify climate risks and vulnerabilities across Puri's urban landscape, with a focus on the most at-risk populations. By analysing factors like geographic exposure, socio-economic sensitivity, and adaptive capacity, this assessment provides the evidence base for designing targeted, inclusive, and climate-resilient programmes. The overarching goal is to enable informed decision-making that strengthens the resilience of urban poor communities, protects livelihoods, and enhances access to essential services in the face of growing climate challenges

1.2.2 Objectives

1. **Assess Climate Vulnerability:** Conduct a comprehensive study to identify key climate risks, and their impact on Puri's urban poor and informal settlements.

2. **Map Livelihood Risks and Opportunities:** Analyse the effects of climate change on key economic sectors such as tourism, fishing, and informal labour, while identifying pathways for resilient livelihood diversification.

3. **Strengthen Community Resilience:** Develop adaptive strategies by integrating climate risk assessments with community-led planning.

4. **Policy and Stakeholder Engagement:** Collaborate with local authorities, NGOs, and community-based organisations to

align project findings with existing government programs and propose policy recommendations for long-term resilience planning.

5. **Technology and Innovation**: Leverage GIS mapping, participatory risk assessments, and innovative climate adaptation strategies to inform targeted interventions and enhance disaster preparedness in vulnerable urban areas.

6. **Sustainable Implementation:** Provide actionable recommendations for integrating climate adaptation and mitigation strategies into Puri's urban planning framework, ensuring long-term sustainability and local ownership of solutions

1.3 Scope

The climate vulnerability and livelihood study aim to address the growing challenges posed by climate stress including disasters and their impacts on urban livelihoods, especially among the city's most vulnerable populations. The project adopts a multi-dimensional, inclusive, and community-driven approach to identify key risks and design transformative solutions for long-term urban resilience.

1.3.1 Urban Climate Risk Assessment

The study focuses on assessing the vulnerability of Puri city to climate stresses and climate-induced hazards. It includes spatial mapping of hazard-prone urban areas such as low-lying wards and informal settlements by integrating historical disaster data, drainage infrastructure, land use patterns, and climate change projections along with heat mapping.

1.3.2 Livelihood Vulnerability in the Urban Context

The risk assessment places special emphasis on the urban poor belonging from different livelihoods like informal workers, including street vendors, fisherfolk, construction labourers, and those dependent on the tourism economy to name a few. These groups' face severe economic and social disruptions every year due to climate stress and disasters adding on to their already existing varied socio-economic conditions. The study aims to identify opportunities for such urban poor populations for livelihood diversification, skill-building, climate-proofing of income sources and thus creating sustainable livelihoods.

1.3.3 Gender and Social Inclusion

Recognising the differentiated impacts of climate stress, the study prioritises gender sensitivity and social equity along with documenting everyday coping strategies, recovery practices, and informal support systems adopted by urban poor communities in Puri to navigate recurring climate and disaster stresses. It explores the specific vulnerabilities of women, elderly person and persons with disabilities, and marginalised urban communities, while also capturing their coping mechanisms and resilience practices. The study incorporates sex- and age-disaggregated data and engaged with women-led groups and community networks.

1.3.4 Participatory Urban Risk Mapping

A core element of the study is participatory engagement with urban residents, community organisations, NGOs, and municipal stakeholders. Through surveys, focus group discussions (FGDs), and community mapping, the study generated grounded insights into perceived risks, critical needs, and adaptive capacities. These will feed into community-based risk maps and action plans.

1.3.5 Climate-Responsive Urban Strategies

The study proposes integrated resilience strategies. Most recommendations align with relevant policies and programs such as the Smart Cities Mission, AMRUT, National Disaster Management Plan, and State Action Plans on Climate Change.

2 Approach and Methodology

2.1 Research Approach

Our broad research approach followed a layered and iterative approach combining literature review, GIS-based spatial analysis, and intensive on-ground fieldwork. The study began with an extensive review of existing literature, including government reports, academic studies, media archives, and climate projections, to establish the historical and current baseline of climate risks and socio-economic conditions in Puri.

Based on this foundation, GIS mapping was conducted to generate thematic layers such as hazard zones, elevation, LST, and informal settlements to name a few, and identify spatial patterns of vulnerability across wards. A vulnerability index was then developed using weighted indicators of exposure, sensitivity, and adaptive capacity with a number of sub indicators, enabling the identification of high-risk wards with significant urban poor populations.

Following this, five of the most vulnerable urban poor communities were shortlisted based on their location in high-risk zones, exposure to recurring climate stress, and dependence on sensitive livelihoods such as fishing, tourism, vending, construction etc. These communities were then engaged through field surveys and FGDs to capture deeper understanding of their issues faced due to climate stress, facilities and support available and their socio-economic conditions.

A household questionnaire was administered using purposive-random sampling, with special emphasis on inclusion, prioritising households headed by women, persons with disabilities, and other

marginalised groups. FGDs ensured broader participation and helped triangulate insights from the surveys.

Finally, findings from the literature review, GIS analysis, and primary data were analysed and synthesised to draw key conclusions and formulate targeted, community-informed recommendations for the urban poor vulnerable population for the city of Puri.

2.2 Methodology:

Figure 1: Broad Methodology

Activity 1: Desk Review

Literature Study:

- Review of existing documents.
- Analysis of future climate scenarios based on credible climate change projections and their anticipated impacts.
- Compilation of case studies and best practices from around the world for climate adaptation and sustainable livelihood strategies.
- Review of policies, urban development plans, and disaster preparedness frameworks, including sectoral

policies on energy access, housing, and economic inclusion.

Activity 2: Data Collection

- Short- structured interviews with residents, vulnerable groups identified in the desk review, including urban poor communities, women, child caregivers, and civil society organisations. These interviews will help document specific challenges they face.
- Surveys assessing energy access, physical and social infrastructure (e.g., water, sanitation, housing, healthcare, education) among vulnerable communities.
- Participatory Rapid Appraisal (PRA) conducted in collaboration with Self-Help Groups (SHGs), Anganwadis, and local NGOs to capture community perspectives.
- Rapid Visual Surveys (RVS) to assess buildings and public spaces where urban poor communities engage in daily activities.
- Heat Island Mapping: Identification of heat hotspots in dense urban areas and assessment of their impact on public health.
- Energy Accessibility Assessment: Evaluating access to affordable, reliable energy sources for vulnerable populations and their role in climate adaptation.

(Emphasis on collecting gender- and age-segregated data wherever possible)

Survey in Puri:

- Most critical urban poor communities selected for deep-dive study: 10% (selected based on disaster vulnerability mapping, informal employment distribution, and settlement patterns)
- Focus Group Discussions (FGDs)
- Household surveys per community

Activity 3: Mapping

Comprehensive spatial analysis using government datasets, field data, and satellite imagery.

Maps:

- Informal Settlement Map
- Ward-wise Population Density Map
- Open Spaces & Green Cover Map
- Occupation & Livelihood Map
- Contour & Elevation Map
- Flood Risk Map
- Rainfall Drainage Map
- Land Surface Temperature (LST) Map
- Climate Vulnerability Map
- Heat Island Map
- Vulnerability Map

The maps overlayed to analyse better along with supporting studies like Kernel Density Estimation (refer annexure 10.1 for details), Livelihood Hazard Exposure etc.

Activity 4: Data Analysis

- Hazard, Vulnerability, Risk, and Capacity Assessment (HVRCA)[2] integrating desk research, field data, and GIS insights. The Vulnerability Index formed a key component of the framework. (annexure 10.2)
- Livelihood gap and needs analysis (gender-segregated) based on survey findings and participatory appraisals.
- Impact analysis of climate change and disasters on vulnerable communities, with special focus on health and livelihoods.

[2] HVRCA is a tool used to access the multi hazard risk assessment, integrating factors including: Hazard identification (e.g., flood zones, cyclone paths), Vulnerability (who/what is at risk), Risk (likelihood × impact x disaster), Capacity (existing coping systems, resources, institutions).

- Energy Accessibility Impact Assessment to understand the role of energy infrastructure in climate resilience.

Activity 5: Recommendations

- Strategic adaptation measures at both macro (city-wide) and micro (community-level) scales.
- Sustainable livelihood strategies to enhance resilience among urban poor communities.
- Energy transition strategies to integrate clean and affordable energy into climate adaptation solutions.
- Heat mitigation strategies through urban planning interventions, green cover enhancement, and cooling solutions.
- Draft report summarising findings and proposed interventions.

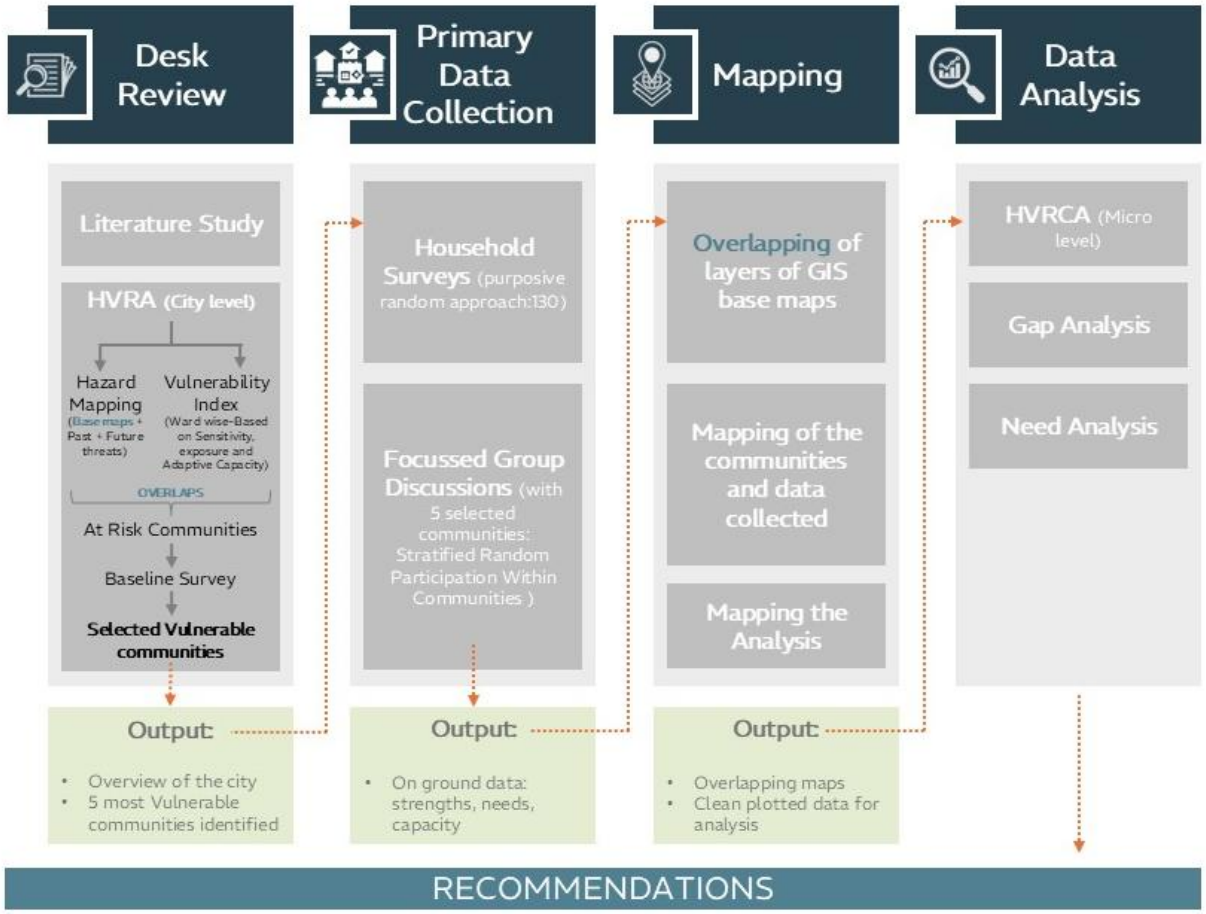
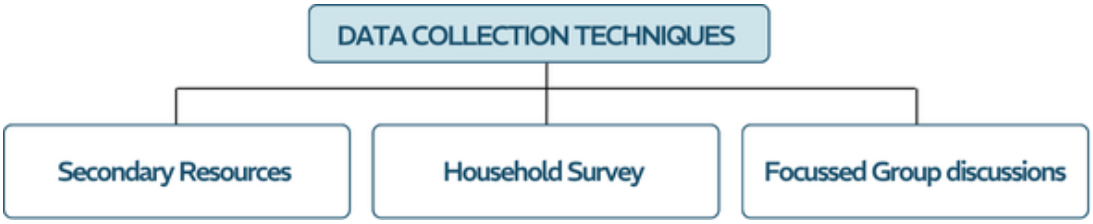


Figure 2: Detailed methodology

2.3 Data Collection Techniques

The risk assessment and resilience planning process for Puri city is underpinned by a robust, multi-method data collection strategy. This ensures a comprehensive understanding of the urban risk landscape, socio-economic vulnerabilities, and the lived experiences of communities. The approach integrates both quantitative and qualitative methods, drawing on diverse sources to enable a holistic and inclusive assessment.



2.3.1. Secondary Resources

A wide range of secondary data sources were reviewed to establish the contextual and historical background of Puri city's exposure to hazards and climate variability. These resources included:

- Government publications and reports (e.g., Census data, District Disaster Management Plan, State Action Plan on Climate Change),
- Meteorological and hydrological data from IMD, NDMA, and the Odisha State Disaster Management Authority (OSDMA),
- Satellite imagery and GIS layers to map land use, flood plains, and hazard exposure,
- Academic literature, past research studies, and sectoral reports on urban development, housing, infrastructure, and livelihoods in Puri.

This review helped identify existing gaps in resilience planning and informed the development of field-level tools and indicators for further investigation.

There were limitations found while referring to the secondary data, as a lot of authentic data is not available for the city of Puri from authentic sources.

2.3.2. Household Survey

A structured household survey was carried out across vulnerable wards of Puri city to capture granular insights into socio-economic status, housing typologies, access to services, livelihood patterns, disaster preparedness, and coping mechanisms. The survey was designed to ensure:

- Representative sampling across high-risk areas, especially informal settlements and coastal zones,
- Gender-disaggregated data, ensuring voices of women and other marginalised groups were adequately represented,
- Use of digital tools for real-time data collection and geo-referencing.

The household surveys were conducted using google maps for timely collection and reduce the chances of loss of data. (refer annexure 10.3 for detailed questionnaire)

In addition to survey data, participatory risk mapping exercises were conducted alongside community members. That maps helped visualise:

- Local hazard hotspots (e.g., areas prone to waterlogging, wind damage, and saline intrusion),
- Availability and condition of critical infrastructure,
- Community assets and evacuation routes.

2.3.3. Focussed Group discussions

Focus Group Discussions (FGDs) are a crucial qualitative research tool, allowing deeper insights into the lived experiences, community-specific vulnerabilities, and socio-political dynamics that are often missed in structured surveys.

1. Understanding Localised Climate & Disaster Risks

Quantitative data (surveys, reports) may indicate that certain areas are flood-prone or cyclone-affected, but FGDs reveal how communities actually experience and respond to these events.

- FGD Insights to Gather:
    - How do different groups (fishermen, slum dwellers, vendors) perceive risks from cyclones, floods, heatwaves, coastal erosion?
    - What traditional knowledge or early warning systems do they rely on?
    - What specific locations or infrastructure (roads, houses, markets) are most vulnerable?

2. Exploring Livelihood Disruptions & Adaptation Strategies

The survey can show which livelihoods are most affected, but FGDs reveal how, when, and why their incomes decline and what alternative strategies they try.

- FGD Insights to Gather:
    - What part of their livelihood cycle is most affected by disasters? (For example, fish spoilage due to heat, transport failures due to floods).
    - What are the barriers to recovery after a disaster? (Lack of capital, damage to tools, reduced tourism, etc.).
    - How do communities cope with job losses? Do they migrate, borrow money, shift to informal labour?

3. Identifying Social Inequalities & Power Dynamics

Government schemes and aid distribution can be unequal, FGDs help understand social hierarchies, political influences, and access barriers.

- FGD Insights to Gather:
    - Who controls access to disaster relief- local leaders, panchayats, or bureaucrats?
    - Do marginalised groups (women, Dalits, migrant labourers) get fair access to compensation, rations, housing support?

- Are there corruption, favouritism, or political pressures in government aid distribution?

4. Heatwave Resilience & Community Adaptation

Heatwaves are a growing crisis in Puri, but their impact varies by occupation. FGDs uncover hidden struggles and adaptation measures.

- FGD Insights to Gather:
    - How do fishermen, vendors, daily labourers, rickshaw pullers deal with rising temperatures?
    - What health issues (heat strokes, dehydration, productivity loss) do they face?
    - Are there local cooling strategies (use of shade, work-hour adjustments, government water supply)?

5. Mapping Migration Patterns & Displacement Triggers

Surveys may indicate migration trends, but FGDs reveal the real motivations and push-pull factors behind migration.

- FGD Insights to Gather:
    - Have people migrated due to disasters, loss of livelihood, or forced eviction?
    - Do they intend to return or permanently settle elsewhere?
    - How do migrants integrate into the host community? Do they face discrimination or job struggles?

6. Understanding Community Perceptions of Government & NGOs

People's trust in government, NGOs, and local leadership affects how they prepare for and recover from disasters. FGDs uncover gaps in governance and disaster preparedness.

- FGD Insights to Gather:
    - How effective are government compensation schemes?

- What is the community's experience with disaster shelters? Are they safe, accessible, and well-maintained?
- What role do NGOs, self-help groups, or religious organisations play in post-disaster recovery?

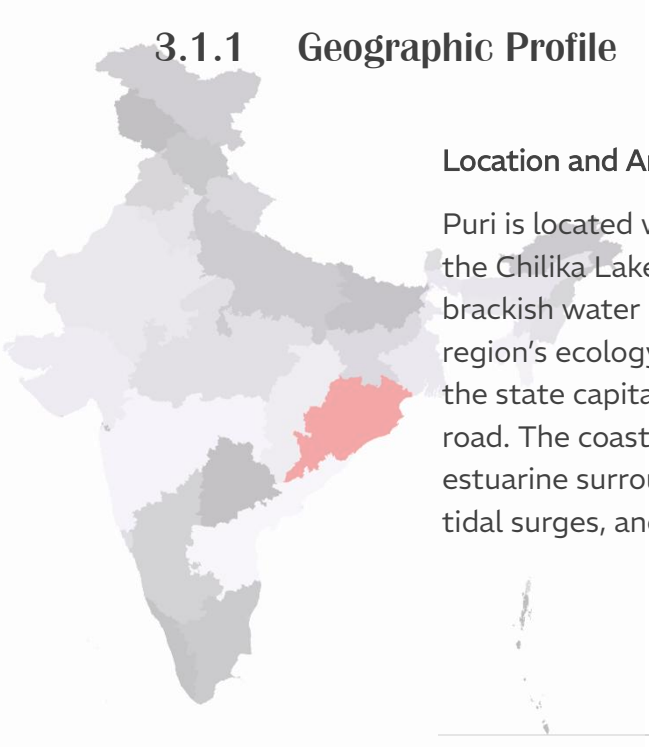
(refer annexure 10.4 for detailed FGD structure for Puri)

3 City Profile and Climate Risks

3.1 Geographic & Demographic Overview

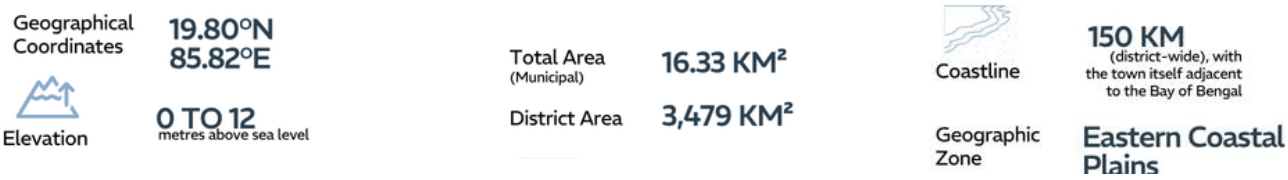
Puri, located in the eastern Indian state of Odisha, is one of the four sacred Hindu pilgrimage sites known as the Char Dham and is internationally renowned for the Jagannath Temple. As a coastal city, Puri holds a unique position both culturally and geographically. Its strategic location along the Bay of Bengal not only defines its landscape and ecology but also plays a pivotal role in shaping its economy, climate vulnerability, and urban development patterns.

3.1.1 Geographic Profile



Location and Area

Puri is located within the Mahanadi River delta and is bordered by the Chilika Lake on its south-western periphery, one of the largest brackish water lagoons in Asia, which plays a vital role in the region's ecology and economy. It lies approximately 60 km from the state capital, Bhubaneswar, and is well connected via rail and road. The coastal topography, combined with low elevation and estuarine surroundings, heightens its exposure to cyclonic storms, tidal surges, and flooding.



3.1.2 Climate and Environment

Puri is frequently exposed to extreme weather events, including cyclones, storm surges, coastal flooding, and heatwaves. Its low elevation and proximity to the coast make it particularly vulnerable to the impacts of climate change and sea level rise. Puri's climate is heavily influenced by its coastal location, with recurring heatwaves and high humidity during the pre-monsoon months. The region is prone to extreme weather events, particularly cyclones (e.g., Fani in 2019), with climate projections indicating an increase in frequency and intensity of such hazards.

3.1.3 Land Use and Urban Form

The city's spatial structure is dominated by religious, residential, and tourism-related functions. Key land use zones include:

- Religious precincts centred around the Jagannath Temple
- Residential areas, including formal housing and slum settlements
- Tourist infrastructure, including hotels, lodges, and beaches
- Ecologically sensitive zones, particularly along the coast and near wetlands
    - Beaches (Puri Beach)
    - Wetlands and estuaries
    - Proximity to Chilika Lake
- Constraints on Expansion: Sacred heritage sites, CRZ regulations, ecological sensitivity

Urban development in Puri has been shaped by a mixture of religious sanctity, tourism pressure, and physical constraints

imposed by natural features. The city exhibits dense inner-core development with peri-urban expansion increasingly infringing on vulnerable and low-lying areas.

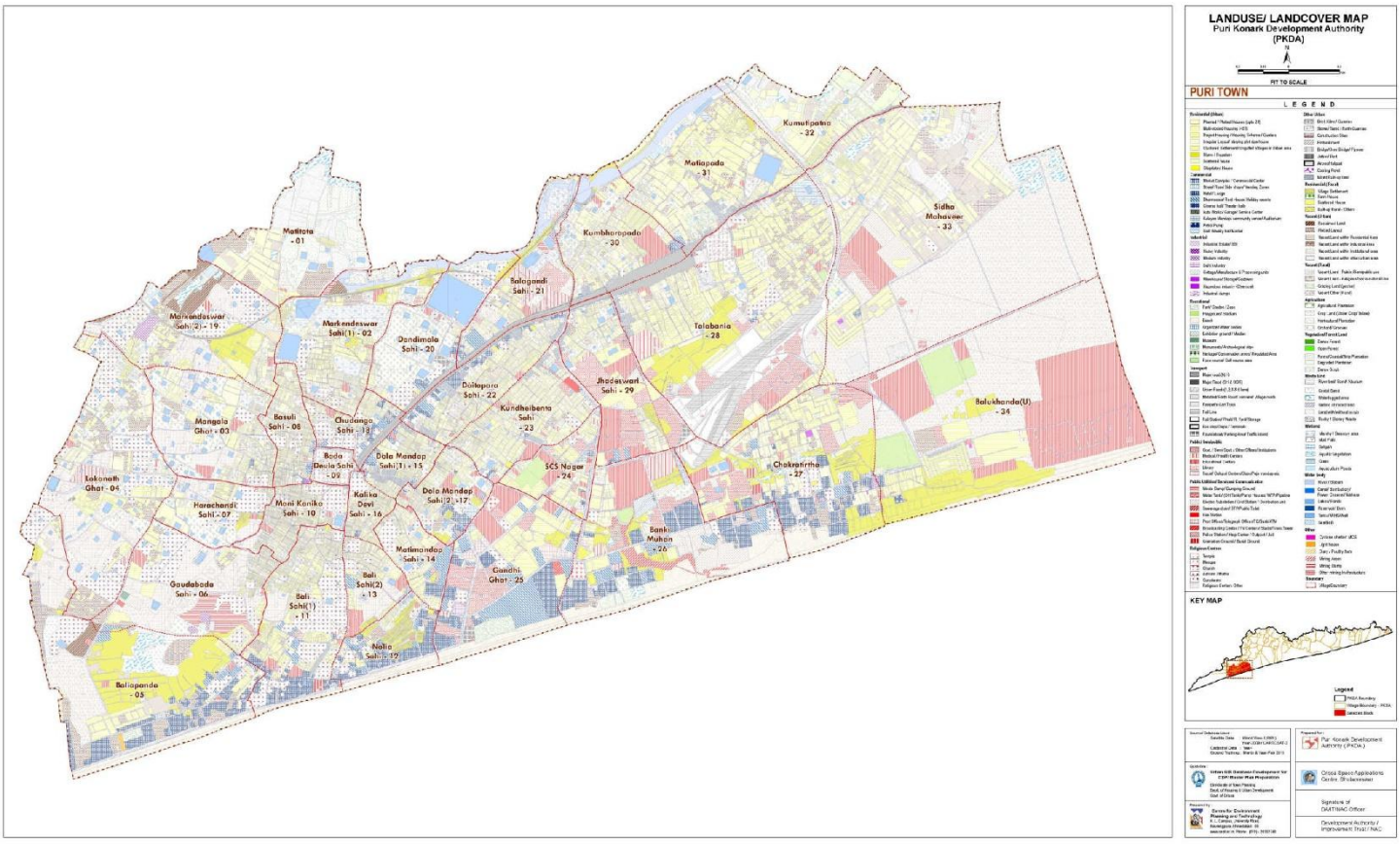
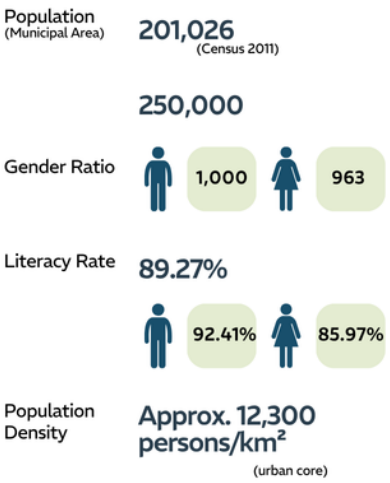


Figure 3: Existing Land use Map of Puri City. Source: (PKDA, 2025)

3.1.4 Demographic Profile



Puri's population experiences seasonal spikes due to the annual Rath Yatra and other religious festivals, drawing lakhs of pilgrims and tourists, placing immense temporary stress on civic infrastructure.

Migration and Urbanisation Trends

- In-Migration: Puri witnesses both permanent and seasonal migration, particularly of informal workers supporting the tourism, religious services, and construction sectors.

- Slum Population: Approximately 46% of the municipal population lives in informal settlements, comprising both notified and non-notified slums.
- Urban Growth Pattern: Largely radial, with significant spill-over towards the periphery and environmentally sensitive zones.

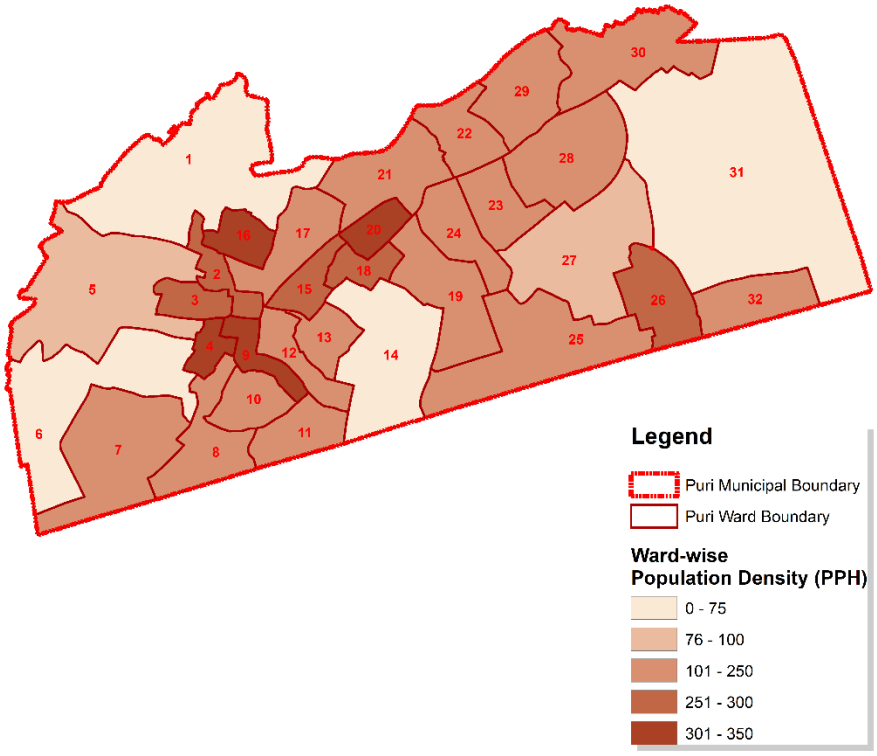
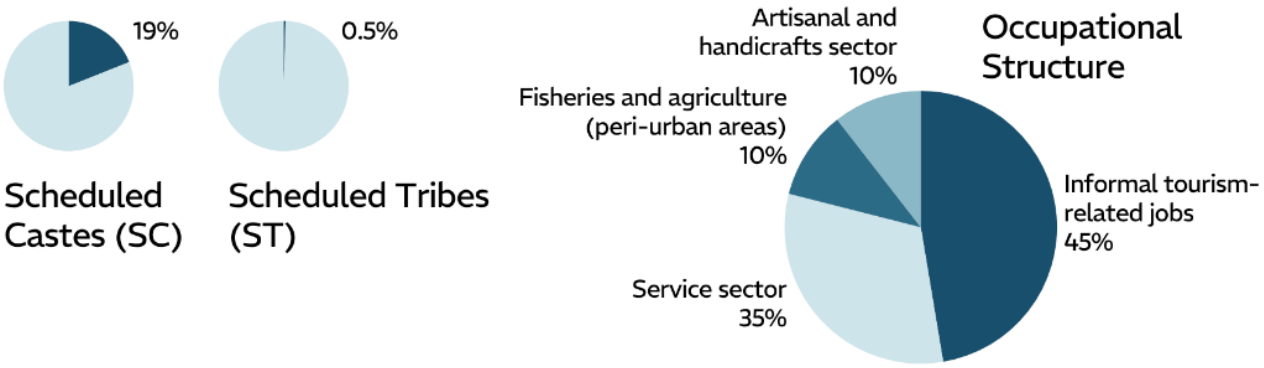


Figure 4:Puri Population Density Ward Wise_PPH. Source (STS, 2025)

Social Composition

- Scheduled Castes (SC): ~19%
- Scheduled Tribes (ST): ~0.5%
- Religious Composition: Predominantly Hindu (STS, 2025), with small Muslim and Christian communities
- Occupational Structure:
  - Service sector: ~35%
  - Informal tourism-related jobs: ~30–40%
  - Artisanal and handicrafts sector: ~10%
  - Fisheries and agriculture (peri-urban areas): ~10%

(Source: census 2011, Economic Survey of Odisha 2022–23, Odisha Handicrafts Policy 2020, Department of Fisheries and Animal Resources Development, Odisha)



Urbanisation Patterns

- Slum Population (Approximate): ~46% of urban residents
- Settlement Types: Mix of formal and informal housing
- Growth Pressure Zones: Near railway station, coastal belt, and pilgrim corridors

3.1.5 Conclusion

Puri's geography and demography are deeply intertwined, shaping the city's vulnerabilities and opportunities. Its location along the cyclone-prone coast, coupled with high-density informal settlements and seasonal population surges, requires targeted resilience-building. A nuanced understanding of the city's physical and social landscape is essential for effective disaster preparedness, urban planning, and climate adaptation.

3.2 Climate Change Trends & Projections

3.2.1 Historic Climate Trends

Table 1: Historic Climate Trends of Puri City

Climate Parameter	Change/Trend	Period	Reference
Annual Mean Temperature	Increased by ~0.2 °C per decade (overall warming trend)	1979–2023	(Meteoblue, 2025)
Annual Precipitation	Slight upward trend, with increasing frequency of heavy rainfall events	1979–2023	(Meteoblue, 2025)
Sea Level Rise (Coastal Odisha)	~9.5 cm rise from 1966 to 2015 (~1.6 mm/year). Regional rise exceeds national average (~8.5 mm/year)	1966–2015	(KHRISTODAS, 2022)
Coastal Erosion (Puri coast)	~67 m shoreline retreat since 1990; Odisha coast lost ~154 km of land between 1999–2016.	1990–2016; 1999–2016	(R.S. Kankara, 2018)

Key Observations

- Rainfall Patterns
  The region has experienced increased interannual variability in rainfall, leading to unpredictable precipitation patterns. Some stations have recorded decreased or fluctuating variability, impacting agriculture, water resources, and infrastructure.
- Sea-Level Rise
  The Chilika-Puri coast is highly susceptible to sea-level rise (SLR), exacerbating risks such as coastal erosion, saltwater intrusion, and habitat loss.

3.2.2 Major Historical Disasters

Table 2: Major Historical Disasters of Puri

Year	Event	Cause	Major Communities Affected
2019	**Cyclone Fani** (Government of Odisha, 2019), (YCDA, 2019), (Wikipedia , 2025)	Originated as a tropical depression in the Indian Ocean, intensifying into an extremely severe cyclonic storm due to favourable sea surface temperatures and atmospheric conditions. Made landfall in Odisha, causing extensive damage.	- **Coastal Communities**: Severe damage to homes and infrastructure in Puri and Khordha districts. - **Fishing Communities**: Destruction of boats and fishing equipment, leading to loss of livelihood. - **Urban Poor**: Extensive damage to informal settlements, exacerbating vulnerabilities.
2019	**Heatwave** (Foundation, 2024), (Sangram Kishor Patel, 2019), (Heat Wave Action Plan, 2023)	Record-breaking temperatures, exceeding 45°C for multiple weeks.	**- Outdoor Workers:** Construction workers, rickshaw pullers, and street vendors faced severe productivity loss. **- Low-Income Households:** Lack of cooling access increased health risks. **- Children & Elderly:** Higher hospitalization rates due to dehydration.
2022	**Odisha Floods** (ACAPS, 2022). ((India), 2022), (Wkipedia , 2025)	Triggered by heavy monsoon rains and multiple depressions over the Bay of Bengal, leading to the release of excess water from reservoirs like Hirakud Dam, which caused rivers, especially the Mahanadi, to overflow.	- **Agrarian Communities**: Over 1.2 lakh hectares of cropland damaged, affecting farmers in districts like Puri, Kendrapara, and Jagatsinghpur. - **Low-Lying Urban Areas**: Flooding in regions such as Bhubaneswar's Sundarpada area, impacting daily life and livelihoods. - **Rural Villages**: Approximately 1 million people across 1,757 villages affected, with over 14,000 houses damaged or destroyed.
2024	**Cyclone Dana** (YSD, 2024), (Al Jazeera, 2024), (Times of India, 2024),	Developed as a tropical storm in the Bay of Bengal, intensifying into a severe cyclonic storm with wind speeds up to 120 km/h, leading to heavy rainfall, strong winds, and potential	- **Tourists and Pilgrims**: Evacuations from Puri, especially those visiting the Jagannath Temple. - **Coastal Residents**: Risk of flooding and infrastructure damage in coastal areas. - **Fishermen**: Advised against

Year	Event	Cause	Major Communities Affected
	(Wikipedia, 2025)	flooding upon landfall in Odisha.	venturing into the sea, impacting their livelihoods.

3.2.3 Future Climate Projections

Table 3: Future Climate Projections of Puri

Parameter	Scenario	2040 Projection	2070 Projection	2100 Projection	Source
Temperature Change	RCP 4.5	- Maximum Temperature: Increase of 0.4°C to 1.2°C - Minimum Temperature: Increase of 0.3°C to 2.7°C	- Maximum Temperature: Increase of 0.8°C to 2.8°C - Minimum Temperature: Data not specified	Data not specified	Odisha State Action Plan on Climate Change (2021-2030), (Odisha, 2021)
	RCP 8.5	- Maximum Temperature: Increase of 0.7°C to 1.4°C - Minimum Temperature: Increase of 0.6°C to 3.9°C	- Maximum Temperature: Data not specified - Minimum Temperature: Data not specified	Data not specified	Odisha State Action Plan on Climate Change (2021-2030), (Odisha, 2021)
Rainfall Variation	RCP 4.5	- Monsoon Rainfall: Increase of approximately 3.9% (from 1,262.2 mm to 1,301 mm) - Summer Rainfall: Decrease of 8.2% (from 167 mm to 153 mm)	Data not specified	Data not specified	The New Indian Express (Express., n.d.)

Parameter	Scenario	2040 Projection	2070 Projection	2100 Projection	Source
		- Winter Rainfall: Decrease of 5.5%			
	RCP 8.5	- Monsoon Rainfall: Increase of 4–8% - Post-Monsoon Rainfall: Increase extending until October - Rainfall Variability: Higher variability with increased frequency of extreme events	- Monsoon Rainfall: Increase of 4–16% - Notable increase over central and coastal Odisha - Rainfall Variability: Higher variability with increased frequency of extreme events	Data not specified	Journal of Water and Climate Change (Volume 15, Issue 9), (Kumar, 2023)
Sea-Level Rise (SLR)	RCP 2.6	- Low: 4.28 cm - Medium: 6.60 cm - High: 8.80 cm	- Low: 13.71 cm - Medium: 21.84 cm - High: 29.49 cm	- Low: 20.24 cm - Medium: 33.19 cm - High: 48.37 cm	Research Gate Publication, (Dash, 2023)
	RCP 4.5	- Low: 4.35 cm - Medium: 6.57 cm - High: 8.71 cm	- Low: 15.76 cm - Medium: 23.58 cm - High: 31.59 cm	- Low: 25.01 cm - Medium: 40.32 cm - High: 55.54 cm	Research Gate Publication, (Dash, 2023)
	RCP 6.0	- Low: 4.15 cm - Medium: 6.35 cm - High: 8.40 cm	- Low: 15.01 cm - Medium: 22.67 cm - High: 30.34 cm	- Low: 26.88 cm - Medium: 40.05 cm - High: 56.04 cm	Research Gate Publication, (Dash, 2023)
	RCP 8.5	- Low: 4.65 cm - Medium: 6.79	- Low: 19.52 cm - Medium: 27.86	- Low: 38.88 cm - Medium:	Research Gate Publication,

Parameter	Scenario	2040 Projection	2070 Projection	2100 Projection	Source
		cm - High: 9.00 cm	cm - High: 36.75 cm	55.72 cm - High: 74.81 cm	(Dash, 2023)

3.2.4 Key Observations

- **Temperature Projections**
  Projections suggest a continued rise in temperatures for Odisha's coastal districts, including Puri. Under Representative Concentration Pathway (RCP) 8.5, significant increases in temperature and heat stress are anticipated (as much as- Maximum Temperature: Increase of 0.7°C to 1.4°C, - Minimum Temperature: Increase of 0.6°C to 3.9°C), posing risks to health, agriculture, and infrastructure.

- **Rainfall Projections**
  Future projections indicate a potential decrease in rainfall for Puri district. For instance, by 2090, a maximum decrease of 399.05 mm is projected under the RCP 2.6 scenario[3].

- **Extreme Weather Events**
  Climate models predict an increase in the frequency and intensity of extreme weather events, including cyclones and storm surges, due to rising sea surface temperatures. The frequency of cyclones in the Bay of Bengal has nearly doubled in the last four decades, with severe cyclonic storms increasing by ~25% since 1980 (IMD, 2021). Odisha has faced more than 8 major cyclones since 1999, with an average of one major cyclone every 2–3 years affecting coastal districts including Puri. Projections under RCP8.5 suggest sea level rise (SLR) of approximately 38.88 cm to 74.81 cm by 2100, significantly increasing the intensity and

[3] RCP (Representative Concentration Pathway) is the most optimistic climate change scenario developed by the Intergovernmental Panel on Climate Change (IPCC). It represents a trajectory of greenhouse gas concentration over time, not just emissions.

reach of storm surges, thereby heightening risks to Puri's low-lying coastal settlements and critical infrastructure.

3.2.5 Implications for Puri

- Agriculture: Altered rainfall patterns and increased temperatures may reduce crop yields and threaten food security.
- Water Resources: Variability in precipitation can lead to water scarcity, affecting both domestic and agricultural water supply.
- Health: Higher temperatures and humidity levels are likely to increase heat-related illnesses and vector-borne diseases.
- Infrastructure: Rising sea levels and extreme weather events pose risks to coastal infrastructure, necessitating climate-resilient urban planning.

AIR AND WATER POLLUTION

- Urbanisation, tourism, and waste mismanagement
- Air pollution (PM2.5 in dry months)
- Water pollution from sewage and effluents

CHANGING RAINFALL PATTERNS

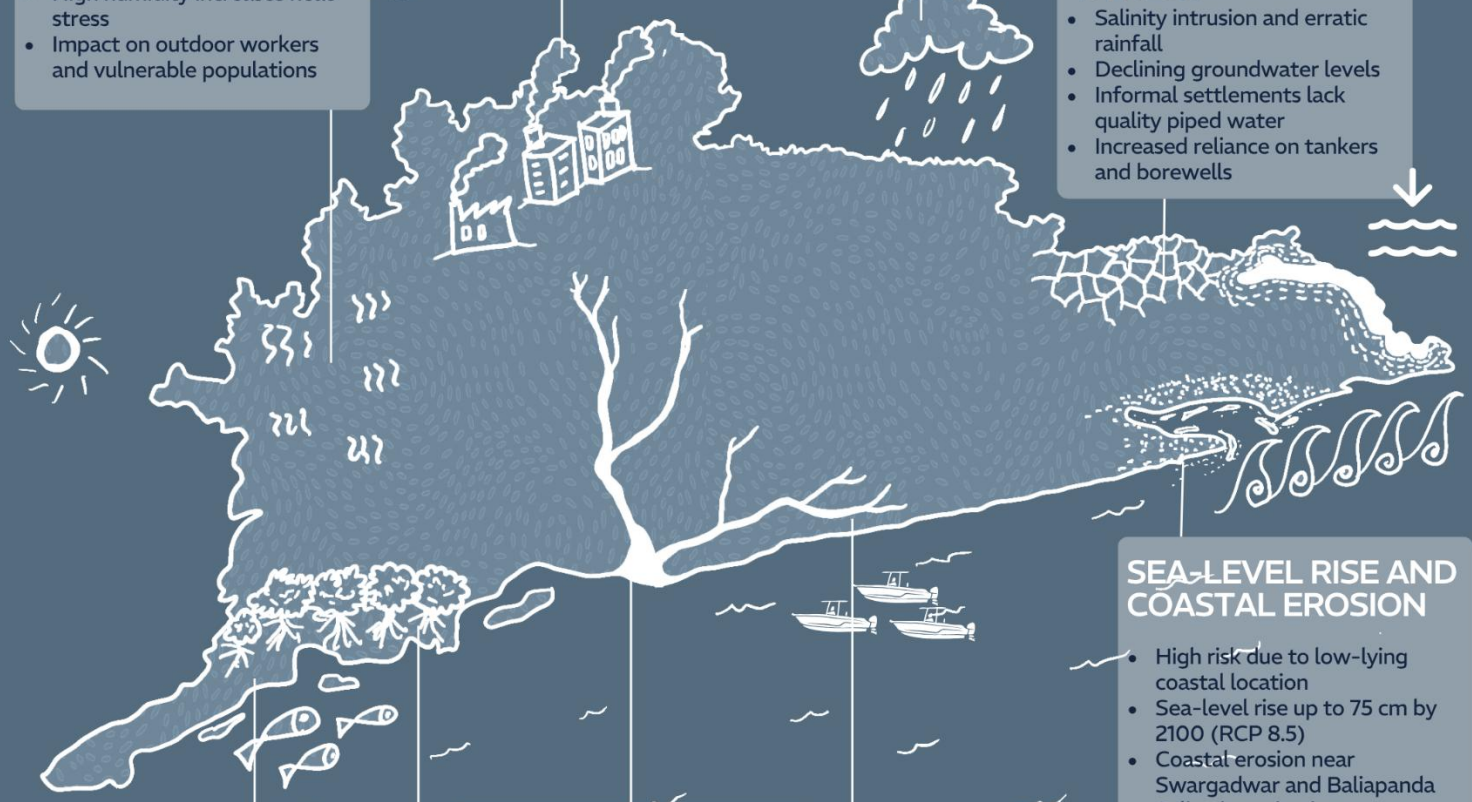
- Delayed monsoon onset
- Intense short-duration rainfall
- Decreased pre-monsoon and winter rainfall
- Impacts on agriculture and aquaculture

HEATWAVES AND RISING TEMPERATURES

- More frequent heatwaves (April–June)
- High humidity increases heat stress
- Impact on outdoor workers and vulnerable populations

WATER RESOURCE STRESS

- Salinity intrusion and erratic rainfall
- Declining groundwater levels
- Informal settlements lack quality piped water
- Increased reliance on tankers and borewells



SEA-LEVEL RISE AND COASTAL EROSION

- High risk due to low-lying coastal location
- Sea-level rise up to 75 cm by 2100 (RCP 8.5)
- Coastal erosion near Swargadwar and Baliapanda
- Saline intrusion into agriculture and freshwater

FLOODING AND INUNDATION

- Poor stormwater drainage
- Encroachments on natural water channels
- Backwater effect from Chilika Lake
- Low-lying slums highly affected

ECOSYSTEM DEGRADATION

- Stress on Chilika Lake ecosystem
- Siltation, fish decline, pollution
- Loss of mangroves and sand dunes

CYCLONES AND STORM SURGES

- Frequent intense tropical cyclones
- Cyclone Fani (2019), Phailin (2013), Amphan (2020)
- Storm surges worsen coastal flooding

LIVELIHOOD RISKS

- Fisherfolk face income loss from cyclones and fish stock changes
- Street vendors, temple workers, and daily wagers face disruption during disasters
- Tourism-based economy is highly sensitive to climate shocks and pandemics

KEY VULNERABLE GROUPS

- Women and children in informal settlements
- Fisherfolk and low-income coastal workers
- Tourism-dependent workers without formal employment
- Elderly and chronically ill vulnerable to heat and water-borne diseases

3.3 Major Environmental and Climate Risks

3.3.1 Sea-Level Rise and Coastal Erosion

- High Risk: Due to its low-lying coastal location along the Bay of Bengal, Puri is highly vulnerable to sea-level rise (SLR). Projections under RCP 8.5 show a possible rise of up to 75 cm by 2100, posing a significant threat to infrastructure, religious sites (like the Jagannath Temple), and livelihoods.
- Puri's entire 5 km shoreline within the municipal boundary is actively subject to coastal erosion and sea-level rise, especially during high tides and storm surges. Coastal wards, particularly those containing Baliapanda (Ward 7) and Penthakota-adjacent areas (Ward 32), may face incremental land loss and higher flood exposure. The exact ward-level impact data is unavailable.
- Coastal erosion is already observed, particularly along the beachfront near Swargadwar and Baliapanda, threatening tourism and housing.
- Saline water intrusion is impacting agricultural lands and freshwater sources.

3.3.2 Cyclones and Storm Surges

Puri is in the path of frequent and intense tropical cyclones from the Bay of Bengal.

Notable recent cyclones include:

- Cyclone Fani (2019) – caused widespread damage to housing, power infrastructure, and coastal ecosystems.
- Cyclone Phailin (2013) and Amphan (2020) – also impacted the district severely.
- Storm surges exacerbate coastal flooding, especially during high tides and cyclonic landfalls.

3.3.3 Flooding and Inundation

Urban flooding is a growing issue, particularly due to:

- Poor stormwater drainage
- Encroachments in natural water channels
- Backwater effect from Chilika Lake during heavy monsoons
- Low-lying slum areas are the most affected due to inadequate basic services.

Specific Details of the city:

- Low Flood Prone + Very Low Flood Prone zones together account for ~55–60% of the municipal area.
- Approximately 55–65% of total urban population is exposed to some degree of flooding (inundation, and flash floods).
- Wards Affected by Flooding: High Exposure Wards (Frequent/Severe Floods): 7, 8, 10, 11, 12, 13, 14, 25, 26, 32, Moderate Exposure Wards (Occasional Flooding): 3, 4, 9, 19, 21, 23, 24, 27 Total affected wards: ~18 out of 32 (≈ 56%)
- Wards with informal settlements in flood-prone areas: 7, 10, 11, 14, 25, 26, 32.
- Wards such as 10, 11, 12, 13, 25, and 26 exhibit a clear overlap of low elevation (as seen in the Contour and Elevation maps, high runoff accumulation (indicated in the Drainage map), and presence within flood-prone zones. This spatial convergence confirms that low-lying topography combined with inadequate drainage significantly contributes to heightened flood risk in these wards. (refer annexure 10.6 for maps).

3.3.4 Heatwaves and Rising Temperatures

Puri has witnessed a notable increase in heatwave events over the last decade, particularly during the peak summer months of April to June. The frequency has risen from 2–3 days/year in the early 2000s to as high as 8–10 days/year in recent years.

While the average temperature of the city touches 45°C in peak summers, but according to the satellite-derived LST data, surface temperatures range from 34.28°C to 47.28°C across the city during

peak summer at micro neighbourhood level. These extremes amplify thermal discomfort, particularly in built-up areas.

Heat indices are exacerbated by high humidity, affecting:

- Outdoor workers in tourism, fishing, construction
- Vulnerable populations like the elderly, women, and children

The next section dives deeper into the findings from Urban Heat Island map and Land Surface Temperature map at ward level. (refer annexure 10.6 for maps)

3.3.5 Changing Rainfall Patterns

Monsoon rainfall is becoming more erratic, with:

- Delayed onset
- Short bursts of heavy rain, increasing flood risks
- Decreased pre-monsoon and winter rainfall, impacting water availability
- Rainfall variability also affects agriculture in the hinterland and coastal aquaculture.

Specific Details of Puri:

- During the monsoon (DPT1–DPT3 decades), Puri recorded: Light rainfall events increased by ~51% deviation. (Nitesh Awasthi Jayant Nath Tripathi 1ORCID, 2024)
  Moderate rainfall events rose by ~27–38% deviation. (htt)
- Extreme Events Trend: Analysis (1991–2014) shows Puri experienced a high share of "very heavy" events- making up 24% of extreme rainfall occurrences in coastal Odisha. (S. PASUPALAK, 2017)

Table 4: Observed deviations in the rainfall patterns of Puri

Metric	Observed Change
Daily deviation	–20% average; peaks of +1,315%, drops to –100%
Light rainfall events	~+51% deviation

Metric	Observed Change
Moderate rainfall events	+27–38% deviation
Very heavy events share	24% of all extreme rainfall

3.3.6 Water Resource Stress

- Salinity intrusion, erratic rainfall, and declining groundwater levels pose risks to freshwater availability.
- Many informal settlements lack piped water or have access to low-quality sources.
- Dependency on tankers and borewells is increasing vulnerability.

3.3.7 Air and Water Pollution

- Increasing urbanisation, vehicular load, tourism, and unregulated waste contribute to:
    - Air pollution, especially PM2.5 during dry months
    - Water pollution from untreated sewage and hotel effluents affecting sea and lake ecosystems.

Water Pollution:

- Water Quality Index (WQI) dropped from 51 (fair) in 2023 to 37 (poor) in 2024, based on Odisha SPCB's coastal health assessment. (V, 2025)
- Key pollutants identified:
    - Microplastics: ~6.4 particles per litre in seawater; sediments at ~190 particles/kg.
    - Heavy Metals: Lead (Pb), Iron (Fe), Manganese (Mn) detected above acceptable concentrations
    - Microbial Pollution: Sharp rise in faecal coliform and Biochemical Oxygen Demand (BOD) during 2024.
- Temple sewage discharge (Rosala outlet):

- Total Soluble Solids (TSS): 4,830 mg/L (Std: 200)
- BOD: 10,200 mg/L (Std: 75)
- COD: 20,159 mg/L (Std: 250)

Air Pollution

- Annual AQI Trends (2020–2025):
  - 2020: 97
  - 2021: 62 (↓36%)
  - 2022: 88 (↑42%)
  - 2023: 106 (↑20%)
  - 2024: 109 (↑3%)
  - 2025: 116 (↑6%)

(Puri AQI , 2025)

→ Overall +7% worsening AQI.

- Particulate Matter (PM10) Levels:
  - Mean around 81 µg/m³ (exceeds WHO 45 µg/m³ according to aqi.in)
  - During festivals, winters and tourist seasons (pilgrim peaks) it spikes much higher.

Key Takeaways

Table 5: Key takeaways in terms of pollution type of Puri

Pollution Type	Current Condition	Public Health Impact
Water	WQI fell from 51 to 37 (poor); high microplastics, heavy metals, organic pollutants, and temple discharge	Risks to marine life, bathing safety, and drinking water quality

Pollution Type	Current Condition	Public Health Impact
Air	AQI persistently above 100; PM10 levels ~1.8× WHO safe limits	Exacerbates respiratory issues—especially during winter pilgrim season

3.3.8 Ecosystem Degradation

- Pressure on Chilika Lake, Asia's largest brackish water lagoon:
  - Siltation, fish population decline, and pollution.
  - Loss of mangroves and sand dunes reduces natural buffers against climate hazards.

3.3.9 Livelihood Risks

Key informal and coastal livelihoods are at high risk as confirmed through triangulated evidence from literature review, household surveys (HH), key informant interviews (KIIs), and focus group discussions (FGDs):

- Fisherfolk face loss of income due to cyclones and fish stock changes as observed in the past post cyclone Fani. Fisherfolk repeatedly reported income loss during cyclone events such as *Fani (2019)* and *Yaas (2021)*. FGDs revealed that over 60% of households faced loss of boats, nets, and catch stock. These impacts are compounded by perceived shifts in fish stock due to sea temperature changes and pollution (Source: FGDs; HH Survey 2025; SPCB Coastal Pollution Report, 2024, (Ray et al., n.d.), (Springer, n.d.), ("Rehabilitation of Fisherfolk Communities," n.d.), (IRJMETS, 2021), (International Journal of Humanities and Social Science Invention, n.d.)).
- Street vendors, temple workers, and daily wagers face disruption during disasters. Street vendors, temple service providers, and daily wage workers highlighted during KIIs and FGDs that they lose 5–10 days of income with each major flood or heatwave. Nearly 45% of surveyed informal workers in said they rely on daily earnings and have no savings or credit access (Source: HH Survey 2025; FGD testimonies; DCHB Puri 2011, (Down To Earth, n.d.)).

- Tourism-based occupations contribute to around 30–40% of informal employment in Puri and are highly sensitive to shocks from extreme weather and events. Disasters (e.g., cyclones) and events like the COVID-19 pandemic halted footfall, leaving vendors and support workers without income for weeks. As per HH data, 38% of respondents in tourism-centric wards reported a complete income halt post-disaster. (ScienceDirect, 2024)

3.3.10 Key Vulnerable Groups

- Women and children in informal settlements
- Fisherfolk and those in low-income coastal occupations
- Tourism-dependent workers without formal employment
- Elderly and chronically ill, vulnerable to heat and water-borne diseases

3.4 Analysis of Existing Major Policy Schemes

While programs like PM SVANidhi, Mission Shakti, and DAY-NULM have fostered livelihood resilience among many urban poor in Puri, significant coverage and accessibility gaps remain. Even though the exact numbers are not available for Puri, from the site surveys, we see that these particularly affect women-led, disabled, 'missing middle,' and street-based informal households. Infrastructure schemes under AMRUT and SBU have made progress, yet sanitation and water services are still inadequate in many slums, further exacerbating vulnerability among these marginalised groups.

3.4.1 Key Government Schemes for Urban Informal Livelihoods in Puri

1. PM SVANidhi (Pradhan Mantri Street Vendor's AtmaNirbhar Nidhi)

- **Launched:** June 2020
- **Purpose:** Micro-credit facility for street vendors with easy collateral-free loans and incentives for timely repayment.
- **Sources & Performance:**
  - Widely implemented across Odisha; many vendors reported positive access, though some marginalised women and disabled individuals faced procedural barriers.
  - Issues with doorstep pension, illustrating delivery gaps that could also affect PM SVANidhi beneficiaries.

2. Mission Shakti (Odisha)

- **Launched:** 2017; expanded urban component by 2018
- **Purpose:** Women's Self-Help Groups (SHGs) supported with micro-enterprises (e.g., dry-fish units, tailoring).
- **Performance:**
  - Many SHGs formed, especially in coastal wards like Baliapanda, engaging women in climate-adaptive livelihoods.
  - However, 'missing middle' households (slightly above poverty line) often fell through the cracks.
  - **Unequal Access:** Nearly 30–40% of SHG members in Puri's districts didn't receive any loans; tribal vs non-tribal disparity evident.
  - **Market Linkage Weakness:** SHGs rely heavily on intermediaries; value-chain integration remains poor.

3. Deendayal Antodaya Yojana – National Urban Livelihoods Mission (DAY-NULM)

- **Launched:** 2013
- **Purpose:** Offers skill training, microfinance access, and social security for urban poor.
- **Performance:**
  - Skilling initiatives reached slum residents in wards like Matitota and Dandimala Sahi.

- However, uptake by persons with disabilities and female informal-worker households remains inconsistent.
- **Limited Access for PWDs & Women-headed HHs**: Though skilling programs exist, lack of tailored support prevents full inclusion of people with disabilities and women-headed households (report gaps).

4. Urban Mission (AMRUT) & Swachh Bharat Urban (SBU)

- **Launched:** AMRUT (2015), SBU (2014)
- **Purpose:** Infrastructure upgrades water, sanitation, waste management.
- **Performance:**

  Improved services in some wards, but many slum settlements still lack toilets and dependable water unda Paula that female-headed and disabled households are disproportionately impacted.

5. Subhadra Yojana (Odisha State Government)

- **Launched:** 2024
- **Purpose:** Infrastructure upgrades water, sanitation, waste management.
- **Performance:**

  Improved services in some wards, but many slum settlements still lack toilets and dependable water unda Paula that female-headed and disabled households are disproportionately impacted.

6. Odisha Garima Scheme 2025

- **Launch Date:** 11 September 2020
- **Objective:** Protect dignity and welfare of core sanitation workers through insurance, skill training, PPE, housing, and accident support.
- **Coverage:** ~20,000 sanitation workers and their families (~100,000 individuals).

- **Status:** First state in India to institutionalise sanitation worker rights; however, consistent implementation and monitoring remain key challenges.

7. Mukhyamantri Karma Tatapara Abhiyan (MUKTA)

- **Launch Date:** February 2021 (evolved from Covid-era urban wage scheme)
- **Aim:** Urban equivalent of MGNREGS — offer daily wage work (drainage, green cover, sanitation, waterbody development, etc.) for urban poor, women, PWDs, migrants.
- **Successes:** Effective early implementation; high participation; integration with JAGA slum upgrading, geospatial tools and SHGs
- **Challenges:** Scaling up sustainably and integrating with broader urban employment and education strategies.

8. Samrudha Krushak, Swayam & Prosper Odisha

- **Launch:** 2024 (under Odisha's 2024–29 growth plan)
- **Purpose:** SME and MSME support through interest-free loans, infrastructure, and cluster development (Swayam, Prosper Odisha).
- **Relevance to Urban Informal Sector:** Provides scope for urban youth and small business owners; yet these schemes are less spotlighted in urban planning, requiring targeted linkages.

3.4.2 Successes vs. Failures

Table 6: Analysis of success vs failures of the few selected relevant government schemes in Puri

Schemes	Successes	Challenges & Failures
PM SVANidhi	Collateral-free loans empowered many street vendors.	Female, elderly, disabled vendors faced documentation or accessibility issues.

Schemes	Successes	Challenges & Failures
Mission Shakti	Enabled resilient income via SHGs among women.	Middle-income and disabled individuals received limited benefits.
DAY-NULM	Some uptakes in vocational training and loans.	Poor reach among disabled, single women, and elderly in informal jobs.
AMRUT/SBU	Better water pipelines and solid waste infrastructure.	Many slums still lack toilets and consistent water supply.
Subhadra Yojana	Large-scale DBT rollout; early disbursement to lakhs of women. Enables women to manage household needs, often first-time access to banking tools. Many SHG-linked and urban informal workers (e.g., fish vendors, street sellers) included.	Risk of digital exclusion for elderly women, disabled persons, and undocumented urban poor. Does not include mandatory integration with skilling or livelihood-building programmes. Unclear data on slum-dwelling or migrating women's inclusion. Limited outreach in unrecognised basis. Women without mobile phones or banking literacy cannot participate meaningfully.
Odisha Garima	Coverage across ULBs	Challenge in scale and institutionalisation
MUKTA	High uptake & integration	Sustainability remains a concern
Swayam/Prosper Odisha	Great potential	Needs urban-level implementation and awareness

3.4.3 Policy Gaps: Who Is Missing?

- **Women-led households**: Face specific barriers accessing schemes due to eligibility criteria or limited outreach.

- **Persons with disabilities (PwDs)**: Ill-fitting facilities, lack of targeted programs, and mobility constraints.
- **'Missing middle' households**: Too above poverty line for subsidy-based schemes, yet too vulnerable for mainstream support.
- **Informal workers** (daily wage, seasonal migrants): Often excluded from pensions, health insurance due to unstable employment.
- **Slum dwellers in unrecognised settlements**: Not covered in infrastructure upgrades or credit subsidy schemes.

3.5 City Profile: Summary

Table 7: Summary of the city profile of Puri

Category	Data Pointers	Data
Governance and Finance	Collector and DM	Shri Siddharth Shankar Swain
	Organisation Structure	Puri Municipality is headed by a chairperson, supported by a Vice-Chairman and 30 Councillors
	Political Profile of the City	Puri operates under a municipal governance system with elected representatives, including a Chairperson and Councillors, overseeing urban administration along with elected representatives including Members of Legislative Assembly (MLAs) and a Member of Parliament (MP).
	Government Type	The city follows a municipal governance structure led by elected officials such as the Chairperson and Councillors.
	Legislative Assembly	Puri city falls under the Puri Assembly constituency (Constituency No. 107). The incumbent MLA, as of the 17th Odisha Legislative Assembly, is Sunil Kumar Mohanty from the Biju Janata Dal (BJD), elected in 2024
	Lok Sabha Constituency	Puri is one of the 21 Lok Sabha constituencies in Odisha. The incumbent Member of Parliament, as of the 18th Lok Sabha, is Sambit Patra from

		the Bharatiya Janata Party (BJP), elected in 2024.
	Political Trends (2014-2019-2024)	In the 2019 Lok Sabha elections, Pinaki Misra of the Biju Janata Dal (BJD) narrowly defeated Sambit Patra of the Bharatiya Janata Party (BJP) by a margin of 11,714 votes. The Biju Janata Dal (BJD) has been a dominant political force in Odisha. However, in the 2024 elections, there was a shift with the Bharatiya Janata Party (BJP) gaining prominence in certain constituencies, including Puri.
	Parastatal Agencies Involved	urban governance in Odisha involves various agencies under the H&UD Department, including: • Odisha Urban Infrastructure Development Fund (OUIDF) • Orissa Water Supply & Sewerage Board • WATCO
	Areas of Interest (as per acknowledged gaps and research)	Urban development and infrastructure improvement have been focal points, as evidenced by the Draft Comprehensive Development Plan for Puri-Konark Development Authority
	Urban Housing Budget (₹ Cr)	The Department of Housing and Urban Development in Odisha reported an overall program budget outlay of ₹6,320.30 crores for the fiscal year 2024-25.
	Feasibility of Projects as per Municipal Governance Scenario	The implementation of projects is influenced by the municipal governance structure, with a focus on efficiency in urban infrastructure and service delivery mechanisms
	Approachability	The municipal governance framework emphasises community participation and accountability of Urban Local Bodies (ULBs) towards citizens.
Demographics	Population (2011)	200,564
	Population Growth (calculated)	Based on the 2011 census population of 200,564 and the 2025 estimate of 291,000, the calculated growth rate suggests a significant increase over the 14-year period.
	Number of Slums	46
	Population Estimates 2025 & Projected 2030	2025: 291,000 2030: 334,000
	Existing Physical Infrastructure	**Puri Beach Promenade** – Developed coastline with walkways and lighting. **Puri Railway Station** – Key transport hub for connectivity.

		Stormwater Drainage System – Prevents monsoon flooding. **Puri-Konark Marine Drive** – Scenic coastal highway. **District Hospital & Civic Amenities** – Healthcare and municipal infrastructure.
	Low-income or Informal Population (% and Number of Slums)	Puri Municipality has 46 notified slums with a total population of 34,160 residing in 10,126 households. Approximately 35.13% of Puri's population resides in slum areas.
	Number of Wards	Puri Municipality is divided into 32 wards
Infrastructure	Physical Infrastructure	Puri has undertaken significant infrastructure projects, including a comprehensive sewerage system covering an estimated population of 233,000.
	Green and Blue Infrastructure	Initiatives in Puri, such as those in the Penthakata community, have focused on enhancing water resilience through blue-green infrastructure, including drain repairs and silt traps
	Waste Treatment Infrastructure	9 metric tons of municipal solid waste daily, with about 69% of waste being segregated at the source.
	Water Sources	Groundwater accessed through deep bore wells and surface water from nearby rivers such as the Bhargavi and Daya.
	Major Water Bodies	Chilika Lake, Sara Lake, and the sacred Pancha Tirtha tanks.
	Water Supply Coverage	Puri provides 24/7 piped potable water supply to residents under the 'Sujal - Drink from Tap Mission
	Shortage of Water	Increased demand during peak tourist seasons and potential over-extraction of groundwater
	Recent Innovative Projects	Puri has implemented the 'Sujal – Drink from Tap Mission,' providing continuous potable water supply, and installed around 400 drinking water fountains to reduce plastic waste.
Climate Action	Swachh Survekshan Rank (2021, 2022, 2023)	2022: Puri Municipality secured the 78th position among Urban Local Bodies (ULBs) with more than 1 lakh population
	Climate Action Plan (Yes/No)	Yes
	Heat Action Plan (Yes/No)	Yes

Livelihood & Informal Economy	Informal Economy Contribution (%)	Approximately 92% of the working population in Odisha is engaged in the unorganised sector.
	Percentage of workforce engaged in informal economy	In Odisha, about 92% of workers are part of the unorganised sector. Although exact figures for Puri are not specified, the city's reliance on sectors like tourism, handicrafts, and small-scale industries suggests a substantial informal workforce.

	Key Sectors	Puri's economy is heavily influenced by the following sectors:
		• **Tourism Industry**: Approximately 80% of Puri's economy depends on tourism, primarily centred around the Jagannath Temple and associated festivals.
		• **Handicrafts and Cottage Industries**: The city is renowned for its traditional arts, including:
		  ○ **Appliqué Work**: Notably from Pipili, involving intricate designs on textiles.
		  ○ **Patta-Chitra Paintings**: Traditional paintings depicting mythological themes.
		  ○ **Stone and Wood Carvings**: Artisans produce various decorative and utility items.
		• **Fishing Industry**: Leveraging its coastal location, Puri has a vibrant fishing community, contributing significantly to local livelihoods.

	Number of Informal Settlements / Slums	46
	Recognised vs. Unrecognised Settlements	In 2001, Puri Municipality identified 46 slums: 26 were notified (formally recognized), and 20 were non-authorised (unrecognised).
	Growth Trends in Informal Settlements	Between 2001 and 2014, the slum population in Puri grew by approximately 11%
	Livelihood Support Programs	Odisha Unorganised Workers' Social Security Board (OUWSSB): Established to provide social security and welfare measures to unorganized workers.
	Government Schemes Supporting Informal Workers	**Pradhan Mantri Shram Yogi Maandhan (PM-SYM)**: Voluntary pension scheme for unorganised workers aged 18–40, offering

		₹3,000/month pension after 60 years; contributions start at ₹55/month. **Shram Portal**: National database registering over 28 crore unorganised workers, facilitating access to social security schemes. **PM SVANidhi**: Provides collateral-free working capital loans up to ₹50,000 to street vendors, with over 94 lakh loans amounting to ₹13,422 crore disbursed as of December 2024. **Odisha Urban Wage Employment Scheme**: Launched in 2020 to provide wage employment to urban poor, including informal workers, through labour-intensive public works
	Water Supply Availability	Puri provides 24/7 piped potable water supply to residents.
	Waste and Sanitation Coverage	**Solid Waste Management**: The city generates approximately 9 metric tons of municipal solid waste daily, with about 69% segregated at the source. **Waste Processing Infrastructure**: Puri has established 6 Micro-Composting Centres (MCCs) and 2 Material Recovery Facilities (MRFs) to enhance waste processing capabilities.
	Energy Access	**Current Capacity**: As of December 2024, Odisha's total renewable energy capacity stands at 2,938 MW, with solar power contributing 21% (approximately 617 MW), comprising 508 MW ground-mounted, 58 MW rooftop, and 42 MW off-grid solar capacity. **Future Targets**: Odisha aims to achieve 10.95 GW of renewable energy capacity by 2030, with solar power expected to contribute 7.5 GW of this target. **Puri District Initiatives**: In June 2024, the Odisha government approved a 49.5 MW wind energy project by ONGC Tripura Power Company Ltd in Astaranga, Puri district, as part of its renewable energy expansion efforts.

	Gender and Livelihoods in Informal Sector	Approximately 32% of Odisha's workforce are women, many engaged in informal sectors such as handicrafts and cottage industries.
	Specific Challenges Faced by Women Workers	Challenges include safety concerns, pay gaps, and job insecurity.
	Financial Inclusion for Informal Workers	Odisha Gramya Bank operates 549 branches, with 446 in rural areas, covering 52% of the state's population, facilitating financial inclusion for informal workers.
	Access to Credit and Microfinance	Mission Shakti in Odisha has linked over 3.1 lakh Self Help Groups (SHGs) for bank transactions, achieving 114% of its financial target, thereby enhancing access to credit for informal workers.
	Social Security Schemes (Insurance, Pension, etc.)	The Odisha Unorganised Workers' Social Security Board provides accidental death benefits of ₹4 lakh, natural death benefits of ₹2 lakh, and disability benefits to registered workers.
	Cases of Displacement Due to Urban Projects	Street vendors in Puri were displaced due to the Srimandir Parikrama project, facing delays in promised rehabilitation measures.

4 Data Analysis (Macro)

4.1. Hazard, Vulnerability, Risk Assessment (HVRA)

HVRA integrates physical, social, economic, and institutional risks in a single framework. This is especially relevant for urban poor populations, where risk is not just from hazard exposure but from systemic vulnerabilities (tenure insecurity, poor housing, livelihood fragility). This approach enabled identification of risk areas and priority wards and clusters for programmatic intervention (housing, livelihood support, infrastructure planning).

HVRA flow: Literature Review → GIS Mapping → Vulnerability Index → Community Engagement → Integrated Risk Hotspot Mapping → Final assessment.

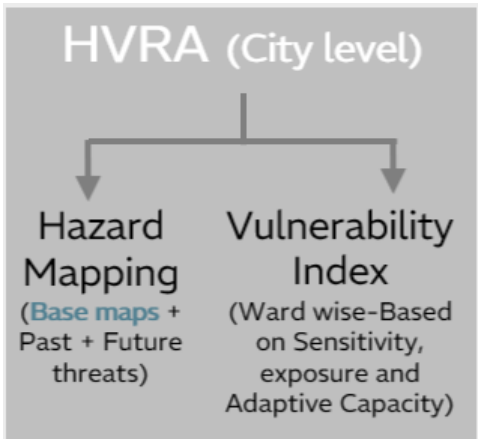


Figure 5: Brief summary of HVRA

4.1.1. GIS Analysis

Base Layers → Overlapping of Layers → Final Analysis Maps

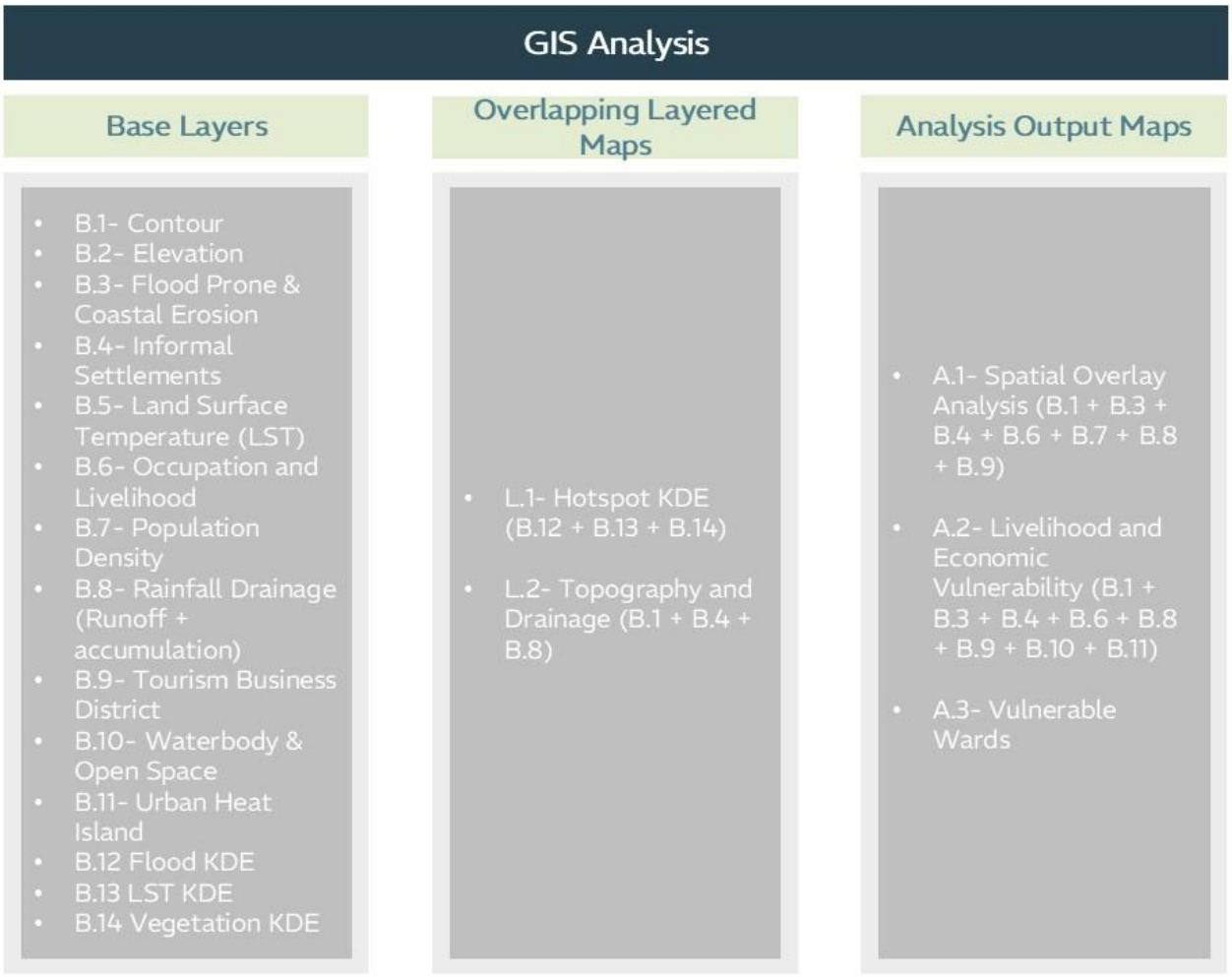


Figure 6: List of Maps for reference

ANALYSIS OUTPUT MAPS

A.1 Spatial Overlay Analysis

A spatial overlay analysis was undertaken using GIS layers that mapped (i) flood-prone and coastal erosion zones, (ii) informal settlements, (iii) population density, (iv) livelihood zones, and (v) elevation (contour data) (refer annexure 10.6 for maps). The objective was to identify intersections between areas of high hazard exposure and socio-economic vulnerability, thereby delineating compounded climate risk zones across the city.

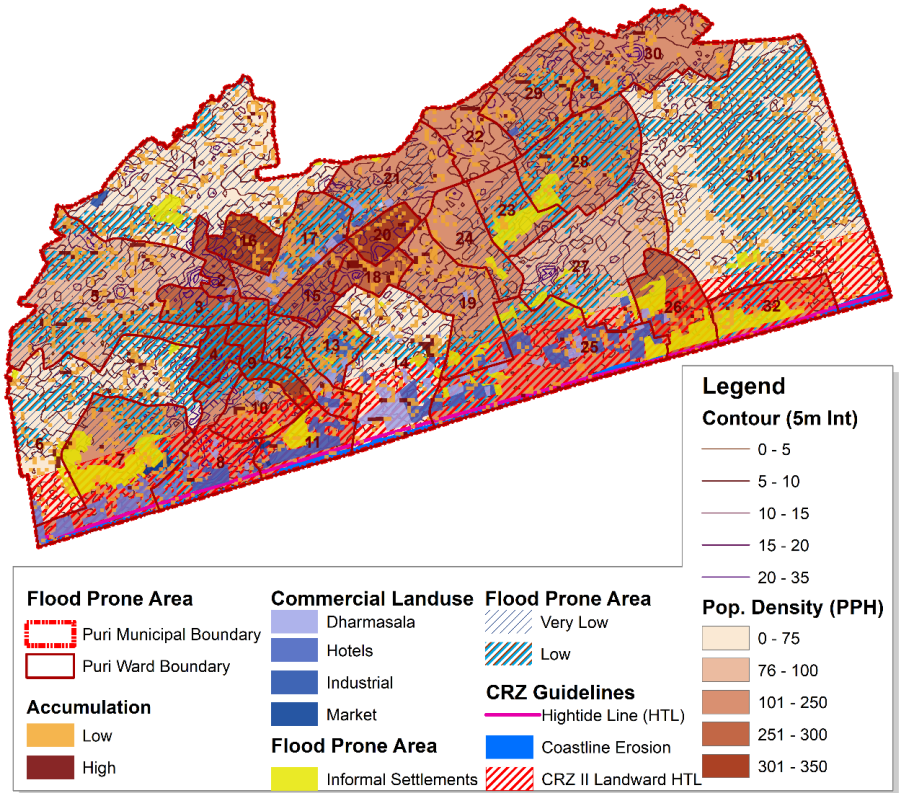


Figure 7: Spatial overlay analysis of Puri, (STS, 2025)

The overlay between flood/erosion zones and informal settlements reveals a stark convergence along the coastal belt, especially in wards 7, 8, 10, 11, 25, 26, and 32. These areas are both ecologically fragile (due to proximity to the coast and low elevation) and socio-economically disadvantaged, hosting dense informal settlements with inadequate infrastructure. Settlements in these areas such as Penthakata and Baliapanda are particularly vulnerable due to both their physical location in flood-prone CRZ zones and their dependence on climate-sensitive livelihoods like fishing and tourism.

When **population density** is overlaid, wards such as 3, 4, 9, 16, and 20 emerge as high-pressure areas, housing large numbers of people per hectare. Many of these are older, congested wards in the city's core, with fragile infrastructure, narrow streets, and insufficient drainage. If affected by flooding, these areas could suffer cascading service failures due to their demographic density.

In terms of **occupational mapping**, sectors such as Dharmashalas, hotels, local markets, and tourism hubs are heavily concentrated along the southern and southeastern coast precisely the zones marked as high-risk for flooding and coastal erosion. This further

amplifies vulnerability, as livelihoods here are not only informal but also reliant on physical presence in high-exposure areas. These include street vendors, daily wage workers, fish processors, auto drivers, and tourism facilitators who cannot afford disruption due to extreme events.

Finally, the **contour map** highlights that many of the informal settlements and key employment clusters are situated at lower elevations, particularly below 10 metres above sea level further increasing their exposure to storm surge, sea-level rise, and waterlogging. This includes vulnerable pockets in wards 7, 11, 14, 23, 25, 26, and 32.

Key Inferences:

- **Wards 7, 10, 11, 25, 26, and 32** represent areas of **compound vulnerability**, where informal settlements, low elevation, high exposure to flooding/coastal erosion, and climate-sensitive livelihoods converge.
- **Tourism and fishing-based livelihoods**, concentrated along the coast, are directly threatened by environmental changes. The spatial clustering of employment sectors in high-risk zones necessitates urgent risk-proofing of these economic corridors.
- Informal settlements in **low-lying areas** with limited infrastructure support and dense populations will likely experience **multiple, compounding shocks** during climate events.
- Spatial analysis reinforces that **climate vulnerability in Puri is not evenly distributed**, and that targeted, ward-level resilience planning must prioritise areas where **hazard exposure overlaps with socio-economic disadvantage**.

A.2 Livelihood and Economy-Based Mapping

The spatial distribution of occupations across Puri, as visualised in the "Occupation and Livelihood" and "Tourism Business District" (TBD) maps, reveals clear economic zones ranging from tourism-dependent corridors, fishing-based coastal belts, to daily-wage informal economies. When overlaid with climate risk maps such as

flood-prone areas, elevation, LST, and informal settlements, it becomes evident that livelihoods in Puri are closely intertwined with environmental vulnerabilities.

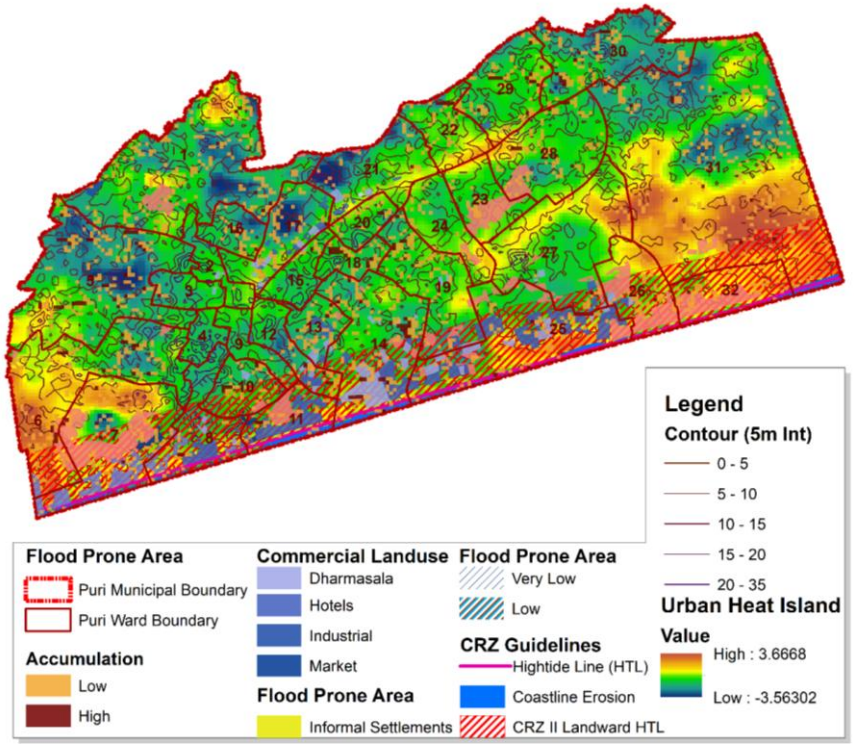


Figure 8: Puri Livelihood and Economy based mapping with climate vulnerability maps (STS, 2025)

1. **Fishing and Coastal Livelihoods (Wards 7, 11, 25, 26, 32):**

    - These wards, particularly Penthakota (Ward 32) and Baliapanda (Ward 7), are highly dependent on fishing and marine-based activities.
    - These zones also overlap directly with coastal erosion areas and CRZ-II zones, making them high-risk for cyclones, tidal surges, and long-term sea-level rise.
    - Livelihood disruptions are frequent post-disaster events like Cyclone Fani, and infrastructure damage (boats, nets, fish drying platforms) is recurrent.

2. **Tourism and Hospitality-Based Livelihoods (Wards 3, 4, 10, 12, 13):**

- The core TBD area (around Wards 3 and 4) houses the Jagannath Temple precinct, hotels, and markets, forming the economic hub.
- These wards show high LST values (above 45°C) and high population density, making them prone to heat stress and congestion.
- Any disruption in tourism (such as post-cyclone recovery delays or extreme heatwaves) immediately impacts street vendors, hotel workers, rickshaw pullers, and shopkeepers, many of whom belong to urban poor categories.

3. **Construction and Daily-Wage Labour (Wards 1, 13, 14, 21, 23)**:
    - These are low-income residential zones with high informal employment in construction, loading-unloading, and sanitation work.
    - These wards coincide with low-elevation, waterlogged zones, identified on the rainfall drainage map, causing repeated flooding and disruption of mobility and work.
    - Poor drainage and housing also lead to health risks and economic shocks for daily-wage earners.

4. **Vending and Street-Based Informal Work (Wards 9, 12, 18, 19, 20)**:
    - These centrally located wards are densely populated, and informal vendors operate along temple roads, bus stands, and public markets.
    - LST map shows these wards as thermal hotspots, and the elevation map reveals many are situated on lower terrain, compounding risks from both heat and waterlogging.
    - Economic activities in these wards are highly vulnerable to climate shocks and need immediate support through shaded vending spaces and emergency income relief.

5. **Overlap with Informal Settlements**:
    - The informal settlement map shows strong overlap with occupational clusters in wards 7, 11, 13, 23, and 32, which also face multiple hazards (heat, flooding, erosion).
    - Unrecognised slums in these areas have minimal legal protection and are thus highly prone to eviction and excluded from welfare schemes, worsening livelihood precarity.

Key Inferences

- **Spatial Economic Risk Zones Identified**: There is a direct spatial correlation between high-risk zones (flood, erosion, heat) and zones of high informal economic activity.
- **Sectoral Vulnerability**:
    - **Fisheries and tourism** are the most climate sensitive.
    - **Daily-wage and informal vendors** are the most economically insecure due to lack of buffers, savings, or job security.
- **Heat and Health Risks**: Wards 7, 10, 13, and 32 emerge as dual-vulnerable to heat stress and poor work conditions, needing urgent cooling and occupational health interventions.
- **Planning Implication**: Climate-resilient livelihood strategies must prioritise spatial vulnerability, especially in urban poor communities concentrated in overlapping hazard zones.
- **Livelihood-Climate Policy Link**: Any future policy or urban programme in Puri must integrate local occupation risk zones into planning, using GIS overlays to prioritise investments and safeguard economic resilience

OVERLAPPING LAYERED MAPS

L.1 Hotspot and Cluster Mapping

To strengthen the spatial understanding of vulnerabilities in Puri, a hotspot and cluster mapping exercise was conducted by overlaying multiple thematic layers: elevation, LST (Land Surface Temperature), rainfall drainage, occupation and livelihood, population density, flood-prone zones, informal settlements, and now, green and blue infrastructure (waterbodies and open space). Kernel density (refer annexure 10.1 for details) estimation and cluster analysis were used to identify zones of compounded vulnerabilities, particularly where environmental stressors intersect with socio-economic fragility.

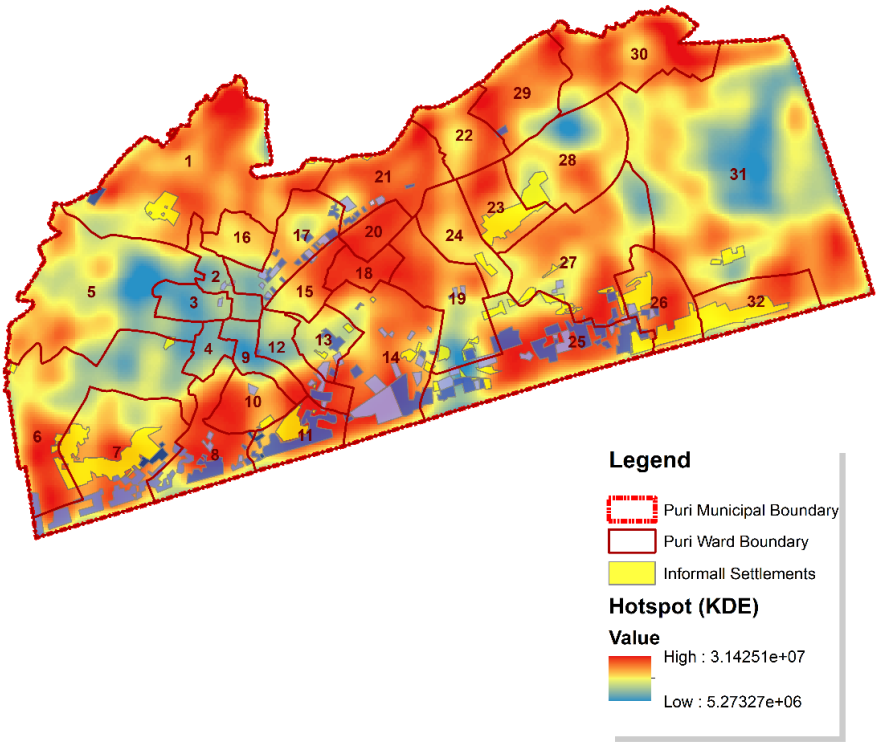


Figure 9: Puri Hotspot (KDE), (STS, 2025)

Key Inferences and Cluster Insights

1. Flood Risk, Low Elevation & Informal Housing Nexus

Wards 7, 10, 11, 25, 26, and 32 consistently emerge as highly vulnerable in multiple datasets. These areas:

- Fall under low elevation (Contour & Elevation maps)
- Lie within or adjacent to coastal erosion and flood-prone zones
- House major informal settlements (e.g., Penthakota in Ward 32, Baliapanda in Ward 7)
- Show limited green cover and water buffering capacity, further increasing runoff and stagnation (as per the Waterbody & Open Space map)

This nexus implies a chronic risk of displacement, waterlogging, and infrastructure failure for thousands of urban poor.

2. Urban Heat Island & Livelihood Stress

The LST map shows extremely high surface temperatures (up to 47°C) concentrated in densely built wards like 3, 4, 9, 10, 16, 20, while the UHI map shows 6, 7, 25, 32, 31, to have higher value which are also home to:

- High population density
- Significant street vending and tourism-based economic activity
- Very limited tree cover or open space (waterbody & vegetation map)
- High-density wards (3, 4, 9, 16, 20), are also extremely sensitive to urban heat stress, health risks, and breakdowns in basic services post-disaster.

This raises health and livelihood risks for daily wage earners and the elderly, suggesting a dire need for climate-resilient infrastructure, shaded public spaces, and heat-action plans.

3. Drainage & Water Accumulation Stress

The Rainfall Drainage map identifies severe runoff accumulation zones in wards 6, 7, 10, 11, 19, 25, 26, 32 especially near informal housing and road infrastructure. Many of these wards also lack adequate green-blue buffers to absorb water, increasing flood retention time.

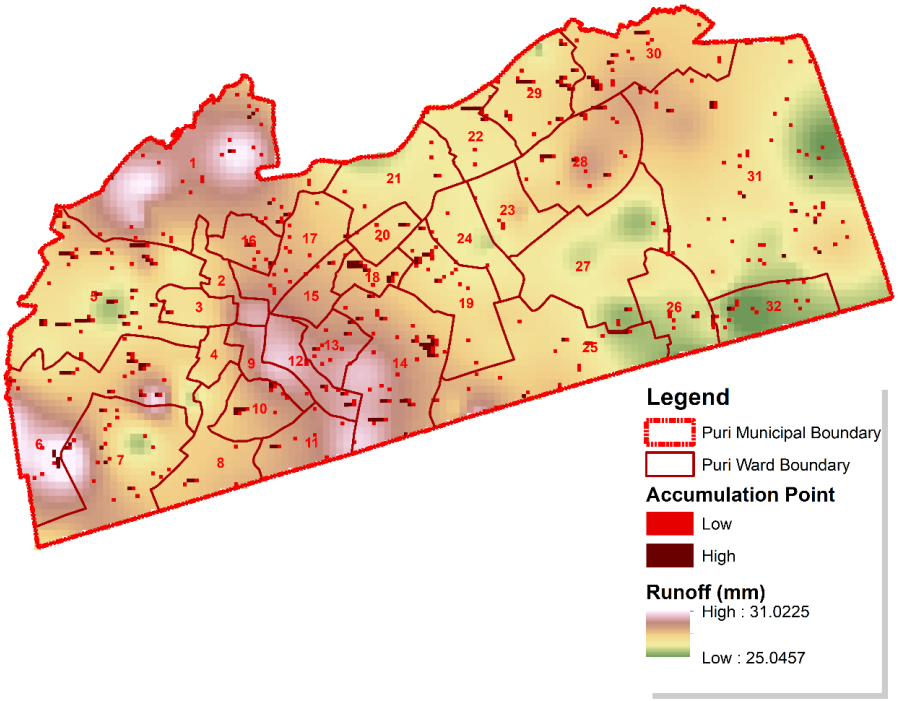


Figure 10: Puri rainfall drainage (Run-off and accumulation points), (STS, 2025)

4. Livelihood and Heritage Vulnerability Clusters

The Occupation and TBD map shows dense market zones, hotels, and dharmshalas in wards 4, 10, 12, 14, 25, 32, intersecting with flood and temperature risk zones. This intersection puts both livelihoods and the tourism economy at high risk.

Similarly, many livelihoods (e.g., fishing in Ward 32, tourism in Ward 10, vending in Wards 4 and 25) are location-sensitive and climate-dependent, intensifying post-disaster economic distress.

5. Blue-Green Infrastructure Gaps

The Waterbody and Open Space map reveals that:

- Wards with highest risk (e.g., 10, 25, 32) have least green or open space to mitigate flood or heat
- Wards like 22, 23, 28, 29 in the northern periphery, despite having more vegetation, are rapidly urbanising and may become vulnerable soon
- This suggests an urgent need to:
    - Preserve and expand waterbodies/green buffers

- Integrate nature-based solutions into urban development

- **Cluster-Level Vulnerability Hotspots Identified**

Cluster	Wards	Risk Factors
Cluster A	7, 10, 11, 25, 26, 32	Flooding, Low Elevation, Informal Settlements, Tourism Dependence
Cluster B	3, 4, 9, 10, 16, 20	High LST, Dense Livelihood Zones, No Open Space
Cluster C	22, 23, 28, 29	Emerging Peri-Urban Risks, Unregulated Expansion, Blue-Green Deficit

L.2 Indundation Vulnerability: Topographic and Drainage Analysis

The topographic and drainage assessment of Puri was carried out using elevation raster data, 1m contour lines, and rainfall runoff and accumulation point mapping. This analysis helped delineate critical low-lying zones, terrain undulations, and poor drainage areas, which are highly correlated with localised flooding and disaster vulnerability, especially for the city's informal settlements.

1. **Topography and Elevation Insights**

- **Elevation Map Findings**: The elevation map of Puri reveals that most central and southern wards (such as Wards 7, 10, 11, 25, 26, and 32) lie at relatively low elevation. These areas form a topographic trough, increasing their susceptibility to water stagnation and urban flooding.
- **High-Risk Wards**: Wards 6, 7, 10, 11, 25, 26, 32 exhibit low elevation profiles and coincide with informal settlements, making them doubly vulnerable.

- **Contour Map**: The contour lines (1m interval) highlight subtle undulations that are otherwise not visible in coarse elevation models. For example, dense clusters in wards like 4, 9, 10, and 13 are in slightly depressed bowls, which can act as natural collection basins during intense rainfall.

2. **Rainfall Drainage and Accumulation Analysis**

   - The Rainfall Drainage Map indicates high runoff accumulation points in wards 6, 7, 10, 11, 25, 26, aligning precisely with low-elevation zones and informal settlements.
   - These areas also demonstrate poor slope gradient, which restricts the natural flow of stormwater, leading to stagnation and prolonged flooding after heavy rain.
   - Wards 19 and 27 show moderate runoff but appear to lack adequate drainage infrastructure, pointing to a latent risk of future flooding, especially under changing rainfall patterns.

3. **Spatial Overlap with Informal Settlements and Drainage Stress**

   When the **informal settlement map** is overlaid on the drainage and elevation layers:

   - A strong spatial correlation emerges between informal housing and flood-prone, low-elevation areas.
   - Settlements in Penthakota (Ward 32), Baliapanda (Ward 7), Dandimala Sahi (Ward 23), and Talabania (Ward 23) are located near accumulation hotspots, with negligible slope-based drainage.
   - These settlements often lack planned stormwater infrastructure, and the compacted ground surfaces further limit infiltration.

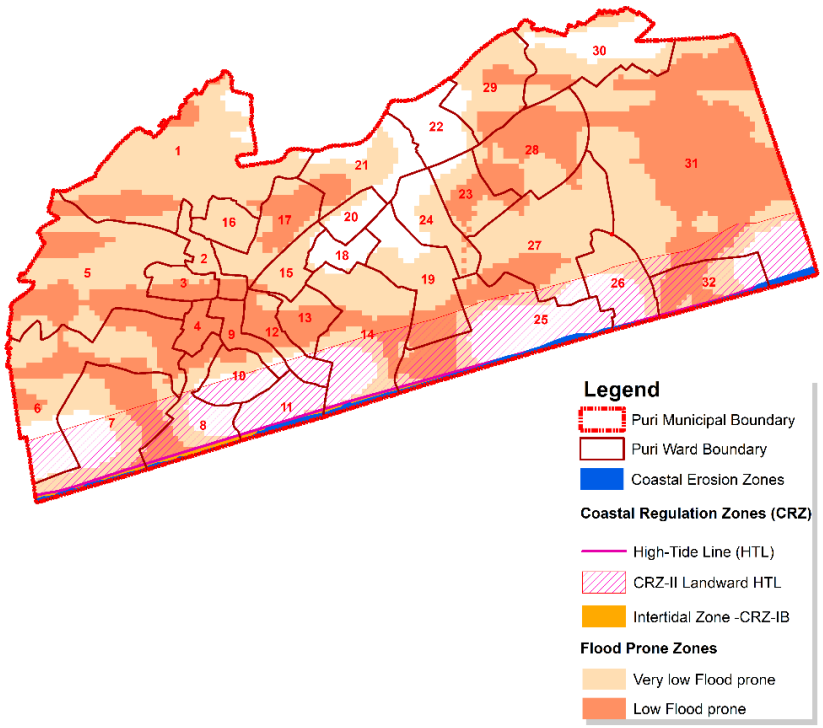


Figure 11: Puri flood prone and coastal erosion zones, (STS, 2025)

Key Inferences

- **Natural Vulnerability of Coastal and Low-Lying Wards**: Coastal wards and the southern-eastern periphery (esp. Wards 7, 10, 11, 25, 26, 32) are inherently prone to flooding due to low elevation, inadequate slope, and proximity to sea-level contours.
- **Drainage Deficit & Built Environment**: Poor slope-based drainage, dense built-up areas, and absence of green cover in informal settlements are major contributors to recurrent waterlogging, especially post-monsoon.
- **Overlay with Socioeconomic Risk**: The convergence of low-lying topography, poor drainage, and poverty means that urban poor communities not only face more frequent flooding but also slower recovery due to lack of resilient infrastructure and services.
- **Early Warning and Infrastructure Priority Zones**: Wards showing both low elevation and high runoff (e.g., 7, 10, 11, 26)

should be prioritised for early warning systems, drainage upgrades, and flood-resilient infrastructure investments.

For base map analysis, refer annexure 10.2

Cumulative GIS Analysis

Table 8: Summary of GIS Analysis (Analysis Output Maps & Overlapping Layered Maps)

Analysis Type	Base Maps Used	Key Focus	High-Risk Areas Identified	Key Insights
1. Spatial Overlay Analysis	Contour, Flood Prone & Coastal Erosion, Informal Settlements, Occupation and Livelihood, Population Density, Rainfall Drainage, Tourism Business District	Hazard exposure + socio-economic sensitivity	Wards 7, 10, 11, 21, 25, 26, 32	Zones with overlapping hazards and informal settlements are highest in vulnerability.
2. Livelihood-Economy Mapping	Contour, Flood prone & Coastal Erosion, Informal Settlements, Occupation and Livelihood, Rainfall Drainage, Tourism Business District, Waterbody and Open Space, Urban Heat Island	Livelihood distribution + exposure	Fishing: Wards 7, 32 Tourism/Vending: Wards 3, 4, 10, 13, 23	Livelihoods in tourism and fishing are highly climate-sensitive and located in hazard-prone areas.
3. Hotspot & Cluster Mapping	Flood KDE, LST KDE, Vegetation KDE	Kernel density estimation of compounding vulnerabilities	Cluster A: Wards 7, 10, 11, 25, 26, 32	Multiple climate and livelihood risks intersect in high-density zones with

Analysis Type	Base Maps Used	Key Focus	High-Risk Areas Identified	Key Insights
				poor infrastructure.
4.Topographic & Drainage Analysis	Elevation, Contours, Drainage, Informal Settlements	Terrain, slope, and runoff analysis	Wards 7, 10, 11, 23, 25, 26, 32	Low elevation + poor drainage = chronic flood risk in informal areas.

4.1.2. Vulnerability Index

As part of the HVRCA process, a Ward-Level Vulnerability Index was developed to quantify climate vulnerability in Puri by combining exposure, sensitivity, and adaptive capacity - the three core dimensions of vulnerability as defined by the IPCC and adopted by national frameworks like NDMA.

This index builds directly on the outputs of GIS mapping and spatial analysis, which identified hazard-prone zones, socio-economic stressors, and environmental risk overlaps. The index added a structured, comparative lens to these spatial layers by scoring each ward across selected indicators and applying a weighted formula:
Vulnerability Index = (Exposure × 0.4) + (Sensitivity × 0.4) + [(5 – Adaptive Capacity) × 0.2]

This helped distil complex spatial and field data into a clear, numeric ranking of vulnerability across wards, allowing targeted identification of the most at-risk urban poor communities. (refer annexure 10.2)

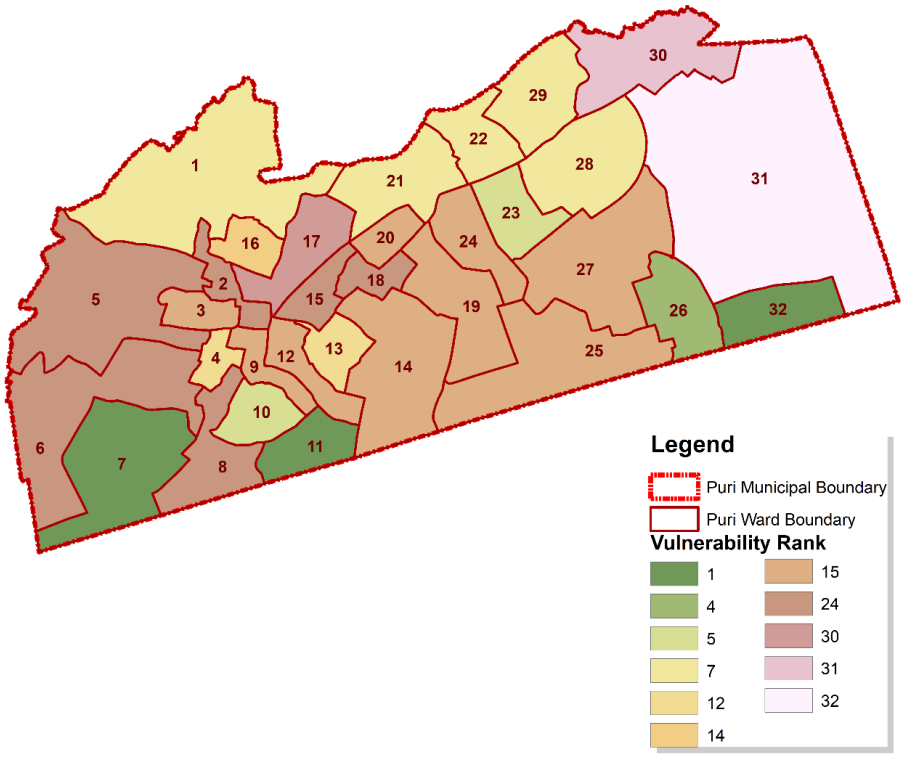


Figure 12: Vulnerability ranking of wards in Puri, (STS, 2025)

Key Inferences from the Vulnerability Index:

- Wards 32, 7, and 11 emerged as most vulnerable, with high exposure to coastal hazards, dense informal settlements, and poor adaptive capacity.
- Sensitivity factors such as livelihood dependence on fishing/tourism and high percentages of children and elderly significantly increased risk.
- Adaptive capacity was found to be weakest in these wards due to limited access to social protection, awareness, and livelihood diversity.

The index acts as a quantitative backbone to the HVRCA framework. While GIS maps gave spatial visibility and community engagement brought in lived experience, the Vulnerability Index allowed comparative, data-driven prioritisation of wards. It ensures that HVRCA is not just descriptive but leads to evidence-based

planning, enabling sharper targeting for risk reduction, resilience planning, and livelihood support programmes.

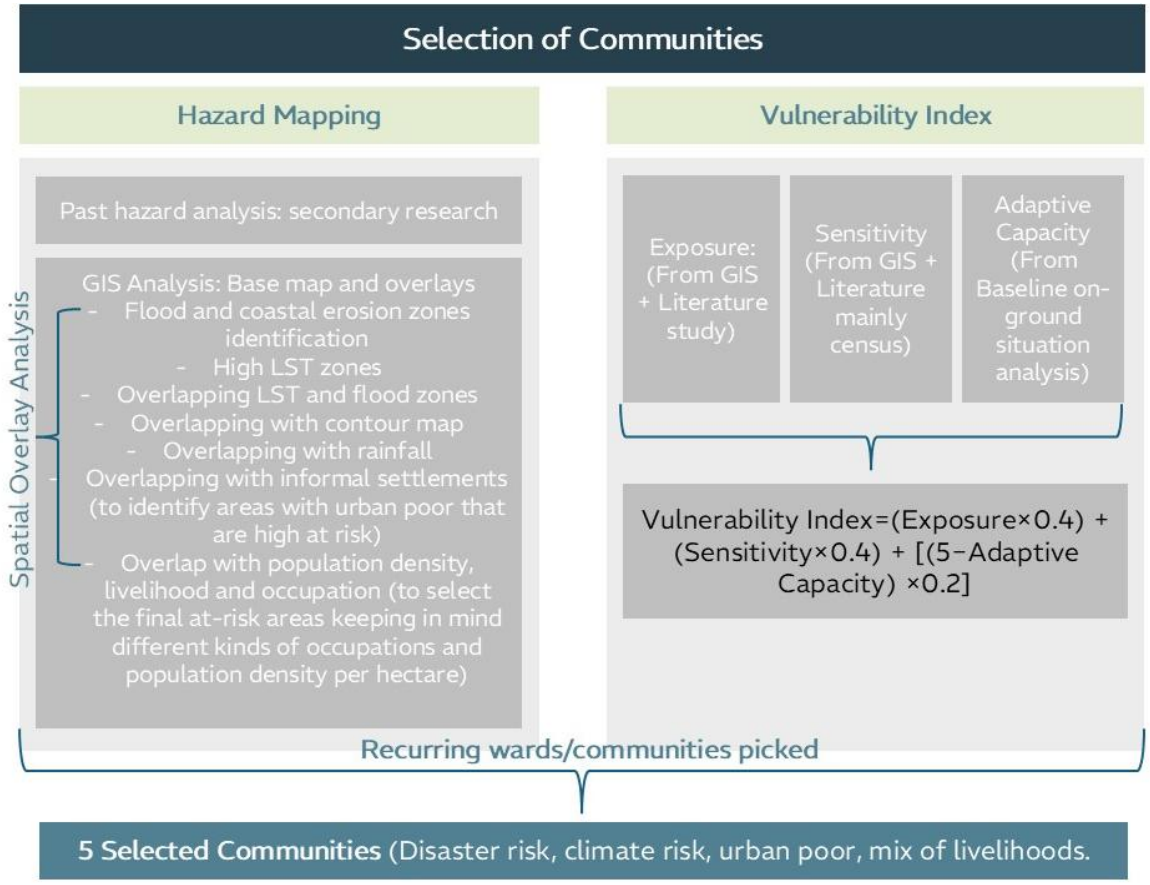


Figure 13: Summary of process of selection of communities

Analysis

The HVRA was carried out using a combination of GIS analysis, ward-level field visits, community FGDs, and stakeholder interviews across Puri's most vulnerable settlements. It incorporated participatory tools such as seasonal calendars, and hazard mapping to capture local knowledge, with an emphasis on gender-sensitive and livelihood-linked vulnerabilities. These findings were triangulated with secondary data and institutional insights to build a comprehensive picture of risks and coping capacities.

Table 9: Conclusion of HVRA of Puri city

Hazard	Causes	Frequency	Affected Communities	Impacted Livelihoods
Cyclones	- Formation of low-pressure systems over the Bay of Bengal. - Intensification due to warm sea surface temperatures and favourable atmospheric conditions.	**1-2 per year** (Severe cyclones every **3-5 years**)	- **Coastal Residents**: Property damage, displacement, and loss of life. - **Fishing Communities**: Loss of boats, gear, and reduced fishing days. - **Urban Poor**: Live in vulnerable housing, facing higher risks during storms. - **Tourists and Pilgrims**: Face evacuation and disrupted travel plans.	- **Fisheries**: Destruction of boats and equipment leads to income loss. - **Agriculture**: Saltwater intrusion and crop damage affect farmers. - **Tourism**: Damage to infrastructure and decreased tourist arrivals impact earnings. - **Small Businesses**: Property damage and reduced customer base.
Floods	- Heavy monsoon rains. - Overflowing rivers, especially the Mahanadi. - Release of water from upstream dams.	**Annually** (Peak risk during monsoon)	- **Residents in Low-Lying Areas**: Face property damage and health risks. - **Farmers**: Experience crop submersion and soil degradation. - **Urban Poor**: Live in areas with inadequate drainage, leading to prolonged waterlogging.	- **Agriculture**: Crop losses due to submersion and soil erosion. - **Livestock Farming**: Loss of animals and fodder. - **Local Markets**: Disruptions in supply chains affect vendors and consumers.
Heatwaves	- Prolonged periods of high temperatures. - Atmospheric conditions leading to sustained heat.	**Every Summer (March-June)**	- **Elderly and Children**: More susceptible to heat-related illnesses. - **Outdoor Workers**: Laborers, farmers, and street	- **Agriculture**: Heat stress affects crop yields and livestock health. - **Construction**: Workers face reduced

Hazard	Causes	Frequency	Affected Communities	Impacted Livelihoods
			vendors face increased health risks. - **Urban Poor**: Limited access to cooling facilities exacerbates vulnerabilities.	productivity and health risks. - **Street Vendors**: Decreased foot traffic leads to reduced sales.
Droughts	- Insufficient rainfall during monsoon seasons. - Over-extraction of groundwater resources.	**Once every 5-7 years**	- **Farmers**: Depend on consistent rainfall for crops. - **Rural Communities**: Rely on local water sources for daily needs.	- **Agriculture**: Crop failures lead to financial distress. - **Animal Husbandry**: Scarcity of water and fodder affects livestock.
Storm Surges	- High-intensity cyclones causing sea levels to rise temporarily.	**During every major cyclone**	- **Coastal Communities**: Experience flooding and erosion. - **Fishing Villages**: Infrastructure and homes are at risk.	- **Fisheries**: Damage to coastal infrastructure hampers operations. - **Tourism**: Beach erosion and property damage deter visitors.
Salinity Intrusion	- Sea-level rise. - Over-extraction of freshwater, reducing river flows.	**Gradual but worsening annually**	- **Agricultural Communities**: Rely on freshwater for irrigation.	- **Agriculture**: Soil salinity reduces crop yields. - **Aquaculture**: Freshwater species cultivation becomes challenging.
Erosion	- Strong wave action during storms. - Human activities disrupting natural sediment flow.	**Annually (Monsoon & Cyclone seasons)**	- **Coastal Residents**: Loss of land and property. - **Tourism Operators**: Beaches are key attractions.	- **Tourism**: Beach loss affects tourist arrivals. - **Real Estate**: Property values decline in vulnerable areas.

Hazard	Causes	Frequency	Affected Communities	Impacted Livelihoods
Waterborne Diseases	- Stagnant water post-flooding. - Contaminated water sources.	**Seasonal (Post-monsoon & Flood events)**	- **Children and Elderly**: More susceptible to infections. - **Low-Income Households**: Limited access to clean water and healthcare.	- **Healthcare**: Increased patient load strains resources. - **Workforce**: Illness reduces productivity across sectors.

5 Study Area (Micro)

To identify the study area, a multi-step spatial analysis was conducted using both hazard mapping and social vulnerability indicators. As floods, cyclones and heat waves are the biggest threats to the city, flood-prone zones were delineated using historical data from NRSC, OSDMA, and NDMA, and these were overlaid with satellite-based Land Surface Temperature data to map heat-stressed areas. Wards experiencing both high flood risk and heat exposure were shortlisted, and this spatial data was further layered with the location of informal settlements. This helped pinpoint urban clusters where climate hazard intersects with social and infrastructural vulnerability.

A Climate Vulnerability Index was then developed to rank wards based on three key parameters: exposure (40%), sensitivity (40%), and adaptive capacity (weighted inversely at 20%). This index allowed a systematic classification of wards into very high, high, medium, and low vulnerability categories. Additionally, spatial livelihood mapping was carried out to understand the nature of occupations practiced by residents in the vulnerable zones. These included fishing, daily wage labour, informal vending, construction work, and sanitation services, all of which are highly sensitive to climate shocks and lacking in formal social protection mechanisms.

Based on this analysis and consultations with the local partner organisation SPANDAN, five communities were selected for in-depth fieldwork: Matitota (wards 1 and 21), Baliapanda (ward 7), Dandimala Sahi and Talabania (ward 23), and Penthakota (ward 32). These communities represent a diversity of urban poor clusters in terms of geography, exposure type, housing condition, and livelihood pattern. Penthakota, for instance, is a coastal fishing village frequently hit by cyclones, while Matitota and Talabania are

low-lying informal settlements affected by waterlogging and heat stress. The selected wards are densely populated with large informal settlements, many of which are decades old and house migrants from within and outside Odisha. Most households are engaged in informal, climate-sensitive livelihoods

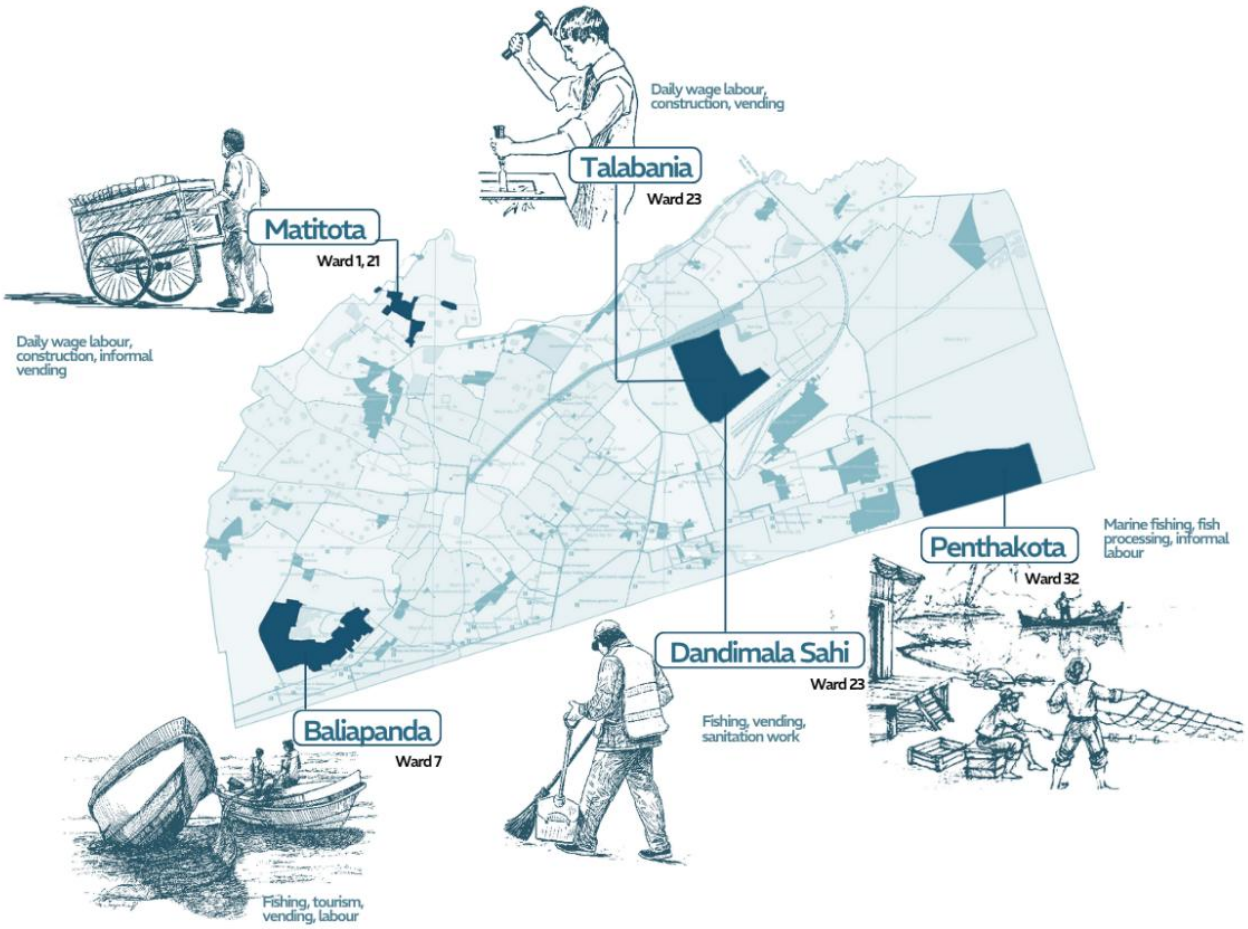


Figure 14: Pictorial depiction of the selected communities

Table 10: Details of the selected communities

Ward No.	Community	Primary Livelihoods
1, 21	Matitota	Daily wage labour, construction, informal vending
7	Baliapanda	Fishing, tourism, vending, labour
23	Dandimala Sahi	Fishing, vending, sanitation work
23	Talabania	Daily wage labour, construction, vending
32	Penthakota	Marine fishing, fish processing, informal labour

To ground the study in lived realities, household surveys were conducted using a purposive-random approach. A total of 130 household surveys were conducted across five of the most climate-vulnerable urban poor communities in Puri, with an average of 25–30 surveys per community. Standard practice in community-based qualitative and mixed-method assessments is to target 20–30 households per community, especially where detailed variables like livelihoods, housing, gender, services, and disaster history are being studied (Similar studies by UN-Habitat, ISET, and NIUA in urban India have adopted sample sizes of 20–30 households per ward/community in vulnerability and resilience studies where the goal is insight generation rather than statistical estimation). This size allows for pattern detection, triangulation with FGDs, and comparative analysis without compromising field accuracy.

This sample size was carefully chosen based on a combination of representativeness, feasibility, and qualitative depth, in line with the objectives and scope of a vulnerability assessment study.

These were selected across these communities, ensuring representation across gender, age, occupation, housing type, and access to services. Women-headed households, migrant families, and persons with disabilities were purposively included to capture intersectional vulnerabilities. The data collected captured not just material losses but also social and emotional dimensions of risk and resilience.

Alongside the surveys, one Focus Group Discussion (FGD) was conducted in each community. Participants were selected using a stratified inclusive approach to reflect diversity in age, gender, occupation, and disability status. While some FGDs had a higher number of women participants due to men being away for work, the discussions provided rich insights into community perspectives on climate risks, livelihood challenges, access to services, and coping strategies.

In summary, the study area selection followed a rigorous spatial and participatory methodology. It ensured that the most climate-vulnerable communities who also face deep livelihood insecurities were brought to the forefront. The findings from these communities now serve as the empirical basis for developing targeted, locally grounded recommendations on resilience building in Puri.

Table 11: Summary of location type and primary hazard of the selected communities

Community	Location Type	Primary Hazard
Penthakata	Coastal Fishing Hamlet	Cyclones, Coastal Erosion, Storm Surge, Heat
Matitota	Urban Slum, Inland	Flooding, Drainage Failure, Heat Stress
Talabania	Near Highway & Railway	Flash Flooding, Eviction Threats
Dandimala Sahi	Low-lying, Urban Core	Waterlogging, Health Hazards
Baliapanda	Coastal, Immigrant Zone	Erosion, Sea-Level Rise, Livelihood Loss

This risk-based diversity ensures a well-rounded understanding of urban vulnerability. (refer annexure 10.2 for detailed process)

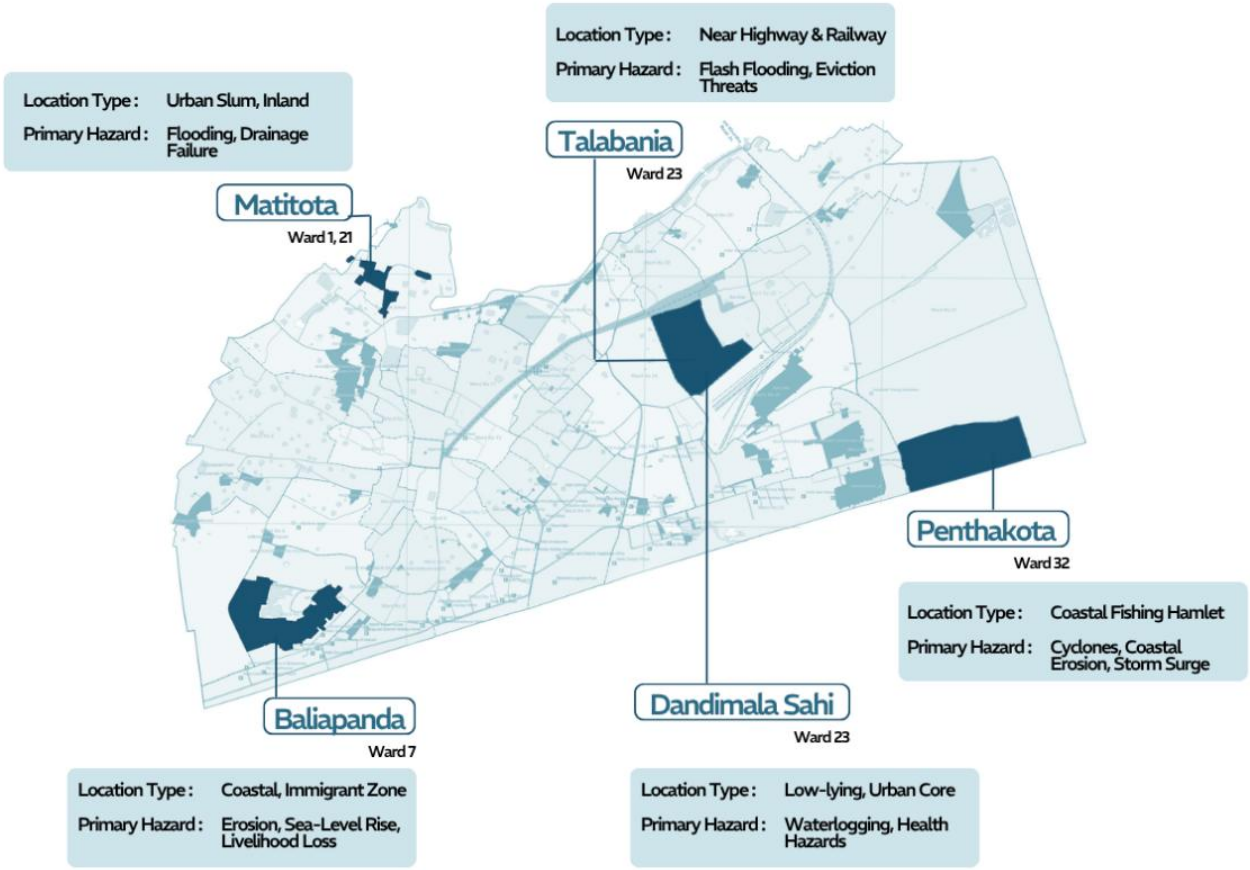


Figure 15: Pictorial depiction of the communities with location and hazards

5.1. Selected Communities:

A mixed approach was taken to select the most vulnerable communities for surveys and FGDs (refer annexure 10.2 for details).

1. **Penthakata (Fishing Community – Coastal Erosion & Cyclones) Ward 32**
   - Disaster Risks: High exposure to cyclones, coastal erosion, and storm surges, heat stress.
   - Livelihood Risks: Fishing-dependent families lose boats, nets, and income due to extreme weather. Labour as well.
   - Affected during Fani (ward 26 and 32)

2. **Matitota (Slum Settlement – Flooding & Waterlogging) Ward 21 & 1**
   - Disaster Risks: Severe waterlogging during monsoons, poor drainage increases flood risks, high temperatures.
   - Livelihood Risks: Many residents are daily wage earners in construction and tourism, vulnerable to job losses during climate events.

3. **Talabania (Slum Near Railway & NH 203 – Flooding & Eviction Risks) Ward 23**
   - Disaster Risks: Frequent flooding due to poor stormwater management, high eviction risks.
   - Livelihood Risks: Street vendors, transport workers, and small business owners struggle with instability and displacement.

4. **Dandimala Sahi (Low-Lying Slum – Health Risks & Livelihood Uncertainty) Ward 23**
   - Disaster Risks: Poor sanitation and water stagnation increase disease outbreaks during floods.
   - Livelihood Risks: Many residents are domestic workers, sanitation workers, or rickshaw pullers, facing economic insecurity.

5. **Baliapanda (Immigrants from other cities and states-Urban slum) 7**
    - Disaster Risks: Coastal erosion, rising sea levels, loss of fish due to ecosystem changes.
    - Livelihood Risks: Seasonal income, frequent damage to boats, high dependence on natural conditions, Tourism.

5.2. Data Snapshot from Survey

Particulars	DANDIMALA SAHI	TALABANIA	PENTHAKOTA	BALIAPANDA	MATITOTA
DEMOGRAPHICS					
Female-Headed HH (%)	34%	30%	77%	65%	65%
Elderly Members (>60 yrs) (%)	40%	44%	42%	35%	Not Specified
HOUSING					
Kutcha/Temporary (%)	59%	59%	81%	74%	90%
Tenure Insecurity (%)	Not Specified	Not Specified	58% Encroached	39% Encroached	1 HH Encroached
INCOME & SAVINGS					
Low Income (%)	78% (≤₹12k/mo)	85% (≤₹9k/mo)	94% (Primary only)	78% (Primary only)	100% (Primary only)
No Savings (%)	81%	63%	100%	96%	85%
Formal Banking Access (%)	Not Specified	22%	16%	26%	Not Specified
LIVELIHOODS					
Primary Occupation (%)	69% Daily Wage	74% Daily Wage	87% Fishing	78% Daily Wage	95% Daily Wage
Cyclone Work Stoppage (%)	53%	37% (Disruption)	68%	65%	100%
Heatwave Work Impact (%)	31%	41% (Income Loss)	52%	30%	60% (Cannot work)
INFRASTRUCTURE					
Frequent Power Cuts (%)	59%	63%	61%	52%	60%
Firewood/Kerosene Use (%)	47%	41%	45%	48%	30% (Firewood)
Lack Toilets/Open Defecation (%)	Not specified	Not specified	74%	39%	Not specified
AID & AWARENESS					
Aid Bias/Corruption (%)	44%	48%	68%	57%	23%
Lack Disaster Training (%)	Not specified	70%	Not specified	Not specified	90%
COPING CAPACITY					
NGO Reliance (Spandan) (%)	Strong Presence	63%	71%	65%	Strong Network

6 Livelihood Assessment

6.1 Socioeconomic Conditions of Urban Poor

This section provides a detailed look at each of the five neighbourhoods based on the data presented from the household surveys focusing on socioeconomic conditions, livelihoods, and barriers to resilience. The data is from the sample data collected through household surveys and FGDs (refer annexure 10.3 & 10.4 for details.) [4]

6.1.1 Ward 23 (Talabania)

1. Socioeconomic Conditions of Urban Poor

Data:

- Demographics: 70% male-headed households, 30% female-headed. 44% have elderly members (>60 years).
- Housing: 59% live in *kutcha* or temporary shelters.
- Income & Savings: 85% earn ≤₹9,000/month. 63% have no savings.
- Financial Inclusion: Only 22% access formal banking.

[4] Urban poor community level latest demographics, and socio-economic data is not available.

> No awareness about government health schemes
> – Nerupamma Tappa.

While predominantly male-headed, the significant minority of female-headed households (30%) are noted as facing higher vulnerability (e.g., resorting to begging). The combination of low income, lack of savings, and poor housing creates widespread baseline vulnerability, particularly heightened for the 44% of households caring for elderly members with potential climate-linked health risks.

2. Key Livelihood Sectors & Employment Trends

> Monthly income ₹9,000, no savings
> – Prithama Ghosh.

Data:

- Primary Occupation: 74% rely on daily wage labour. 11% resort to begging (often linked to age/disability).
- Climate Impact: 37% report work disruption during cyclones/heatwaves.

The heavy reliance on daily wage labour makes income highly susceptible to weather disruptions. Heatwaves directly impact the ability to perform outdoor work, leading to immediate income loss for a significant portion of the community. The presence of begging as a notable income source highlights extreme destitution for some.

3. Vulnerabilities & Barriers to Economic Resilience

> Last cyclone took my nets. Still in debt replacing them
> – Chepala Kashiratnam.

Data:

- Aid Issues: 48% report corruption or inequality in aid distribution ("Only certain communities' benefit").
- Healthcare Access: 30% must travel over 3 km for healthcare services.
- Awareness: Lack of awareness about government schemes is noted.

Significant perceived corruption in aid distribution undermines trust and effectiveness of support systems. Poor access to healthcare (distance) likely delays treatment and increases

costs, further straining limited finances. Lack of awareness prevents households from accessing potentially beneficial government programs.

6.1.2 Ward 23 (Station Road / Dandimala Sahi)

> Heat gives headaches, but we must fish or starve
> – Osipilli Appalasha.

1. Socioeconomic Conditions of Urban Poor

Data:

- Demographics: 63% male-headed, 34% female-headed, 1 transgender-headed. 40% have elderly members (>60 years). 59% have 3-5 members.
- Housing: 59% live in *kutcha* or temporary shelters; 28% in semi-pucca.
- Income & Savings: 78% earn ≤₹12,000/month. 81% have no savings.

Similar to Talabania, fragile housing and a near-total lack of savings (81%) dominate the socioeconomic landscape. Even though the income threshold noted is slightly higher (≤₹12k vs ≤₹9k), the overwhelming lack of financial buffer indicates extreme precariousness. The presence of elderly members in 40% of households adds a layer of health vulnerability.

> Monthly income ₹5,000, no savings
> – Pintu Nayak.

2. Key Livelihood Sectors & Employment Trends

Data:

- Primary Occupation: 69% rely on daily wage labour. 9% are street vendors.
- Climate Impact: 53% report income loss during cyclones ("Complete stoppage of work"). 31% cite heatwaves as a barrier ("Cannot work outside").

Cyclones have a devastating impact, causing majority income loss and destroying crucial small business assets (like vending carts). The lack of savings makes replacing these assets nearly impossible without external aid or debt. Heatwaves add a chronic stressor, reducing work capacity for almost a third of the community.

> TV and phone warnings stop just when storm comes- need ways to keep getting news

Lost vending cart in cyclone, no money to rebuild
– Buli Mani Das.

3. Vulnerabilities & Barriers to Economic Resilience

Data:

- Aid Issues: 44% report biased aid distribution ("Only certain communities' benefit").
- Healthcare Access: 25% travel >1 km for healthcare.
- Awareness: Lack of awareness about government health schemes is noted.

Perceived bias in aid distribution affects a large portion (44%), hindering equitable recovery. While healthcare access distance seems slightly better than in Talabania (>1km vs >3km), lack of awareness about *health* schemes specifically points to a critical information gap impacting well-being and potential financial protection.

6.1.3 Ward 32 (Pentakota)

We eat only if we catch fish that day
– Koviri Nagamani.

1. Socioeconomic Conditions of Urban Poor

Data:

- Demographics: 77% female-headed households. 42% have elderly members (>60), some are primary earners. 45% have 5+ members.
- Housing: 81% live in *kutcha* or temporary shelters. 58% lack legal land ownership ("Encroached").
- Income & Savings: 94% rely solely on primary income. 100% have no savings.
- Financial Inclusion: Only 16% use formal banking; 0% access credit.

Our hut washes away every cyclone season
– Arjili Chittamma.

This ward exhibits extreme vulnerability markers: exceptionally high female-headed households, overwhelming reliance on single income sources, total absence of savings, very poor housing quality, and significant tenure insecurity. The lack of land ownership adds a major risk of displacement. The complete lack of savings and credit access offers zero financial flexibility or buffer against shocks.

> No savings; we eat only if we get work that day
> – Pramila Mallick.

2. Key Livelihood Sectors & Employment Trends

Data:

- Primary Occupation: 87% depend on fishing.
- Climate Impact: 68% experience work stoppage during cyclones. 52% cannot work during extreme heat (reducing earnings 30-50%). 84% face asset loss (boats, nets) during cyclones.

The near-total dependence on fishing makes the community's economy exceptionally sensitive to both cyclones (asset loss, inability to go to sea) and heatwaves (reduced fishing times/capacity). The quote "must fish or starve" starkly illustrates the lack of alternatives and the direct link between climate, work, and basic survival. Asset loss translates directly into debt due to the lack of savings.

> Our thatch roof flies off every cyclone season
> – Jamunna Barik

3. Vulnerabilities & Barriers to Economic Resilience

Data:

- Aid Issues: 68% report exclusion from relief or corruption ("Only leaders' relatives get help").
- Healthcare Access: 100% travel >3 km to clinics. 42% cannot afford treatment.
- Education: 35% have children missing school to supplement income (child labour).

Extremely high levels of perceived aid corruption (68%) severely undermine external support. Universal poor access to healthcare (distance and cost) creates significant health risks. The prevalence of child labour as a coping mechanism highlights intergenerational poverty transmission, sacrificing future opportunities for immediate survival needs, often triggered by climate shocks.

6.1.4 Ward 7 (Baliapanda)

> My son quit school to fish after the cyclone
> – Dailipilli Satyavathi.

1. Socioeconomic Conditions of Urban Poor

Data:

- Demographics: 65% female-headed households. 35% have elderly members (>60). 30% have 5+ members.
- Housing: 74% live in *kutcha* or temporary shelters. 39% are encroachers (lack legal tenure).
- Income & Savings: 78% rely solely on primary daily wage income (0% secondary income). 96% have no savings.
- Financial Inclusion: 26% use formal banking.

High prevalence of female-headed households combined with reliance on single, unstable income sources (daily wage) and almost no savings (96%) creates significant vulnerability. Housing is poor for the majority, and lack of tenure for 39% adds insecurity. The quote from Pramila Mallick echoes the precarious daily existence seen elsewhere.

> Women struggle the most after cyclones- cooking, water, even toilets are hard; relief must reach us all

2. Key Livelihood Sectors & Employment Trends

Data:

- Primary Occupation: 78% rely on daily wage labour.
- Climate Impact: 65% report work stoppages during cyclones. 30% cite heatwaves as disruptive. 57% report asset loss (tools, etc.) during cyclones.

Similar to other daily wage-dependent wards, livelihoods are highly susceptible to climate events. Cyclones cause widespread work stoppage and asset loss, impacting not just labourers but also small businesses like tea shops. Recovery is slow due to lack of capital, as highlighted by the three-month rebuilding time.

> My son fishes instead of studying after cyclones
> – Gangiri Yarama

3. Vulnerabilities & Barriers to Economic Resilience

Data:

- Aid Issues: 57% report exclusion from relief or corruption ("Only leaders' kin get help").
- Healthcare Access: 100% travel >1 km to clinics. 39% cite unaffordable costs.
- Education: 26% have children missing school to supplement income (child labour).

High levels of perceived aid corruption (57%) persist. While distance to healthcare (>1km) is less extreme than Pentakota, universal travel need and unaffordability for 39% remain major barriers. Child labour as a coping strategy, particularly post-disaster, is a significant concern, hindering long-term development.

6.1.5 Ward 21 and 1[5] (Maltitota)

> Last cyclone ruined my tea shop; took 3 months to rebuild
> – Sukantha Pradhan.

1. Socioeconomic Conditions of Urban Poor

Data:

- Demographics: 65% female-headed households. 70% have young children (0-5 years).
- Housing: 90% live in *kutcha* homes. High home ownership (100%, though 1 household encroached).
- Income & Savings: 100% rely solely on primary daily wage income. 85% have no savings (15% minimal).
- Health Access: 80% access govt healthcare within 1-3 km; 20% travel >3 km to private facilities.

This ward combines high female headship with a large number of young children, suggesting significant childcare burdens potentially impacting women's work capacity. Despite high home ownership, the extremely poor quality of housing (90% kutcha) offers little protection. Near-universal reliance on daily wages and lack of savings mirror vulnerabilities seen elsewhere.

[5] The community Maltitota extends from ward 21 to ward 1. A slight part of the community lives in ward 1 as well, hence both the wards referred.

2. Key Livelihood Sectors & Employment Trends

Data:

- Primary Occupation: 95% depend on daily wage labour.
- Climate Impact: 100% experience complete work stoppage during cyclones. 60% report "cannot work outside" during heatwaves.

The dependence on daily wage labour is near total here (95%). Vulnerability to climate shocks is extreme, with cyclones halting *all* work, and heatwaves significantly impacting 60% of the workforce. This suggests near-complete economic paralysis during major climate events.

> We take loans to repair, and every time, the debt gets bigger. Give us a way to work, not just a relief package

3. Vulnerabilities & Barriers to Economic Resilience

Data:

- Aid Issues: 15% report bias; 30% report unfair compensation ("only certain communities benefit").
- Financial Access: 100% lack access to credit/microfinance.
- Education: 40% cite financial constraints for children not attending school.
- Awareness: 90% lack awareness about government schemes. 90% lack disaster training.

While reported aid bias (15-30%) seems lower than in some other wards, the complete lack of credit access is a major barrier to self-recovery or investment. Extremely low awareness (90%) about schemes and disaster preparedness severely limits the community's ability to leverage external support or mitigate risks effectively. Financial constraints are a major driver for children missing school (40%).

> No awareness about schemes (repeated in 90% of responses).

6.2 Key Livelihoods Comparison and Emerging Concerns

The survey data reveals distinct livelihood clusters across wards, with **daily wage labour** emerging as the most common occupation (reported by **~85% of households**). However, significant variations exist based on geographic location, migration history, and access to resources.

Table 12: Ward wise/community wise summary of key livelihood comparison and observations

Ward No.	Primary Occupation (Frequency)	Secondary Income Sources (if any)	Key Observations
1	Daily Wage Labour (72%), Fishing (18%), Street Vending (10%)	Minimal secondary income (5% report street vending)	High dependence on informal labour; fishing concentrated in coastal hamlets.
7	Daily Wage Labour (65%), Tourism-related work (20%), Construction (10%), Fishing (5%)	Street vending (15%), Domestic Work (5%)	Tourism-linked livelihoods near beaches; some households diversify with construction.
21	Daily Wage Labour (70%), Fishing (15%), Street Vending (10%), Tourism (5%)	None reported	Coastal fishing communities with some tourism-based income.
23	Daily Wage Labour (75%), Fishing (10%), Street Vending (8%), Construction (7%)	Domestic Work (12%), Street Vending (8%)	Most diversified ward, with some households engaged in multiple informal sectors.
32	Fishing (55%), Daily Wage Labour (40%), Street Vending (5%)	None reported	Strong fishing-based economy; some labour migration from Andhra Pradesh.

Please note: these numbers are derived from the 130 household surveys conducted.

6.2.1 Key Trends & Disparities

Informal Labour Dominance: Across all wards, **daily wage labour** (construction, agriculture, menial work) is the most common occupation, reflecting economic precarity.

Geographic Specialisation:

- **Wards 21, 23, 32**: Higher fishing activity due to proximity to water bodies (~20-55% of households).
- **Ward 7**: Tourism-related work (20%) is more prevalent, likely due to proximity to tourist hubs.

Gender Disparities:

- Women are more likely to engage in **domestic work, street vending, or unpaid family labour** (e.g., in fishing households).
- Men dominate **fishing, construction, and skilled labour**.

- **Secondary Income Gaps**: Only **~15% of households** report secondary income sources, indicating high vulnerability to economic shocks.

6.2.2 Migration & Livelihood Shifts

Migrant Households (Wards 1, 32): Often engaged in fishing or labour-intensive work, having relocated due to **climate disasters (cyclones, erosion) or livelihood loss** in Andhra Pradesh.

Non-Migrant Households (Wards 7, 23): More likely to have stable but low-paying occupations (e.g., tourism, street vending).

6.2.3 Policy & Intervention Insights

1. **Diversification Needed**: Given the over-reliance on daily wage labour, skill development (e.g., handicrafts, small trade) could reduce vulnerability.
2. **Fisherfolk Support**: Wards 21, 23, and 32 need disaster-resilient fishing gear and market access to stabilise incomes.

3. **Women's Economic Inclusion**: Only ~30% of women report independent income; expanding microfinance and self-help groups (like Spandan) could help.
4. **Tourism Potential**: Ward 7 shows nascent tourism-linked livelihoods; local homestays or artisan markets could be further developed.

6.2.4 Data Limitations & Further Research

- **Missing Income Data**: Many households did not report exact earnings, making income stratification difficult.
- **Seasonal Variations**: Fishing and tourism incomes fluctuate; longitudinal data would improve accuracy.

6.3 Insights- Vulnerabilities & Barriers to Economic Resilience

The data reveals a landscape of precarious livelihoods across the five wards, characterised by a heavy reliance on daily wage labour and significant vulnerability to climate-related shocks.

6.3.1 Key Issues and Insights:

- **Precarious Employment**: A substantial majority in each ward depend on daily wage labour: Talabania (74%), Dandimala Sahi (69%), Baliapanda (78%), and Maltitota (95%). This dependence creates hand-to-mouth conditions, as illustrated by the quote from Pramila Mallick in Baliapanda: "No savings; we eat only if we get work that day".
- **Climate Vulnerability**: Livelihoods are deeply affected by climate events. Cyclones cause widespread work stoppages in all areas, with Maltitota reporting a complete halt of work (100%) during such events. Heatwaves also disrupt work, as seen in statements like "Cannot work outside during heatwaves". In Pentakota, 52% report being unable to work during extreme heat, leading to a 30-50% reduction in earnings.

- **Asset Loss and Debt**: Climate disasters frequently lead to the loss of essential assets. For instance, person from Dandimala Sahi reports losing their vending cart in a cyclone and lacking the funds to rebuild. This asset loss, combined with a widespread lack of savings, often forces households into debt to replace essential tools or restart their livelihoods, perpetuating a cycle of poverty.
- **Gendered Vulnerabilities**: Female-headed households[6] face compounded challenges. They represent a significant proportion of households, such as 77% in Pentakota and 65% in both Baliapanda and Maltitota. These households often grapple with childcare burdens alongside unstable incomes.
- **Limited Economic Diversification**: The data indicates a lack of diversified income sources. In several wards, a large percentage of households rely solely on their primary income, such as 94% in Pentakota and 100% in Maltitota. This lack of diversification limits resilience against economic shocks and climate-related disruptions.
- **Child Labour:** In some communities, households are resorting to child labour as a coping mechanism, with 35% of households in Pentakota and 26% in Baliapanda reporting children missing school to supplement family income as reported in the household surveys. This has long-term implications for human capital development and poverty reduction.

6.3.2 Future Implications:

The current scenario paints a concerning picture for the future of these communities. The increasing frequency and intensity of climate events, coupled with existing vulnerabilities, could further erode livelihoods and deepen poverty. Without interventions aimed at diversifying income sources, building climate resilience, and improving access to resources and support systems, these communities are likely to face:

- Increased poverty and inequality: The lack of economic diversification and climate vulnerability will likely exacerbate

[6] Female headed households refer to the households where the head of the family is a woman, in terms of decision making and earning. In case of urban poor communities of Puri, usually seen in houses where the husband passed away and the responsibility fell on the woman.

existing poverty levels and widen the gap between the vulnerable and more resilient populations.

- Intergenerational poverty: Child labour, driven by economic hardship, will hinder educational attainment and limit future opportunities for younger generations, perpetuating a cycle of poverty.
- Social instability: Increased economic hardship and inequality could lead to social unrest and instability within these communities.
- Forced migration and displacement: As climate impacts intensify, some households may be forced to migrate in search of alternative livelihoods or safer living conditions, leading to displacement and further social disruption.

6.3.3 Areas for Investment and Development:

To mitigate these risks and build more resilient livelihoods, the following areas require urgent attention and investment:

- Livelihood Diversification: Programs aimed at diversifying income sources, such as skill development and support for microenterprises, are crucial. For example, in Baliapanda, there is a request for sewing training to create alternative income opportunities.
- Climate Resilience: Investments in climate-resilient infrastructure, such as cyclone-resistant housing and flood-resistant farming techniques, are essential to protect livelihoods and assets from climate shocks.
- Social Protection: Strengthening social protection mechanisms, including safety nets and access to credit, can help households cope with economic shocks and build greater resilience.
- Education and Skills Development: Investing in education and skills development, particularly for women and children, is crucial for breaking the cycle of poverty and creating opportunities for future generations.
- Equitable Aid Distribution: Ensuring transparent and equitable distribution of aid and resources is essential for building trust and maximising the effectiveness of support programs.

6.4 Energy Accessibility and Infrastructure

6.4.1 Data Snapshot on Energy

Table 13: Summary of data on energy collected through household surveys from the selected communities

Ward (Neighbourhood)	Primary Energy Sources	Electricity Access	Cooking Fuel	Renewable Use	Key Challenges
23 (Dandimala Sahi)	Grid (80%), Kerosene (15%)	Unstable (daily cuts range from average 1 hour to 6 hours)	Firewood (60%), LPG (30%)	Solar (2%)	High firewood use, frequent outages
23 (Talabania)	Grid (85%), Solar (5%)	Moderate (weekly cuts)	LPG (50%), Firewood (40%)	Solar (5%) (mostly small business owners had one)	Better LPG access but solar uptake low
32 (Pentakota)	Grid (70%), Kerosene (25%)	Very unstable	Firewood (75%), Kerosene (15%)	None reported	Extreme energy poverty
7 (Baliapanda)	Grid (90%), Solar (3%)	Relatively stable	LPG (60%), Firewood (35%)	Solar (3%)	Tourism zone but limited clean energy
21+1 (Maltitota)	Grid (75%), Kerosene (20%)	Frequent outages	Firewood (55%), LPG (35%)	Solar (1%)	Coastal vulnerability to grid damage

6.4.2 Energy Access and Renewable Potential in Five Coastal Wards

The survey data reveals stark disparities in energy access and usage patterns across the five adjacent neighbourhoods Dandimala Sahi (Ward 23 Station Road), Talabania (Ward 23 Sanjay Colony), Pentakota (Ward 32), Baliapanda (Ward 7), and Maltitota (Wards 21+1). While all wards rely heavily on grid electricity, its reliability varies dramatically. Dandimala Sahi and Pentakota suffer the most severe power outages, with 65-75% of households reporting daily cuts, forcing dependence on kerosene and firewood. In contrast, Baliapanda's grid is relatively stable, likely due to its tourism economy, though affordability remains a barrier for clean cooking fuels like LPG.

Cooking energy poverty is pervasive, particularly in Pentakota, where 75% of households use firewood, exposing families especially women and children to indoor air pollution. Talabania stands out with higher LPG adoption (50%), attributed to its semi-urban character, but even here, solar energy penetration is limited to just 5% of households. Renewable energy adoption is negligible across the board, with only sporadic solar use in Talabania and Baliapanda, and none reported in Pentakota. This gap highlights untapped potential, especially in Pentakota, where biogas from fishing waste could address both energy and waste management needs, and in Maltitota, where coastal winds offer ideal conditions for hybrid wind-solar systems.

The neighbourhoods' geographic and economic contexts shape their energy futures. Baliapanda's tourism sector could leverage solar streetlights and mandates for guesthouses to adopt renewables, creating a model for eco-tourism. Meanwhile, Dandimala Sahi's dense settlement pattern makes it ripe for solar microgrids, replicating Talabania's modest solar success at scale. Pentakota's extreme energy deprivation demands urgent intervention biogas pilots and emergency solar lantern distributions could immediately reduce firewood dependence. Maltitota's vulnerability to cyclones underscores the need for resilient decentralised energy, such as wind-solar hybrids to power fish-drying livelihoods.

A sustainable transition would require ward-specific strategies. For instance, Talabania's existing solar uptake could be expanded through rooftop leasing programs, while Pentakota's fishing communities need targeted biogas infrastructure. Community

engagement is critical: women's self-help groups could manage renewable systems in Maltitota, and tourism revenues in Baliapanda could fund solar subsidies. Without intervention, business-as-usual scenarios predict worsening deforestation and health crises in firewood-dependent wards, while Baliapanda's tourism growth may stall due to unreliable energy.

In conclusion, these five wards exemplify how hyper-local energy solutions grounded in geographic, economic, and social realities can bridge the gap between energy poverty and renewable potential. Pilot projects in Talabania (solar) and Pentakota (biogas) could offer blueprints for scaling across the region, with Spandan NGO's existing networks providing a trusted platform for implementation. Future research should quantify household energy expenditures and seasonal impacts to refine these proposals further.

6.4.3 Comparative analysis across the Neighbourhoods

Table 14: Summarised comparative analysis across selected neighbourhoods/communities

Metric	Dandimala Sahi	Talabania	Pentakota	Baliapanda	Maltitota
Grid Reliability	Worst	Moderate	Worst	Best	Poor
Clean Cooking Access	Low (30% LPG)	Medium (50%)	Lowest (15%)	High (60%)	Medium (35%)
Solar Adoption	2%	5%	0%	3%	1%
Priority Tech	Microgrids	Rooftop Solar	Biogas	Solar Streetlights	Wind-Solar Hybrids (mostly reported by small business owners)

7 Gap and Needs Analysis

The objective was to identify vulnerabilities, programmatic gaps, and opportunities for targeted interventions for the urban poor of Puri, especially those vulnerable to climate hazards, economic marginalisation, and systemic neglect, and to propose entry points for inclusive program design.

7.1.1. Livelihood Security

Table 15: Existing scenario, gaps and opportunities in Livelihood Security

Existing Scenario	Gaps Identified	Opportunities for Intervention
Urban poor engaged in informal work (street vending, tourism services, fishing, sanitation) with seasonal income patterns.	No integrated livelihood resilience program exists targeting urban informal workers. Loss of income post-disasters is not insured or compensated.	Design livelihood recovery schemes post-disaster (e.g., quick cash-for-work programs); develop a microinsurance product with claim-based disaster payouts. Promote alternative skill-building for climate-resilient trades.

7.1.2. Housing and Infrastructure

Table 16: Existing scenario, gaps and opportunities in Housing and Infrastructure

Existing Scenario	Gaps Identified	Opportunities for Intervention
Slum dwellings are concentrated in high-risk flood or erosion zones. Structures are often non-permanent.	Limited access to resilient housing. Urban flood mitigation doesn't prioritise informal settlements. Many are excluded from formal housing schemes like PMAY due to lack of documentation.	Implement nature-based infrastructure pilots in slums. Support tenure documentation drives and develop DRR-compliant shelter prototypes with local partners.

7.1.3. Water, Sanitation and Hygiene (WASH)

Table 17: Existing scenario, gaps and opportunities in Water, Sanitation and Hygiene (WASH)

Existing Scenario	Gaps Identified	Opportunities for Intervention
Intermittent water supply and inadequate sanitation, especially in congested informal settlements. High risk of disease outbreaks post-disaster.	Climate-resilient WASH is not integrated in slum improvement programs. No provision for flood-proof toilets or decentralised water systems.	Develop modular, elevated toilet and water units for flood-prone areas. Engage community workers for WASH awareness and early warning systems for vector-borne disease outbreaks.

7.1.4. Education & Child Protection

Table 18: Existing scenario, gaps and opportunities in Education and Child Protection

Existing Scenario	Gaps Identified	Opportunities for Intervention
Schools are often used as shelters but lack continuity plans for education post-disaster. Girls drop out due to domestic burdens and insecurity.	No continuity-of-education framework during climate disruptions. Child protection mechanisms are weak in urban slums. Due to the lack of funds and livelihood post disasters, children are forced to work and drop out of schools.	Design mobile learning centres, disaster-ready school plans, and psycho-social support programs for children. Create girls' safety networks and drop-out tracking in vulnerable areas.

7.1.5. Social Protection and Insurance

Table 19: Existing scenario, gaps and opportunities in Social Protection and Insurance

Existing Scenario	Gaps Identified	Opportunities for Intervention
Government schemes like ration cards, BSKY, PMAY exist but uptake is low among urban poor due to migration, lack of ID, or awareness.	No universal climate-risk social registry. Microinsurance and portability of benefits (e.g., health, food, ID) are missing for migrants.	Launch a city-level Urban Poor Climate Registry with integrated climate risk scores. Pilot a unified social protection interface for disaster-affected informal households.

7.1.6. Disaster Risk Reduction (DRR) and Preparedness

Table 20: Existing scenario, gaps and opportunities in DRR and Preparedness

Existing Scenario	Gaps Identified	Opportunities for Intervention
Puri has a multi-hazard plan, early warning systems, and cyclone shelters, but limited community engagement from the urban poor.	DRR plans are top-down. Ward-level action and last-mile access to early warning is poor in informal settlements.	Set up ward-level disaster resilience committees (including women, youth, and disabled persons). Establish micro-evacuation plans and risk signage in slums. Expand the AI-based early warning system to be hyperlocal and vernacular.

7.1.7. Gender and Inclusion

Table 21: Existing scenario, gaps and opportunities in Gender and Inclusion

Existing Scenario	Gaps Identified	Opportunities for Intervention
Women-headed households and elderly residents are highly vulnerable but rarely targeted in resilience programs.	Gender-disaggregated data lacking. No program systematically includes disabled persons or transgender persons in DRR.	Initiate gender-sensitive hazard mapping. Develop livelihood and safety schemes for women, including access to safe shelters and income. Promote inclusive feedback systems for DRR programming.

7.1.8. Systemic and Governance

Table 22: Existing scenario, gaps and opportunities in Systemic and Governance

Area	Observed Gaps	Recommendations
Data & Mapping	Lack of granular vulnerability maps and real-time risk data for informal areas.	Integrate slum vulnerability mapping using GIS, participatory tools, and AI/ML sensors (like in your air pollution project).
Local Government Capacity	ULB has limited DRR budget and low integration of urban poor issues in climate planning.	Build ULB capacity to mainstream inclusive resilience in City Disaster Management Plan and Smart City investments.
Financing	No specific funding earmarked for resilience of urban poor.	Propose convergence with AMRUT, SBM-U 2.0, and climate financing windows like GCF or ADB Urban Resilience programs.

7.2. Climate Impact on Employment & Well-being- Coping Mechanisms

The data reveals that communities employ a range of coping mechanisms to deal with economic hardship, climate shocks, and lack of access to resources. However, many of these mechanisms are indicative of distress and highlight the precariousness of their situation.

7.2.1. Economic Hardship:

- **Child Labour:** A significant number of households resort to child labour to supplement income. This is reported in Baliapanda (26% of households) and Maltitota (40%), indicating that financial constraints force children to miss school and engage in work.

- **Borrowing:** In the aftermath of disasters, a significant proportion of households are compelled to borrow money, often from informal sources, to meet their basic needs. For instance, 68% of households in the "32.xlsx" dataset report borrowing post-disaster. This likely leads to increased debt and further impoverishment.
- **Reducing Consumption:** While not explicitly stated, the reliance on daily wage labour and the lack of savings strongly imply that households reduce their consumption of essential goods, including food, during times of economic hardship or unemployment. The quote *"We eat only if we catch fish that day"* from Pentakota vividly illustrates this hand-to-mouth existence.

7.2.2. Climate Shocks:

- **Relocation to Shelters:** During cyclones, a substantial number of households relocate to temporary shelters. In Baliapanda, 52% of households report doing so, and this figure is similar in other wards. This indicates a lack of safe housing and the need for communal shelter during extreme weather events.
- **Dependence on Aid:** Communities heavily rely on external aid, particularly from NGOs like Spandan, for basic necessities like food. In some areas, this dependence is very high, with 71% relying on Spandan in one dataset.

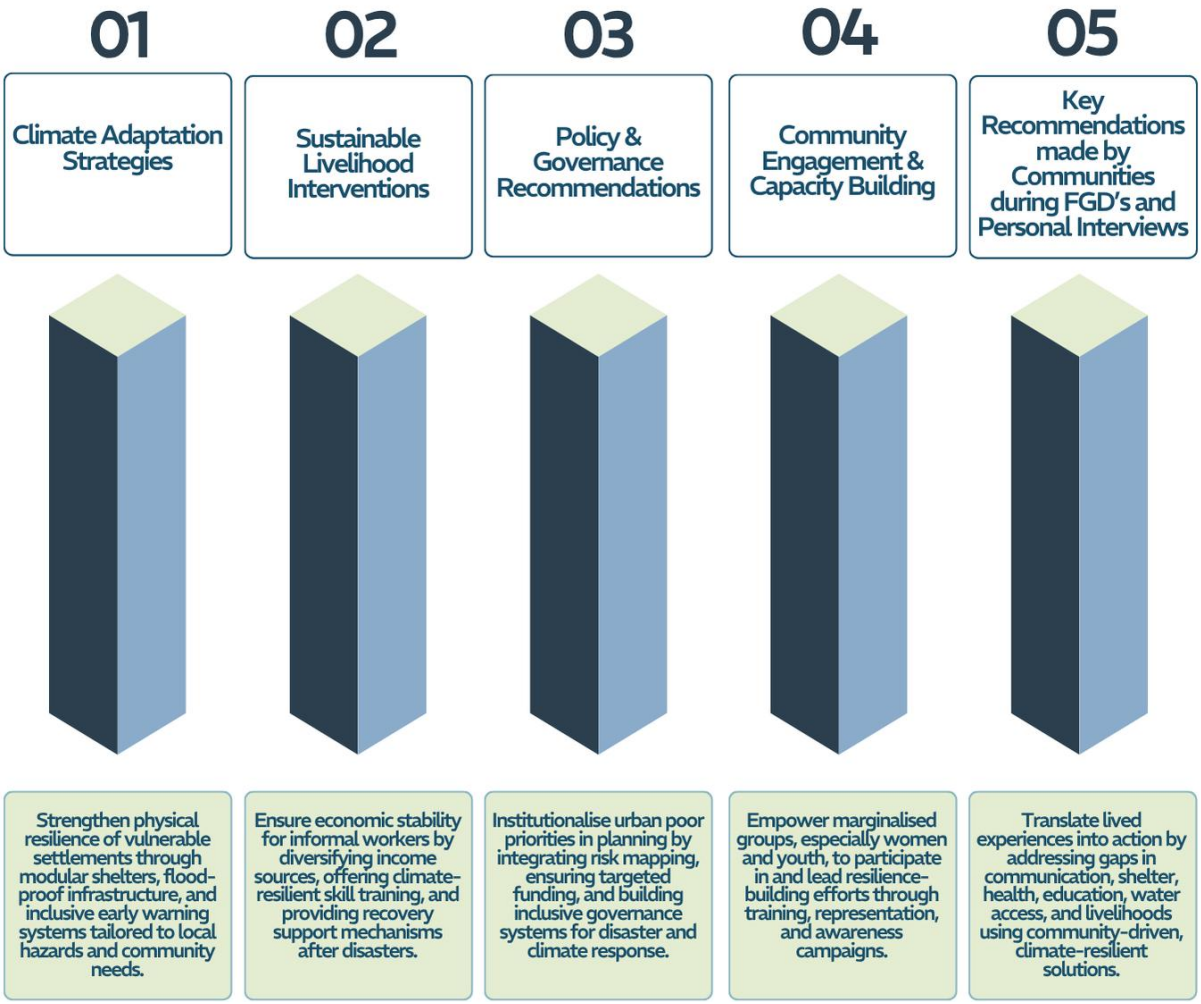
Lack of Access to Resources:

- **Informal Coping Networks:** In the absence of formal financial services, households likely rely on informal networks of support, such as relatives and neighbours, for small loans or assistance in times of need.
- **Delayed Healthcare:** Due to the distance and cost of healthcare facilities, individuals often delay seeking treatment, potentially leading to worsening health conditions.

7.2.3. Overall Assessment:

The coping mechanisms employed by these communities reveal a state of chronic vulnerability. They are often reactive, short-term, and unsustainable, perpetuating a cycle of poverty and hindering long-term development. The reliance on child labour, borrowing, and aid highlights the lack of resilience and the urgent need for interventions that address the root causes of their vulnerability.

8 Recommendations and Action Plan



8.1. Climate Adaptation Strategies

Objective: Reduce vulnerability of low-income settlements and enhance preparedness for climate-induced risks such as cyclones, coastal erosion, flooding, and heatwaves.

8.1.1 Key Recommendations

- **Micro-Scale Climate Resilient Infrastructure:**
  - Promote elevated, modular shelter units in flood-prone informal settlements.
  - Pilot green infrastructure (bioswales, permeable pavements) to improve drainage.

- **Heat-Resilient Urban Design and Housing Interventions:**
  - Establish cooling shelters or shaded rest zones in high-temperature wards, especially for street vendors, sanitation workers, and outdoor labourers.
  - Promote cool roofs, ventilated housing designs, and reflective paint schemes in informal housing clusters to reduce indoor heat stress.
  - Introduce urban greening initiatives in heat-stressed areas—e.g., street tree plantations, community parks, and rooftop gardens.

- **Hyperlocal Early Warning Systems:**
  - Deploy AI/ML-enabled, ward-level early warning mechanisms using SMS, loudspeakers, and visual cues, especially in slums.
  - Ensure language- and gender-inclusive messaging for children, disabled persons, and elderly.

- **Urban Climate Risk Mapping:**
  - Conduct participatory risk assessments with community members to map local hazards, seasonal patterns, and safe zones.
  - Integrate maps into city and ward-level disaster management plans.

- **Nature-Based Coastal Defence:**
  - Restore mangroves and coastal vegetation buffers in collaboration with community groups and local NGOs to reduce storm surge impact.

- **Climate-Resilient WASH Access:**
  - Introduce elevated, flood-proof toilets and decentralised water units (e.g., solar-powered borewells, community tanks) in high-risk areas.
  - Ensure availability of drinking water points and misting stations during extreme heat events.

8.2 Sustainable Livelihood Interventions

Objective: Diversify and secure livelihoods of urban poor through climate-sensitive, gender-equitable, and inclusive economic interventions.

8.2.1 Key Recommendations

- **Livelihood Diversification:**
  - Offer vocational training in climate-resilient trades (e.g., renewable energy, climate-smart agriculture, eco-tourism services).
  - Encourage multi-source income through dual livelihood schemes (e.g., fish vending + tailoring).

- **Post-Disaster Livelihood Recovery Support:**
  - Implement rapid deployment of cash-for-work or relief-linked microenterprise grants post-cyclones.
  - Establish emergency funds accessible to verified vulnerable households.

- **Microinsurance & Social Protection Access:**
  - Develop a pilot Unified Insurance Interface (UII) model for urban informal workers, covering livelihood loss, health, and asset damage.
  - Ensure portability of entitlements (e.g., ration cards, pensions) for migrants and homeless populations.

- **Mobile Livelihood Support Hubs:**
  - Establish ward-level pop-up units offering training, microfinance access, insurance enrolment, and documentation support.

8.3 Policy & Governance Recommendations

Objective: Embed urban poor priorities into municipal climate and disaster governance through institutional reforms, convergence, and planning.

8.3.1 Key Recommendations

- **Inclusive Urban Planning:**
  - Mandate inclusion of slum vulnerability mapping in all ward-level DRR and Smart City plans.

- Regularly update a City Urban Poor Vulnerability Atlas.

- **Urban Poor Climate Registry (UPCR):**
  - Institutionalise a digital registry of vulnerable households capturing socio-economic data, hazard exposure, and entitlements.

- **Convergence of Schemes:**
  - Align city-level DRR actions with housing (PMAY), sanitation (SBM-U), and livelihood (NULM) missions for targeted outreach.

- **Budget Allocation & Financing:**
  - Earmark specific funds in city and ward budgets for community-led resilience actions and informal worker support.

- **Inclusive Governance Mechanisms:**
  - Strengthen community representation in ward committees and urban planning cells.
  - Institutionalise a Resilience Task Force within the ULB focused on informal settlements.

8.4 Community Engagement & Capacity Building Recommendations

Objective: Empower vulnerable communities, especially women, youth, and marginalised groups, to lead resilience actions and participate in decision-making.

8.4.1 Key Recommendations

- **Ward-Level Resilience Committees:**

  - Form inclusive committees with representation of women, youth, disabled persons, and transgender community to co-design risk mitigation measures.

- **Women Resilience Champions Network:**

  - Identify and train women leaders to act as communicators, responders, and mentors in climate and disaster preparedness.

- **Community Awareness & Simulation Drills:**

  - Conduct quarterly drills in cyclone shelters and local schools, integrated with IEC campaigns on climate adaptation, early warning, and entitlements.

- **Youth-Led Climate Action:**

  - Launch campaigns and school clubs on climate awareness, water conservation, and waste management with youth leadership.

- **Feedback and Grievance Redressal:**

  - Create real-time feedback systems (physical and digital) for informal settlement residents to report risks, service gaps, and post-disaster needs.

8.5 Key Recommendations made by Communities during FGD's and Personal Interviews:

The following points reflect the insights and recommendations shared by community members in Puri during focused group

discussions (FGDs) and personal interviews. These are based on lived experiences and observations post-disaster and are grounded in a framework that moves from Immediate Response to Anticipation, Adaptation, and finally, Transformation (relocation, when necessary).

8.5.1 Early Warning Systems

- Communities highlighted frequent breakdowns in information flow post-disaster due to electricity and network failures.
- Recommended solar-powered meteorological stations and DRE-based local alert systems to ensure continuous information.
- Suggested providing satellite phones to local response teams for two-way communication during network outages.

8.5.2 Resilient Shelter Design

- Existing housing is structurally weak, especially in low-lying areas, and lacks ventilation.
- Communities proposed multi-hazard resilient housing designs suited for cyclonic winds and extreme heat.
- Urged inclusion of such designs in existing urban housing schemes with improved planning.

8.5.3 Livelihood Resilience

- Livelihoods in fishing, tourism, and labour are highly vulnerable post-disaster.
- Emphasised the need for climate-resilient, women-led livelihoods.
- Suggested:
    - Climate-smart dry fish production and marketing.

- Solar-powered micro-enterprises (tailoring, roti-making, grocery shops, LSK units).
- Skill development programmes linked to tourism and hospitality.
- Integration with Mission Shakti schemes.

8.5.4 Education Infrastructure

- Schools and Anganwadi centres remain shut post-disaster, affecting education and nutrition.
- Recommended:
  - DRE-based power systems for schools and early recovery of educational services.
  - Equipping Anganwadi centres and mass education offices with resilient infrastructure.

8.5.5 Health Services

- Small, community-level health centres are slow to resume post-disaster due to power issues.
- Suggested powering select local health centres with solar energy for quick access to care.

8.5.6 Water Supply Systems

- Piped water supply is disrupted due to non-functional electric pumps.
- Proposed solar-powered pump houses to restore water access quickly after disasters.

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10 Annexures

10.1 Process followed for Kernel Density Estimation (KDE) of Compounding Vulnerabilities

Step 1: Collect Problem Points (Vulnerability Factors)

First, we identified and mapped the major types of vulnerabilities across the city these are like "problem points" on the map. For Puri, these included:

Table 23: Vulnerability factors along with it sources

Vulnerability Factor	Source of Data
Flood-prone areas and coastal erosion zones	Flood and CRZ maps
Low elevation and water accumulation zones	Elevation and drainage maps
Informal settlements	Informal housing map
Heat stress hotspots	Land Surface Temperature (LST) map
Livelihood-sensitive areas (e.g. fishing, tourism, vending)	Occupation and TBD map
Lack of green/open space	Waterbody & open space map
Poor drainage proximity	Rainfall & runoff map

Each of these was treated as a separate layer of vulnerability.

Step 2: Convert the Layers into Point Data

In GIS, we converted these hotspots into points for example:

- A cluster of informal homes in Ward 32 = a vulnerability point.
- A flood-prone street vending zone in Ward 10 = another point.
- A heat-exposed tourist area in Ward 4 = another point.

Now we had hundreds of points showing where climate and social vulnerabilities exist across Puri.

Step 3: Apply KDE: The Ripple Effect

Using KDE, we added a ripple (like a heatwave) around each vulnerability point:

- Each point gets a soft circular zone (a kernel) around it.
- The closer these ripples are to each other, the more intense the combined effect becomes.
- Where many points are close together (e.g. heat + flooding + poor housing), the density increases and creates a "hotspot."

So, instead of just seeing random dots, we now see continuous zones where multiple vulnerabilities overlap.

Step 4: Generate the KDE Heat Map

The software then **blends all those ripples together** to create a **density surface** a map that shows:

- **Red zones**: High vulnerability (many overlapping issues).
- **Orange zones**: Medium vulnerability.
- **Green zones**: Low vulnerability (fewer overlapping issues).

This gave us a clear, visual picture of where Puri's most at-risk communities live and work.

Results of the KDE for Puri

The KDE revealed three critical vulnerability clusters:

Cluster A: Coastal and Low-lying Informal Settlements

- **Wards: 7, 10, 11, 25, 26, 32**
- Combined risks: flooding, coastal erosion, fishing livelihoods, informal housing, low elevation, drainage issues.
- Action needed: cyclone-resilient housing, drainage upgrades, early warning systems, livelihood support.

Cluster B: High Heat + Livelihood Pressure Zones

- **Wards: 3, 4, 9, 10, 13, 16, 20**
- Combined risks: urban heat islands, vending hotspots, high density, poor green cover.
- Action needed: shaded vending zones, heat action plans, urban greening.

Cluster C: Peri-urban Emerging Risk Areas

- **Wards: 22, 23, 28, 29**
- Risks: expanding informal housing, lack of services, proximity to runoff zones.
- Action needed: anticipatory planning, housing regulation, drainage investment.

Why KDE Matters for Puri

- It helped identify not just individual problems but zones where problems overlap which is much more useful for planning.
- It visually shows how social and environmental vulnerabilities come together, especially for informal workers and poor households.

10.2 Details of Process of Selecting Communities

Three different techniques were used to complete the selection of most vulnerable communities:

1- **GIS Analysis:** Using secondary data, satellite imagery, and ward-level spatial layers, this method provided a bird's-eye view of risk patterns across the city. Layers such as flood zones, informal settlements, elevation, LST (heat), drainage, and occupation zones were overlaid to identify high-risk clusters. Hotspot and kernel density analysis enabled us to visualise areas where multiple hazards intersect with socio-economic fragility, e.g., Wards 7, 10, 11, 23, 25, 26, and 32. This method is particularly useful for macro-level planning, zoning, and infrastructure investment.

2- **Vulnerability Index:** A climate vulnerability index was developed using a weighted scoring system based on three core dimensions: Exposure (40%), Sensitivity (40%), and Adaptive Capacity (20%). Each ward was ranked (refer the next section for details) using normalised values of indicators like elevation, LST, housing quality, access to services, and population density. This approach added a quantitative lens to classify vulnerability across all 32 wards and helped in shortlisting locations for intervention with evidence-backed comparability.

3- **Manual and Participatory Community Selection:** Recognising that data cannot always capture lived realities, this method relied on ground-truthing, stakeholder inputs, and qualitative filters to finalise five study sites. Variables such as historical disaster exposure, economic precarity, marginalisation (e.g., migrant/female-headed households), and field observations were used to manually verify GIS and index findings. This step ensured that intersectional vulnerabilities such as gender, disability, tenancy insecurity were adequately considered, which spatial data alone cannot capture.

The mixed approach used to select the communities made sure that all the aspects, be it qualitative or quantitative, climate, or infrastructure or livelihood, all were given some kind of weightage to decide upon the most vulnerable communities.

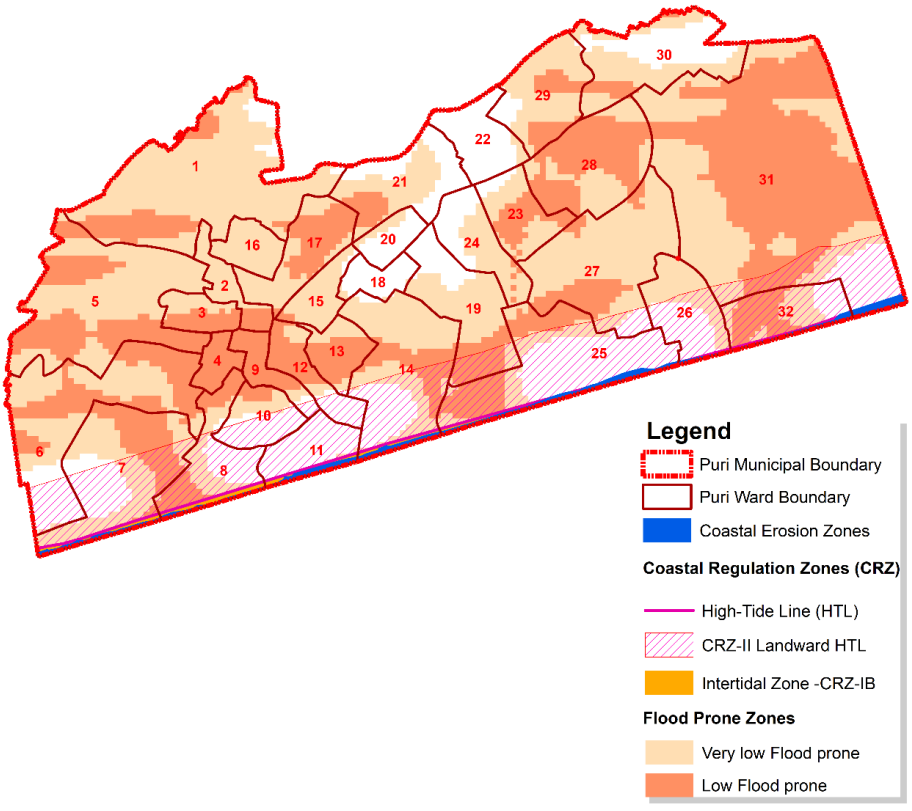
2.1.1. Summary of Steps followed (RAW DATA):

STEP 1:

Flood mapping (historic data, Flood Hazard Zonation Atlas: NRSC, OSDMA, NDMA).

As a first vulnerability layer, areas prone to flooding is identified and marked.

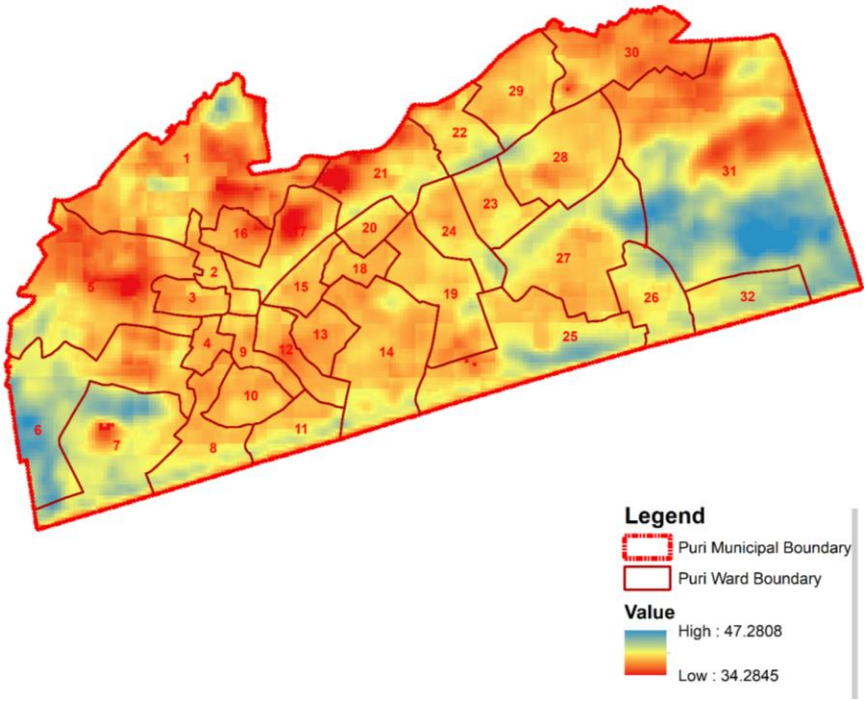
Puri Flood Prone and Coastal Erosion Zone



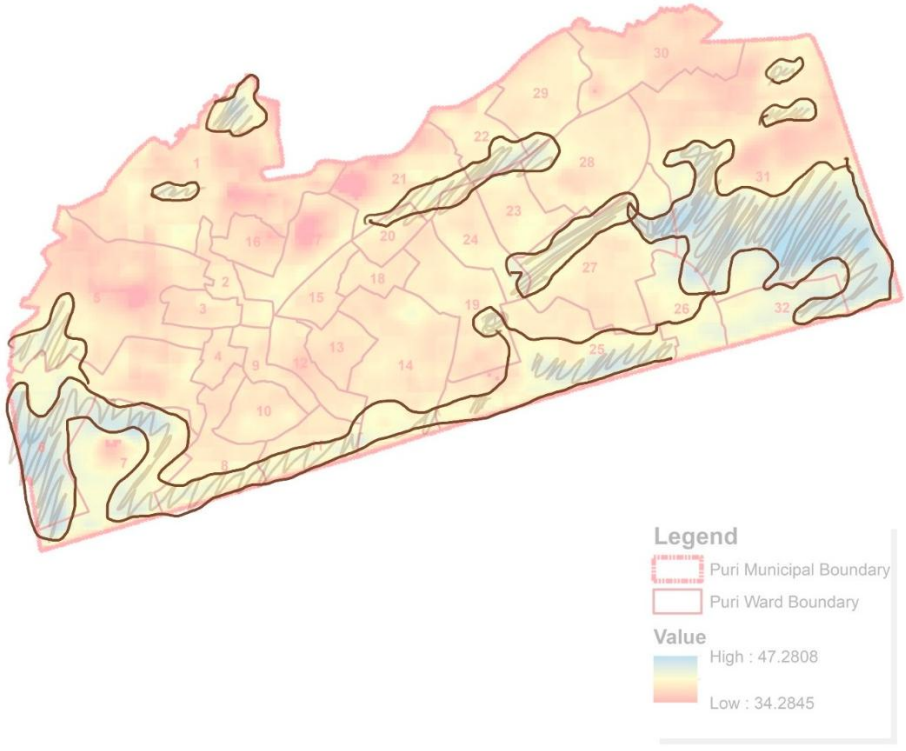
STEP 2:

Marking areas with High temperature: As a second layer, areas prone to high land surface temperature is marked.

Puri Land Surface Temperature (LST)

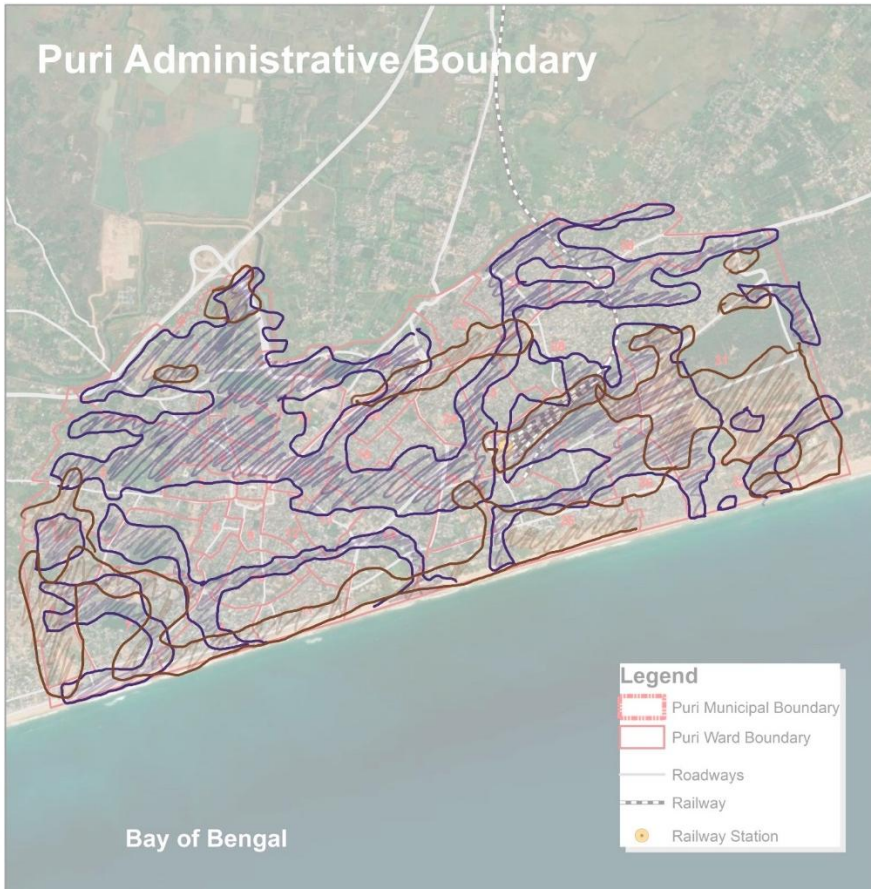


Puri Land Surface Temperature (LST)



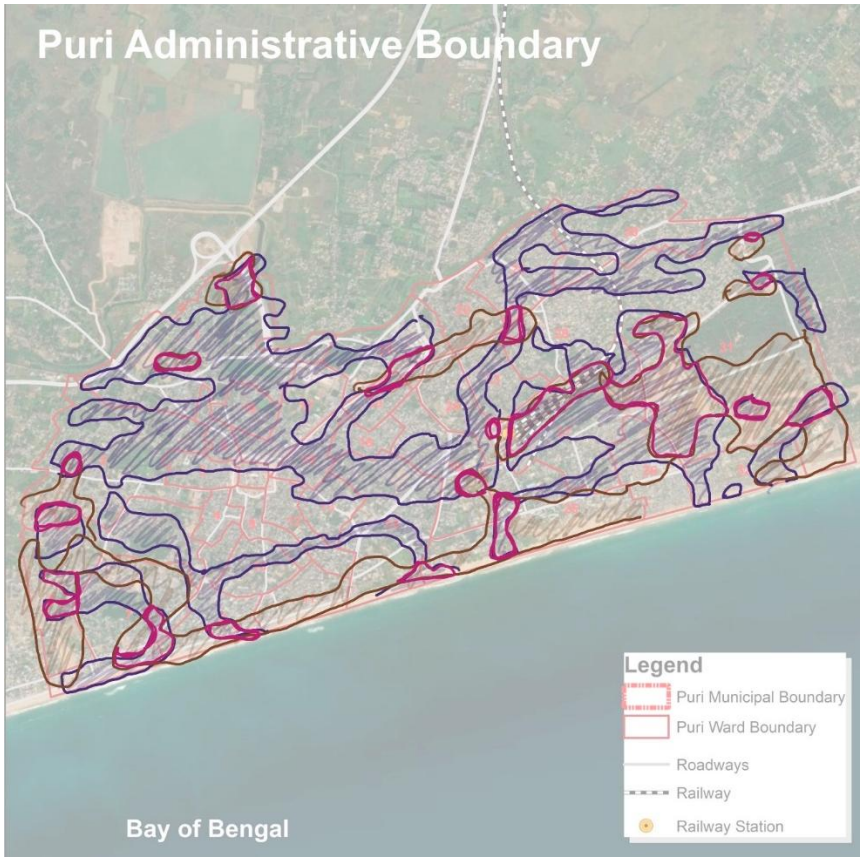
STEP 3:

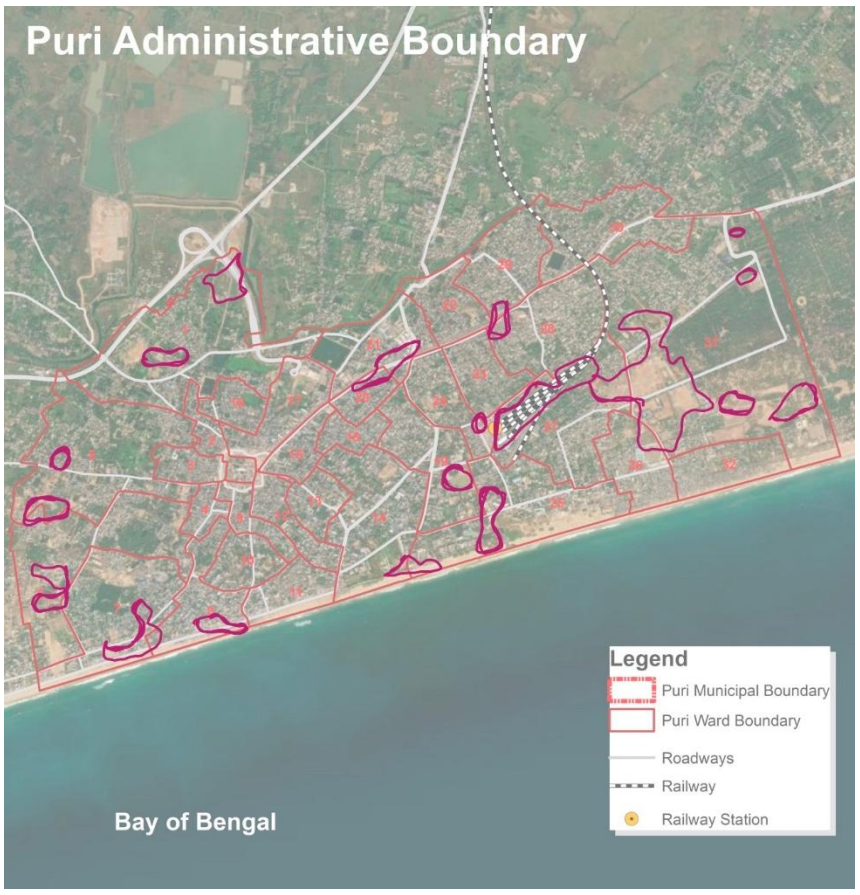
Overlapping LST and flooding: The layer 1 depicting flooding and layer 2 depicting surface temperature is overlapped to generate intersections of vulnerable areas.



STEP 4:

Marking common areas and shortlisting most vulnerable ward. The intersections of layer 1 depicting flooding and layer 2 depicting surface heat are extracted to determine areas vulnerable to both heat and flood. The wards in which these intersections lie are noted by overlaying the administrative boundary maps.

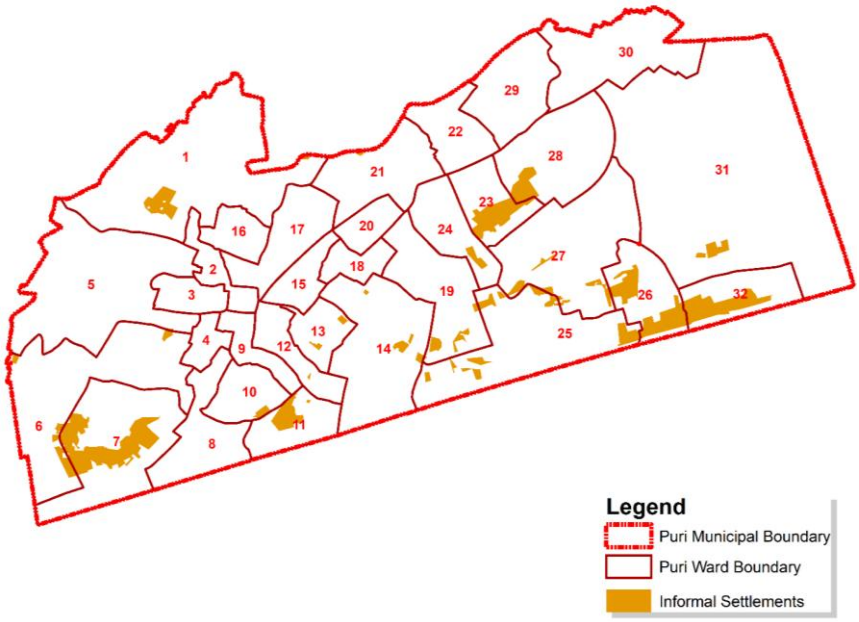

Puri Administrative Boundary
Legend
Puri Municipal Boundary
Puri Ward Boundary
Roadways
Railway
Railway Station
Bay of Bengal

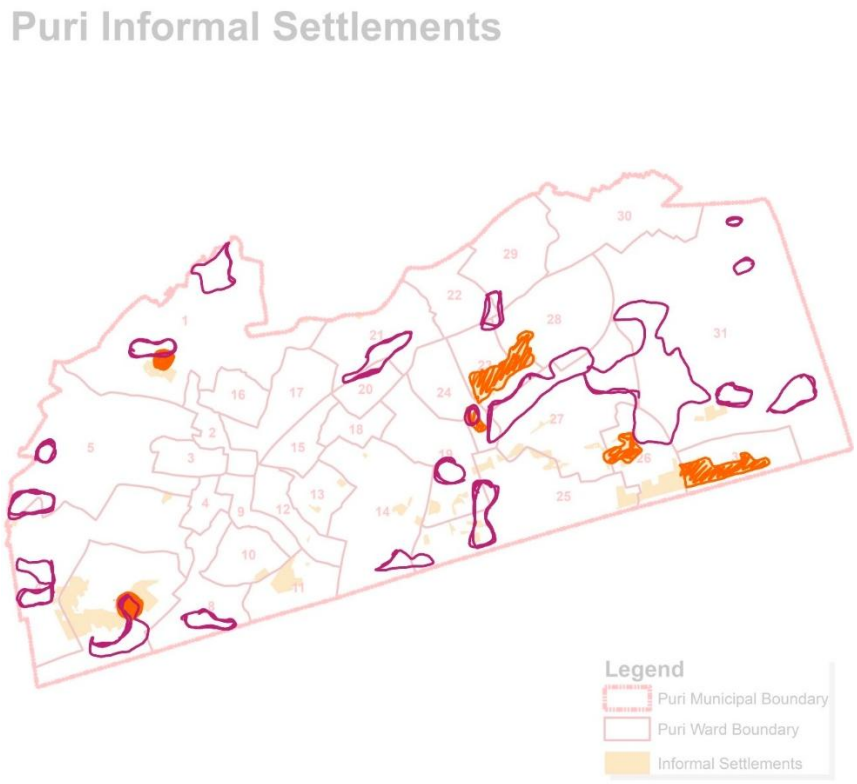

Puri Administrative Boundary
Legend
Puri Municipal Boundary
Puri Ward Boundary
Roadways
Railway
Railway Station
Bay of Bengal

STEP 5:

Overlapping with notified informal settlements: The informal settlements are located across the wards and overlayed with the vulnerable intersections identified. The informal settlements overlapping/ closest to the vulnerable areas of the city are chosen as probable wards for study.

Puri Informal Settlements





Probable wards and communities: 1, 23, 24, 28, 29, 7, 25, 26, 32, 27, 6, 9

BASE MAP ANALYSIS

B.5 Land Surface Temperature (LST) Mapping

The Land Surface Temperature (LST) map of Puri, derived from satellite imagery (Landsat 9), provides valuable insight into heat stress patterns across the city. LST values in the map range from approximately 34.2°C to 47.3°C, clearly highlighting thermal variations between densely built-up zones, coastal areas, and green/open spaces.

1. **High-Temperature Clusters (Thermal Hotspots)**:

- Central and western wards such as 2, 3, 4, 9, 10, 12, 13, 15, 16, 20 and 21 show elevated surface temperatures (approaching 45–47°C).

- These hotspots correspond to high-density built-up areas with minimal green space or open land, indicating the urban heat island (UHI) effect.
- Wards like 7 and 11, despite being coastal, also experience elevated LST due to extensive construction, limited tree cover, and compact housing in informal settlements.

2. **Moderate LST Zones**:
    - Wards 14, 19, 23, and 27 fall into moderate LST zones, where scattered vegetation and a mix of built and open areas offer some thermal relief.
    - These areas, though relatively better off, still experience heat stress during peak summers, especially in pockets with dense housing and poor ventilation.

3. **Lower LST Zones**:
    - Eastern wards such as 31 and 32, and northern parts of Wards 28, 29, and 30, show lower surface temperatures (around 34–36°C).
    - This is primarily due to the presence of natural vegetation, waterbodies, and open lands (confirmed by overlaying the Waterbody & Open Space map).
    - These regions act as microclimate buffers but may still lack adequate access to cooling infrastructure in informal settlements.

4. **Heat Vulnerability of Livelihood Groups**:
    - Outdoor workers such as street vendors, sanitation workers, construction labourers, and fisherfolk in Wards 7, 10, 11, and 23 are highly vulnerable to extreme heat exposure.
    - Women involved in dry fish processing (Ward 32 - Penthakota) also face intense heat in open, unshaded workspaces, exacerbated by prolonged sun exposure and lack of cooling facilities.

5. **Correlation with Vegetation and Open Space**:
    - Comparing the LST map with the Waterbody & Open Space layer, it is evident that areas with dense tree cover and parks (e.g., parts of Wards 28 and 31) consistently record lower LST.
    - Conversely, wards with bare or built-up surfaces experience heat entrapment, creating chronic heat stress zones, especially where informal settlements overlap.

Key Inferences

- **Urban Heat Island Intensification**: The city core and densely populated informal settlements suffer from high LST, reflecting the impact of impervious surfaces, unplanned housing, and lack of vegetation.
- **Health & Productivity Risks**: Outdoor workers, particularly in wards with LST above 45°C, are at serious risk of heat-related illnesses, reduced work capacity, and long-term health deterioration.
- **Livelihood Sensitivity**: Livelihoods tied to tourism, construction, vending, and fishing which are often undertaken outdoors are disproportionately affected by rising surface temperatures.
- **Nature-Based Solutions Are Crucial**: Urban greening interventions, such as planting along streets, community parks, and rooftop vegetation, should be strategically implemented in high-LST wards to mitigate heat stress.
- **Planning Priority Zones**: Wards **7,** 10, 11, 13, and **32** should be prioritised for cooling infrastructure, shaded workspaces, early heat warning systems, and targeted support for heat-vulnerable livelihoods.

Proximity and Buffer Analysis

Buffer zones were created around key ecological and hydrological features coastline, water bodies, drains, vegetation patches, and open spaces to assess their influence on surrounding settlements in terms of climate vulnerability and ecological resilience. This

approach helped evaluate exposure risks (like proximity to flood-prone coastal belts or poor drainage areas) as well as adaptive advantages (like access to green and blue infrastructure that mitigates heat or supports drainage).

1. Coastal Buffer Zones (500m, 1km from shoreline)

- Wards 7, 10, 11, 25, 26, and 32 fall well within the 1 km coastal buffer, with wards like 7 (Baliapanda) and 32 (Penthakota) located almost directly on the shoreline.
- These wards face high exposure to coastal erosion, sea-level rise, and cyclone storm surges, as shown in the flood and erosion zone map.
- Livelihoods here (mainly fishing and tourism) are at constant risk due to physical exposure.
- Coastal buffer zones highlight the need for resilient housing, early warning systems, and coastal green belts (e.g., mangroves or dune restoration).

2. Waterbody and Drain Proximity (100–300m buffer)

- Settlements in wards 1, 13, 19, 21, and 23 are within close proximity to open drains, tanks, and rivers, as seen on the Rainfall Drainage and Waterbody & Open Space maps.
- While proximity could provide potential access to water or drainage, these wards also show frequent waterlogging and poor sanitation, due to ineffective stormwater infrastructure.
- These areas are also associated with informal settlements, amplifying their vulnerability.
- Infrastructure upgrades and decentralised rainwater management systems are necessary within these buffers.

3. Vegetation & Open Space Buffers (200m buffer around green areas)

- The vegetation/open space map indicates significant green cover in wards 5, 16, 20, 28, and 31, and lack thereof in core urban areas like wards 3, 4, 9, 10, 12, 13, and 18.

- Most informal and densely built settlements lack proximity to any green or open space, which contributes to urban heat stress, as validated by the LST (Land Surface Temperature) map.
- High LST zones coincide with areas far from green buffers, such as wards 12, 13, 18, 19, and 32.
- These findings support interventions like urban greening, shaded public spaces, and nature-based cooling infrastructure in heat-vulnerable communities.

4. Proximity to Water as Livelihood Resource

- Fishing communities in wards 7 and 32 benefit from direct access to the sea, but this also results in high livelihood vulnerability due to climate shocks.
- No alternative water-based livelihood zones (like protected inland aquaculture or eco-tourism) were found within inland buffers, indicating a gap in diversified economic opportunities tied to proximity zones.

Key Inferences

- High-risk coastal zones urgently require multi-purpose buffer-based planning: physical (retaining walls), ecological (mangroves), and socio-economic (early evacuation networks).
- Settlements close to inland water bodies and drains are not necessarily more resilient; in fact, they are often at higher risk due to poor drainage and flood management.
- Proximity to vegetation and open spaces is a major determinant of urban heat resilience. Core commercial and slum areas are notably deprived of such buffers.
- Buffer-informed micro-zoning can be an effective planning tool to regulate development, prioritise investments, and implement low-cost, localised climate-resilient infrastructure.

STEP 6:

Vulnerability Index

To assess the climate vulnerability, we considered a combination of hazard exposure, physical vulnerability, socio-demographic sensitivity, livelihood vulnerability, and access to basic services. Each factor is assigned a weight based on its relative importance. This framework helped assess the **relative climate vulnerability** of different wards in Puri by combining three core dimensions:

Exposure and sensitivity are the two core elements that shape the immediate risk a system faces from climate hazards.

The impact of climate hazards is a function of both how much is exposed and how sensitive those exposed elements are. High exposure with low sensitivity, or high sensitivity with low exposure, both result in moderate vulnerability; only when both are high does' vulnerability peak.
Giving equal weight ensures that neither the physical presence of hazards (exposure) nor the inherent characteristics that amplify harm (sensitivity) dominate the index. This maintains a balanced and objective assessment, preventing bias towards either environmental conditions or socio-economic fragility.

No matter how good the adaptive capacity of a community is, if a greater level of disaster strikes (exposure), the community tends to get affected, specifically urban poor communities (sensitivity), hence adaptive capacity holds lower in the ratio x:x:y (exposure: sensitivity: adaptive capacity)

Adaptive capacity acts as a *moderator* or buffer it reduces vulnerability by enabling communities to cope with, adjust to, or recover from climate impacts, but it does not eliminate the risk posed by high exposure or sensitivity

Exposure and Sensitivity are equally important because if you are highly exposed or highly sensitive (e.g., poor, old, unprotected), your vulnerability is high even if you are prepared.

Adaptive Capacity helps in coping, but its impact is often limited if the exposure or sensitivity is extreme. Hence it is weighted lower.

Where x>y,

While there is some bias in assigning values to x and y, the ranking of the wards remains the same as long as the above holds true.

1. **Exposure (Weight: 0.4)**

Definition: Degree to which a ward is exposed to climate hazards like floods, cyclones, coastal erosion, heatwaves, and sea-level rise.

Indicators used:

Indictors used	Primary Source
Frequency and intensity of extreme events	NDMA, OSDMA, IMD cyclone/flood reports, NRSC Flood Atlas ((G. S. Mandal), (IMD, 2024), (NSRC, 2023))
Proximity to coastline or rivers	GIS coastal buffer and CRZ maps (STS, 2025) (Refer map no. B.3 annexure 10.6)
Low-lying elevation or flood-prone areas	Contour and Elevation Maps (DEM and 1m interval contours) (STS, 2025)(Refer map no. B.1 & B.2 annexure 10.6)
Hazard-prone infrastructure	GIS layers of informal settlements overlaid with hazard zones (STS, 2025) (Refer map no. A.1 annexure 10.6)

Why 0.4? Exposure is given the highest weight (40%) because no matter how strong or adaptive a community is, high exposure significantly increases vulnerability. For example, Penthakata and Baliapanda face frequent cyclones due to their coastal location.

2. Sensitivity (Weight: 0.4)

Definition: Degree to which the population is affected by exposure, based on socio-economic and demographic conditions.

Indicators used:

Indictors used	Primary Source
Proportion of population in informal housing or slums	Census Data, Municipal Slum Records, field surveys ((Census, 2011), (O, 2013), (CDD, 2017))
Percentage of children, elderly, and persons with disabilities	Field surveys and secondary demographic data from Census and local administration ((Census, 2011), (O, 2013), (CDD, 2017))

Population density	Ward-wise population from Census, validated with field reports ((Census, 2011), (O, 2013), (CDD, 2017))
Livelihood dependence on climate-sensitive sectors (e.g., fishing, tourism)	Past experiences from NGOs
Poor sanitation, water supply, or waste infrastructure	Infrastructure Maps, field verification during transect walks (CDD, 2017)

Why 0.4? Sensitivity is equally weighted with exposure because communities with high social vulnerability (e.g., marginalised, low-income) face amplified impacts, even from lower-intensity events. For instance, Matitota and Dandimala Sahi are flood-prone and home to vulnerable populations like daily wage earners and migrants.

3. Adaptive Capacity (Weight: 0.2: inverse)

Definition: The ability of the community to respond, adapt, or recover from climate events.

Indicators used:

Indictors used	Primary Source
Access to social security schemes	Community survey data, SHG and NGO interviews
Availability of evacuation shelters	DDMP, discussions with Municipality and Disaster Management Office
NGO or community-based resilience programmes	Stakeholder interviews (e.g., SPANDAN, SEEDS, local SHGs)
Awareness and preparedness levels	Past experiences from NGOs
Livelihood diversification and access to credit	Local livelihood assessments, SPANDAN database

Why inverse and only 0.2? This is inversely weighted because higher adaptive capacity reduces vulnerability. However, it's assigned a lower weight (20%) because in many urban poor settings (especially in cities like Puri), adaptive capacity is constrained and slow to develop it helps buffer the impact but doesn't eliminate it.

Final Vulnerability Index Formula:

Vulnerability Index=(Exposure×0.4) + (Sensitivity×0.4) + [(5−Adaptive Capacity) ×0.2] [7]

Table 24: Vulnerability Index for each ward

Rank	Ward Number	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index	Justification
1	32	5	5	1	4.8	Highly exposed coastal zone with recurrent cyclones, storm surge, and erosion. Densely populated informal settlement with poor housing and sanitation. Dependence on fishing and dry fish processing (climate-sensitive), low access to schemes and no backup shelters.
1	7	5	5	1	4.8	Coastal ward with both informal housing and tourism dependence. Frequent exposure to cyclones and heatwaves. Poor drainage, lack of vegetation. Vendors and hotel staff face livelihood shocks. Low adaptive capacity due to economic precarity.

[7] (Sources referred: IPCC AR4, IPCC SREX, Research paper:

Vulnerability assessment studies on climate change: A review of the research in Mexico

Areli NÁJERA-GONZÁLEZ1 and Fátima Maciel CARRILLO-GONZÁLEZ2*)

Rank	Ward Number	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index	Justification
1	11	5	5	1	4.8	Includes vulnerable slums, low elevation and prone to waterlogging. Populated by sanitation workers and rickshaw pullers. Poor health infrastructure access. High sensitivity and very low adaptation mechanisms.
4	26	5	4	2	4.2	Coastal and low-lying zone with frequent waterlogging and poor drainage. Informal housing on risky terrain. Labour-intensive economy with limited green buffers. Shelters and government outreach are limited.
5	23	4	5	2	4.2	Includes informal settlements next to flood-prone areas. Drainage system is broken; livelihoods include vending and construction. Marginalised population. Access to credit or recovery support is negligible.
5	10	5	4	2	4.2	Coastal, tourism-based, high LST, low housing resilience
7	1	4	4	2	3.8	Covers flood-prone slums area near embankments. Houses daily wage earners and tourism workers. Overcrowded, sensitive demographics, and limited

Rank	Ward Number	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index	Justification
						access to healthcare or sanitation.
7	22	4	4	2	3.8	Transition zone with growing informal pockets. Some green cover, but flood-sensitive drainage and infrastructure gaps exist. Vulnerable to development pressure and heat.
7	29	4	4	2	3.8	Low-income, newly expanding area. Limited infrastructure and public service access. Livelihoods mostly daily wage and dependent on mobility, which is disrupted during rain and heat.
7	21	4	4	2	3.8	Informal settlements prone to waterlogging. Migrant-heavy population. Limited access to support schemes or awareness on disaster response. Sensitivity scores high due to social composition.
7	28	4	4	2	3.8	Peri-urban zone with scattered vulnerability. Inadequate infrastructure, especially sanitation and safe water. High density and low adaptive capacity due to lack of NGO or institutional presence.
12	4	3	4	2	3.4	Dense commercial activity, high population, informal

Rank	Ward Number	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index	Justification
						vendors, limited green cover
12	13	3	4	2	3.4	Waterlogging, vending & labour, low open space, recurring service disruption
14	16	3	3	2	3.0	High density, informal jobs, limited green cover
15	20	3	3	2	3.0	High heat zone, some slum clusters, but connected to city core
15	3	3	3	3	2.8	Tourism hub, exposed to heat and density but moderate infrastructure
15	9	3	3	3	2.8	Central area with congestion, affected by heat, but decent awareness
15	12	3	3	3	2.8	Temple proximity, informal sector reliance, average adaptive services
15	27	3	3	3	2.8	Moderate exposure, partly flood-prone, low adaptive outreach
15	24	3	3	3	2.8	Moderate elevation and population density. Decent access to basic services, but small informal clusters exist with limited resilience programmes.
15	19	3	3	3	2.8	Vulnerable to drainage issues and lacks consistent waste infrastructure. Somewhat exposed to heat. Livelihoods are mixed, with

Rank	Ward Number	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index	Justification
						partial dependence on vending.
15	14	3	3	3	2.8	Contains a mix of formal and informal households. Not directly exposed to floods or coastal risk but shows medium sensitivity due to household vulnerability.
15	25	3	3	3	2.8	Close to coast, includes portions of tourism activity. Moderate risk exposure, but population density is lower. Still lacks robust climate adaptation infrastructure.
24	2	3	2	3	2.4	Moderately dense ward, limited climate-sensitive jobs, some basic services present
24	5	3	2	3	2.4	Inland zone with better elevation and access to green cover. No major informal housing. Services moderately functional.
24	8	2	3	3	2.4	Inland ward with low density and relatively planned housing. No significant climate-sensitive employment.
24	6	2	3	3	2.4	Has moderate risk from drainage issues but benefits from better housing and

Rank	Ward Number	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index	Justification
						access. Infrastructure relatively intact.
24	15	2	3	3	2.4	Peripheral ward, moderate services, low exposure
24	18	2	3	3	2.4	Commercial spillover zone, lacks green cover but moderate exposure
30	17	2	2	3	2.0	Mostly residential, basic infrastructure available
31	30	2	2	4	1.8	Better access to green areas, low population, good coping capacity
32	31	1	2	4	1.4	Least vulnerable due to elevation, green cover, low density, and access to open space. Not exposed to major climate hazards. Some adaptive mechanisms in place via proximity to peri-urban areas.

Vulnerability index.xlsx (for details of the indictors and marking)

Based on the weighted index, we classified the wards into different vulnerability levels:

- **Very High Vulnerability**: Index ≥ 4.5
- **High Vulnerability**: 3.5 ≤ Index < 4.5
- **Medium Vulnerability**: 2.5 ≤ Index < 3.5
- **Low Vulnerability**: Index < 2.5

Very high and high vulnerable wards: 32, 7, 11, 26, 23, 10, 1, 22, 29, 21, 28

STEP 7:

Livelihood mapping based on variety not vulnerability

Ward Number	Urban poor community name	Major occupation	Population (approx.)
32	Penthakota	Marine fishing is predominant, with most men engaged in fishing activities. Women often participate in fish processing and vending.	2936
7	Baliapanda	Fishing is a primary occupation, especially in Baliapanda. Other livelihoods include tourism-related services, daily wage labour, and small-scale vending.	1580
11	Dandimala Sahi, Municipality, Red Cross road	Residents engage in fishing, daily wage labour, and informal vending.	1445
26	Jali Sahi, Railway Adibasi Basti	Tourism, fishing and daily wage labour	698,227
23	Dandimala Sahi & Talabania (Sanjayaji Colony)	Predominantly involved in daily wage labour, construction, and informal vending.	3550
1	Matitota, Gokha Sahi & Mangala Ghat	Residents are mainly engaged in daily wage labour, construction work, and informal vending.	442, 1309, 661
22	Narendrakona	Occupations include daily wage labour, construction, and informal sector jobs.	2140
29	Binoba Nagar	Similar to other urban poor areas, residents are involved in daily	1750

		wage labour, construction, and informal vending.	
21	Matitota	Occupations mirror those in Ward 1, with residents engaged in daily wage labour, construction, and informal vending.	442
28	Dandikhiaar Sahi & Jatiakhia Sahi	Residents primarily work in daily wage labour, construction, and informal sector activities.	624

STEP 8:

Overlapping the mapping and GIS Analysis with vulnerability index to identify the communities

Wards based on climate vulnerability: GIS Mapping	Wards based on Vulnerability index	Remarks (reason for selection/not selection)
Ward 1	**Ward 1**	
Ward 23	**Ward 23**	
Ward 24		
Ward 28	Ward 28	Adjacent to ward 23. The same communities extend to ward 28.
Ward 29	Ward 29	Extremely small group of urban poor residing in the ward.
Ward 7	**Ward 7**	
Ward 25		
Ward 26	Ward 26	Adjacent to ward 32. Same community. Same livelihood.
Ward 32	**Ward 32**	
Ward 27		
Ward 6		
Ward 9		

	Ward 11	
	Ward 21	An extension of ward 1. Same community residing.
	Ward 22	
	Ward 10	
	Ward 4	
	Ward 13	

Final identified communities:

Ward 1 and 21: Matitota

Ward 23: Dandimala Sahi

Ward 7: Baliapanda

Ward 23: Talabania (Sanjayaji Colony)

Ward 32: Penthakota

Prior experience of ground truthing and inputs on information availability and execution viability of site by SPANDAN NGO who has been working extensively with the communities has been deployed as a plug in advisory to narrow down to 5 wards that are chosen for the in-depth study.

Sample selection criteria:

Household Surveys done: 130

A Purposive-Random (Stratified Random within Purposive Framework) sampling was used. We purposely selected the target communities, their areas of residing, gender of respondent, age profile and livelihood types. Of these shortlisted households, there was a random selection of households surveyed to remove any preconceived biasness and ensure fairness.

Mixed Sampling:

Reason	Benefit
Combine depth with representativeness	You reach the *right groups* and still avoid selection bias within them
Ethical and inclusive	Avoids cherry-picking just the "worst cases" or "easiest to find" cases
Scientifically sound	Gives your findings more credibility while still focusing on the vulnerable

1. **Gender of Respondent / Head of Household**

Sub-group	Target
Female-headed households	40%
Male-headed households	40%
Other genders	10%
Joint/elderly-headed households	10%

Women and elderly-led households are often more vulnerable in disasters. This also captures gendered risk.

2. **Age Profile of Primary Respondent**

Age Group	Target
Below 35	30%
36–60	50%
Above 60	20%

Ensures intergenerational vulnerability is captured especially how youth, adults, and elderly respond differently to risks.

3. Livelihood Type / Source of Income

Type	Target
Fishing-based livelihoods	40%
Daily wage/construction labour	20%
Informal vending or tourism work	30%
Unemployed/seasonal/migrant jobs	10%

Captures livelihood-specific climate risk and income instability.

4. Vulnerability/Exclusion Indicators

Group	Target
Elderly or disabled household members	as on field
Migrant or resettled families	as on field
No access to PDS/Toilets/Water	as on field
Households with children <5 years	as on field

To include those who may be socially invisible but are highly at-risk during climate events. This is decided impromptu on field.

FGD: 5 conducted

Focus Group Discussions were conducted in five purposively identified vulnerable communities of Puri. Within each FGD, a stratified and inclusive recruitment strategy was used to ensure representation across gender, age, disability, and occupational backgrounds. While availability influenced attendance, efforts were made to engage male and female participants equally and to include marginalised voices, including persons with disabilities and diverse gender identities.

In this study, one Focus Group Discussion (FGD) was conducted in each of the five purposively selected urban poor communities in

Puri, identified based on high climate exposure, diverse informal livelihoods, and recurring disaster impacts.

A Purposive-Random approach was adopted for selecting FGD participants to ensure inclusivity, diversity, and contextual relevance, while also attempting to minimise bias in group representation.

Step 1: Purposive Selection of Communities

The following communities were selected purposively, based on:

- High vulnerability to cyclones, flooding, erosion
- Representation of different livelihood types (fishing, vending, construction, sanitation work)
- Locations that regularly face climate-related disruptions

Step 2: Stratified Random Participation Within Communities

Within each selected community, participant recruitment was guided by stratified diversity, where field teams actively sought to include people from varied demographic and social groups. While selection was done on-the-ground (based on availability), an intentional balance was maintained across:

Strata	Inclusion Target
Gender	Women, men, and trans/non-binary participants were included
Age Groups	Youth (18–30), adults (30–60), elderly (60+)
Persons with Disability	Participants with visible and invisible disabilities (where possible)
Occupational Background	Fisherfolk, daily wage earners, vendors, domestic and sanitation workers

Note: In some communities, female participation was higher, as many male members were unavailable due to work commitments. This was acknowledged and documented in the participation logs.

Why This Approach Works

- **Purposive Selection** ensures FGDs are rooted in high-risk communities, where insights are most relevant to climate vulnerability. This is conducted through inputs from the prior experience and information on lived experience of SPANDAN NGO employees.
- **Random and Inclusive Participant Recruitment** enhances the credibility and equity of perspectives gathered, even when selection is constrained by real-world field conditions.

10.3 Survey Questionnaire and Recorded Data

The survey questionnaire was carefully curated keeping in mind all the aspects of the study. The questionnaire was in the form of a google form. Most of the questions were made objective kind, to make it easier for the community to fill and get exact data.

Household Identification

1. Name of Head of Household*

2. Gender* *Mark only one oval.*

Male

Female

Other:

3. Age of Head of Household*

4. Household Size (Number of members):*

5. Number of Children*(0-5 years):*

6. Number of Elderly (Above 60 years):

7. Contact Number:

8. Ward No.: *

9. Name of the locality/community *

10. House Type: *

Mark only one oval.

☐ Kutcha

☐ Semi-Pucca

☐ Pucca

☐ Temporary Shelter

11. Ownership Status *

Mark only one oval.

☐ Owned

☐ Rented

☐ Occupied (Encroached)

12. Duration of Stay in this Settlement: ___ years*

Migration History

13. Did your family originally live here, or did they migrate? If migrated, year of migration ____*

14. If migrated, what was the reason? *

Mark only one oval.

• ☐ Climate disasters (Cyclone, Floods, Erosion, Heat)

• ☐ Livelihood loss

• ☐ Eviction/Relocation due to development projects

• ☐ Better job opportunities

• ☐ Other (Please specify): _____

15. If migrated, from where? *

Livelihood and Income

16. Primary Occupation of Head of Household: *

Mark only one oval.

☐ Fishing

☐ Tourism-related work

☐ Daily Wage Labour

☐ Street Vending

☐ Domestic Work

☐ Construction

Other:

17. Secondary Source of Income (if any): *

18. Other Household Members' Occupation: *

19. Monthly Household Income (Approx.): ₹_____

20. Monthly Savings (if any): ₹_____

21. Access to Formal Banking: *

Mark only one oval.

No

Yes

22. Access to Credit or Microfinance Loans: *

Mark only one oval.

No

Yes

23. Have you faced job loss due to extreme weather events? *

Mark only one oval.

No

Yes

24. Do you receive any government financial assistance (e.g., pension, welfare schemes)? *

Mark only one oval.

Yes

No

25. How often is your work affected by disasters? *

Mark only one oval.

☐ Every year

☐ Sometimes

☐ Rarely

26. Which disasters impact your work the most? *

Mark only one oval.

☐ Cyclones

☐ Floods

☐ Heatwaves

☐ Coastal Erosion

Other:

27. At what stage does the disaster affect your livelihood? *

Tick all that apply.

☐ Before the event (Loss of stock, disrupted supply chains, fear of damage)

☐ During the event (Complete stoppage of work, damage to assets)

☐ After the event (Recovery challenges, no job opportunities)

Housing and Infrastructure

28. Does your house have electricity? *

Mark only one oval.

No

Yes

29. If yes, do you pay bill for the electricity you receive? *

Mark only one oval.

No

Yes

30. Primary Source of Drinking Water *

Mark only one oval.

☐ Piped

☐ Borewell

☐ Tanker

Other:

31. Water Availability *

Mark only one oval.

☐ Daily

☐ Alternate Days

☐ Weekly

Other:

32. Sanitation Facility*

Mark only one oval.

☐ Private Toilet

☐ Shared Toilet in house

☐ Community Toilet

☐ Open Defecation

Other:

33. Waste Disposal Method: *

Mark only one oval.

☐ Municipal Collection

☐ Open Dumping

Other:

34. Access to Cooking Fuel*

Mark only one oval.

☐ LPG

☐ Firewood

☐ Kerosene

Other:

35. Frequency of Power Cuts: * *Mark only one oval.*

☐ Daily

☐ Few times a week

☐ Rarely

☐ Never

36. Have you noticed water contamination (salinity, bad taste, smell)? *

Mark only one oval.

Yes

No

37. How often does your house get flooded during heavy rains? *

Mark only one oval.

☐ Never

☐ Occasionally

☐ Every Year

38. Have you made any modifications to your house for disaster protection? *

Mark only one oval.

No

Yes

39. If yes, what kind *

Climate & Disaster Vulnerability

40. What climate-related hazards have affected your family in the past 5 years? *

Mark only one oval.

☐ Cyclone

☐ Flooding

☐ Heatwaves

☐ Coastal Erosion

☐ Saline Water Intrusion

Other:

41. What has been the biggest impact on your family due to disasters? *

Mark only one oval.

☐ House Damage

☐ Livelihood Loss

☐ Health Issues

☐ Increased Expenses

Other:

42. How do you get disaster warnings? *

Mark only one oval.

☐ Government SMS

☐ Radio/TV

☐ Community Alert

☐ No Early Warning

43. Have you ever had to relocate due to disasters? *

Mark only one oval.

No

Yes

44. If yes, where did you move temporarily? *

Mark only one oval.

☐ Relatives' house

☐ Shelter Camp

Other:

45. Do you have emergency savings or resources for disasters? *

Mark only one oval.

No

Yes

46. What support do you need most during disasters? *

Mark only one oval.

☐ Food

☐ Temporary Shelter

☐ Medical Assistance

☐ Financial Aid

47. Do you receive government support after disasters?*

Mark only one oval.

Yes

No

48. If yes, what kind of support?

Mark only one oval.

☐ Food assistance

☐ Temporary shelter

☐ Financial aid

☐ Reconstruction assistance

Other:

49. If no, why not?

Mark only one oval.

☐ No awareness about schemes

☐ Delays in getting help

☐ Corruption/Preference given to certain groups

☐ No official papers to claim benefits

Other:

50. Do local leaders or government officials help in getting compensation?*

Mark only one oval.

Yes

No

51. If compensation is available, do all affected people receive it equally? *

Mark only one oval.

☐ Yes, fairly distributed

☐ No, only certain communities benefit

Other:

52. Are there local organisations/NGOs that help during disasters? *

Mark only one oval.

Yes

No

53. If yes, name them*

Health & Education

54. Do household members have access to healthcare facilities? *

Mark only one oval.

Yes

No

55. Have you noticed an increase in diseases (diarrhoea, skin infections, heatstroke) due to climate conditions? *

Mark only one oval.

Yes

No

56. What type of health facility do you visit? *

Mark only one oval.

☐ Government

☐ Private

☐ None

57. Distance to nearest healthcare facility: *

Mark only one oval.

☐ <1 km

☐ 1-3 km

☐ >3 km

58. Do children in your household attend school? *

Mark only one oval.

Yes

No

59. If no, what is the reason? *

Mark only one oval.

☐ Financial Constraints

☐ Distance

☐ No interest

Other:

60. How frequently do children miss school due to disasters? *

Mark only one oval.

☐ Never

☐ Occasionally

☐ Frequently

Gender & Social Inclusion

61. Who makes the major financial decisions in the household? *

Mark only one oval.

Male

Female

Both

62. Do women in the household have access to independent income? *

Mark only one oval.

No

Yes

63. Are there women-led livelihood groups in the community? *

Mark only one oval.

No

Yes

64. Are there safety concerns for women in this area? *

Mark only one oval.

No

Yes

65. Has anyone in your family faced discrimination in accessing jobs or resources or disaster relief? *

Mark only one oval.

No

Yes

66. Do you feel included in community decision-making? *

Mark only one oval.

No

Yes

67. Are there any community disputes or power struggles that prevent access to aid? *

Mark only one oval.

Yes

No

Energy Access & Environment

68. Primary Source of Lighting *

Mark only one oval.

☐ Electricity

☐ Kerosene

☐ Solar ☐ Other:

Other:

69. Do you experience extreme heat during summers? *

Mark only one oval.

Yes

No

70. What measures do you take to cope with heat? *

Mark only one oval.

☐ Use Fans

☐ Seek Shade

☐ Modify House

Other:

71. How does extreme heat affect your household? *

Mark only one oval.

☐ Cannot work outside

☐ Higher electricity bills (cooling needs)

☐ Water shortage

☐ Health issues (headaches, dehydration, heat strokes)

Other:

72. How does heat affect your livelihood? _____*

73. Are there trees or green spaces near your home? *

Mark only one oval.

Yes

No

74. Have you noticed increasing temperatures over the years? *

Mark only one oval.

Yes

No

75. Have you received any awareness programs on climate change or disaster preparedness? *

Mark only one oval.

Yes

No

Future Needs & Aspirations

76. What support would help your livelihood become more stable? *

Mark only one oval.

☐ Skill Training

☐ Government Schemes

☐ Microfinance

☐ Alternative Employment

77. What are your biggest concerns for the future? *

Mark only one oval.

☐ Housing

☐ Income

☐ Education

☐ Climate Risks

☐ Health

Other:

78. Do you have any suggestions for improving disaster resilience in your community? *

SPANDAN to also note and Share:

1. Community details: to be filled by SPANDAN

• Name of the area

• Ward number

• Overall Condition of the community

2. Geo tagged Photos of all the household surveyed.

Survey response sheet:

10.4 Focussed Group Discussion Tool

The FDG will be conducted in 5 different communities which are climate vulnerable. The FDGs would be conducted in participatory manner with activities and discussions.

9.1.1 FDG Schedule (2 hours in total)

Activity 1: Briefing (15 minutes)

Objective: The group would be briefed regarding the project and why are we gathered there.

How It Will Be Done:

Moderator (in local language): "We are here to understand how people in Puri, especially those in neighbourhoods like yours, are affected by climate events like cyclones, floods, heatwaves, and other challenges. We want to hear from you about the problems you face whether it's damage to homes, loss of work, water shortages, or anything else that makes life difficult during these times.

Our goal is to learn how these issues impact your livelihoods, daily life, and future security. We also want to understand what has helped you cope in the past and what kind of support whether from the government, NGOs, or community efforts works best for you. Based on what you share, we will suggest solutions that can help improve conditions for your community and make Puri better prepared for climate challenges.

Your voices are important because you are the ones most affected. The ideas and experiences you share today will help shape better policies and actions that truly benefit your community."

It should be explicitly established and told that we will talk towards the end regarding the needs. The first few discussions are only focussed on problems.

Activity 2: Issue identification (45 minutes)

Objective: An activity to identify the issues that the community faces related to climate hazards and livelihood issues.

How It Will Be Done:

The activity will be in two parts

◇ Part 1: The moderator will ask participants about the major climate-related problems they have faced in the last 5-6 years (e.g., cyclones, floods, extreme heat, water shortages). These issues will be written on large sheets of paper and placed under the "Climate Hazards" column for everyone to see. The moderator to also ask, the months that the communities suffer the most, in terms of each individual climate hazard.

◇ Part 2: After listing the hazards, the discussion will shift to how these hazards affect daily life. The moderator will ask the following questions in an explanatory and detailed format:

- What problems do these hazards cause for your homes and relocation?
- How do they affect your jobs and income?
- What other difficulties arise, such as health issues, school closures, transport disruptions, or damaged infrastructure?

Each issue will be written on post-its or separate sheets and categorised under:

- Relocation/housing issues had to migrate to a different place, the issues of the houses they live in during disasters etc.

- Livelihood challenges: Changes in livelihood due to disasters

- Other issues (education, health, transport, infrastructure, etc.)

- Gender based issues (example. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)

By the end of the activity, a clear visual representation of the community's challenges will be created.

Table to be printed on an A1 sheet.

Post-its of different colours, pens, papers required for the session.

Climate related hazards that they face	Peak duration (in months)	Issue: Housing condition / Relocation / Shifting from place to another	Issues: Livelihood/ Occupation	Issues: Others (Education, Health, transport, infrastructure issues etc.)	Issues: Gender based issues (eg. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)

Activity 3: Discussions on issues (30 minutes)

Objective: To discuss the issues enlisted and get a deeper understanding of the issues along with finding hidden nuances.

How It Will Be Done:

The issues that came out of the previous activity will be discussed in detail by going through them in depth one by one.

Post that specific prompt to be given (if not discussed earlier) on the below listed topics (MANDATORY TO COVER):

- Schemes that they are benefitted from (BSUP, PMAY, MNREGA, NULM etc.)
- Who they go to if they have issues? For example, going to the ward councillor or any local leader, police, or any other official
- Any major NGO's or SHG's who are associated with them and solve their issues

- Municipal services: condition and how frequent do you use it

Activity 4: What can be done according to them: Need (30 minutes)

Objective: To understand solutions from their end and their needs in the times of climate hazards for betterment of livelihood opportunities and other aspects affecting them.

How It Will Be Done:

Specific prompts to be given by the moderator to understand the smallest nuances from their day-to-day life from the solutions point of view.

The moderator to enlist them and ask follow-up question to design specific solutions for the issues discussed previously.

The moderator to share pictures, notes, videos and activity charts.

9.1.2 FGD & Survey Report

This assessment was conducted jointly by STS and SPANDAN in 5 selected habitations in Puri.

Name of the Cluster	Nature of affecting Issues	Types of communities	Nature of livelihoods
Matitota	Urban Flooding, Water logging, cyclone	Urban poor families	Daily labour, seasonal migration
Dandimalasahi	Cyclone, Poor sanitation and water stagnation increase disease outbreaks during floods	Poor families	Many residents are domestic workers, sanitation workers, or rickshaw pullers, facing economic insecurity.

Baliapanda	Coastal erosion, rising sea levels, loss of fish due to ecosystem changes.	Migrants from various rural villages	Tourism vendors, daily wage labourers
Talabania	Cyclones, Frequent flooding due to poor stormwater management, high eviction risks.	Poor families from various villages	Street vendors, transport workers, and small business owners struggle with instability and displacement.
Penthakota	Coastal erosion, Tropical cyclones, storm surges	Immigrants from Andhra, land title issues, broken houses	Marine fishing, Dry fish making, Daily labour

1. Personal Interviews:

As per the plan personal interviews were conducted in the selected 5 locations. The target was to reach at least 25 persons in each landscape. Google survey format was provided to the assessing team. A total of 130 surveys were conducted between 17th to 25th March.

2. Focus group discussions:

The FGDs are conducted by SPANDAN as per the guidelines prepared by STS. The following table gives the dates and details of FGD.

Date of FGD	Place of FGD	Participants
25/03/2025	Dandimalasahi	32
26/03/2025	Talabania (Sanjaya Colony)	26
26/03/2025	Baliapanda	25
28/03/2025	Matitota	25
04/03/2025	Penthakotta	35

The initial discussions were made to introduce the purpose of the work. They were then promoted to express their experiences relating to disaster. The livelihood challenges they have encountered in the aftermath of the disaster.

Post that, the discissions were summarised through a table. In the second half of the discussion, the team facilitated in mapping these vulnerabilities and possible suggestions to develop resilience in their communities. Following tables summarises the discussion, location wise.

1. Baliapanda (Ward 7)

Climate related hazards that they face	Peak duration (in months)	Issue: Housing condition / Relocation / Shifting from place to another	Issues: Livelihood/ Occupation	Issues: Others (Education, Health, transport, infrastructure issues etc.)	Issues: Gender based issues (eg. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)
Increased pace of tropical cyclones	Oct to January	Houses are incapable of resisting stress of wind during cyclone.	Primary livelihood of 'beach vending' is stopped for months, so long as tourism starts.	* Schools remain closed * Water supply, electric supply remains closed for	* Increased workload over female along with all rehabilitation challenges.

				undeclared time	
	May to June	They have to shift to the nearest safe buildings, as recommended by Govt.	Construction work affected, no income	* Nearest Medical facilities/ services remain irregular	* Debt burden enhanced.
Water logging	July to Aug	Houses remain cut off from the mainland.	Affects regular income source	Children can't go to the facilities.	Electric supply gets affected – no house lightening systems
	Oct to Dec	Snake and other animals enter to the house.		Health hazards due to snake bites	
Heat wave	May to June	Houses in the habitation – increased temp.	Difficult to work	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.
Shutdown due to Corona		Houses are crowded -	No income	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.

2. DandimalaSahi (Ward 23)

Climate related hazards that they face	Peak duration (in months)	Issue: Housing condition / Relocation / Shifting from place to another	Issues: Livelihood/ Occupation	Issues: Others (Education, Health, transport, infrastructure issues etc.)	Issues: Gender based issues (eg. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)
Increased pace of tropical cyclones	Oct to January	Houses are incapable of resisting stress of wind during cyclone.	Primary livelihood of 'beach vending' is stopped for months, so long as tourism starts.	* Schools remain closed * Water supply, electric supply remains closed for undeclared time	* Increased workload over female along with all rehabilitation challenges.

	May to June	They have to shift to the nearest safe buildings, as recommended by Govt.	Construction work affected, no income	* Nearest Medical facilities/ services remain irregular	* Debt burden enhanced.
Water logging	July to Aug	Houses remain cut off from the mainland.	Affects regular income source	Children can't go to the facilities.	Electric supply gets affected – no house lightening systems
	Oct to Dec	Snake and other animals enter to the house.		Health hazards due to snake bites	
Heat wave	May to June	Houses in the habitation – increased temp.	Difficult to work	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.
Shutdown due to Corona		Houses are crowded -	No income	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.

3. Talabania/ Sanjaya Colony (Ward 23):

Climate related hazards that they face	Peak duration (in months)	Issue: Housing condition / Relocation / Shifting from place to another	Issues: Livelihood/ Occupation	Issues: Others (Education, Health, transport, infrastructure issues etc.)	Issues: Gender based issues (eg. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)
Increased pace of tropical cyclones	Oct to January	Houses are incapable of resisting stress of wind during cyclone.	Primary livelihood of 'beach vending' is stopped for months, so long as tourism starts.	* Schools remain closed * Water supply, electric supply remains closed for	* Increased workload over female along with all rehabilitation challenges.

				undeclared time	
	May to June	They have to shift to the nearest safe buildings, as recommended by Govt.	Construction work affected, no income	* Nearest Medical facilities/ services remain irregular	* Debt burden enhanced.
Water logging/ splash flood	July to Aug	Houses remain cut off from the mainland.	Affects regular income source	Children can't go to the facilities.	Electric supply gets affected – no house lightening systems
	Oct to Dec	Snake and other animals enter to the house.		Health hazards due to snake bites	
Heat wave	May to June	Houses in the habitation – increased temp.	Difficult to work	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.
Shutdown due to Corona		Houses are crowded -	No income	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.

4. Matitota (Ward 1 & 21):

Climate related hazards that they face	Peak duration (in months)	Issue: Housing condition / Relocation / Shifting from place to another	Issues: Livelihood/ Occupation	Issues: Others (Education, Health, transport, infrastructure issues etc.)	Issues: Gender based issues (eg. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)
Increased pace of tropical cyclones	Oct to January	Houses are incapable of resisting stress of wind during cyclone.	Primary livelihood of 'beach vending' is stopped for months, so long as	* Schools remain closed * Water supply, electric supply remains closed for	* Increased workload over female along with all rehabilitation challenges.

			tourism starts.	undeclared time	
	May to June	They have to shift to the nearest safe buildings, as recommended by Govt.	Construction work affected, no income	* Nearest Medical facilities/ services remain irregular	* Debt burden enhanced.
Water logging/ splash flood	July to Aug	Houses remain cut off from the mainland.	Affects regular income source	Children can't go to the facilities.	Electric supply gets affected – no house lightening systems
	Oct to Dec	Snake and other animals enter to the house.		Health hazards due to snake bites	
Heat wave	May to June	Houses in the habitation – increased temp.	Difficult to work	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.
Shutdown due to Corona		Houses are crowded -	No income	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.

5. Penthakotta (Ward 32):

Climate related hazards that they face	Peak duration (in months)	Issue: Housing condition / Relocation / Shifting from place to another	Issues: Livelihood/ Occupation	Issues: Others (Education, Health, transport, infrastructure issues etc.)	Issues: Gender based issues (eg. women have to take care of kids as well as elderly, a trans person might not be allowed to enter the washroom etc.)
Increased pace of tropical cyclones, storm surges	Oct to January	Houses are incapable of resisting stress of wind during cyclone.	Primary livelihood of 'beach vending' is stopped for months, so long as	* Schools remain closed * Water supply, electric supply remains closed for	* Increased workload over female along with all rehabilitation challenges.

			tourism starts.	undeclared time	
	May to June	They have to shift to the nearest safe buildings, as recommended by Govt.	Construction work affected, no income	* Nearest Medical facilities/ services remain irregular	* Debt burden enhanced.
Water logging	July to Aug	Houses remain cut off from the mainland.	Affects regular income source	Children can't go to the facilities.	Electric supply gets affected – no house lightening systems
	Oct to Dec	Snake and other animals enter to the house.		Health hazards due to snake bites	
Heat wave	May to June	Houses in the habitation – increased temp.	Difficult to work	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.
Shutdown due to Corona		Houses are crowded -	No income	School remains closed- child at home for days together	Increased pressure over women. Sanitation issues arise due to shortage of water supply.

Visit of Team from Selco Foundation to the sites:

It was on 4th April' 25, two experts from Selco Foundation, Bangalore joined the team. They interacted with the communities in Penthakotta. Since the participants number were more, it was decided to conduct the FGD in two groups. Each of them joined in separate group processes. The finding from both the groups were shared in the large group. Very interestingly both the findings were identical (It is summarised in the above table).

Then both of them make transact work inside the community. They also visited an Anganwadi centre in the same hamlet.

Suggestions, community recommendations:

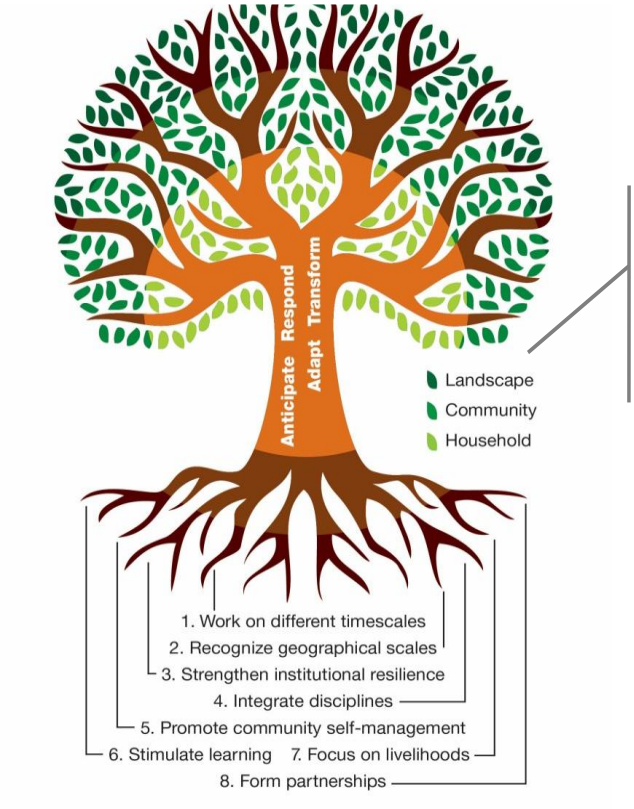
The following suggestions/ requests are based on the reflection of community views on how to minimise the risk and build resilience. It can be further elaborated, and information can be gathered accordingly.

But it is here noteworthy that, intervention to reduce impact of climate change can never be a uniform approach. It varies depending on various landscapes and timescales.

In a disaster situation we need to work on 'immediate response the issue'; then we need to focus on 'anticipation' spheres. The approach then needs to concentrate on 'Adaptation'. This is most important since it talks about community participation. Then the last approach is 'transformation', which means to shift from the place. It is here assumed that no other action/ approach is going to save the particular landscape/ the community.

Approach to develop resilience

- Respond
- Anticipate
- Adapt
- Transform



Levels of intervention

- Landscape
- Community
- Household

Followings are some of the views as discussed with the target communities. It is here noteworthy that all these points are focusing based on the experiences of previous challenges appeared after the disaster.

1) Warning System:

Challenges: -

Getting warning/ information is highly important in a disaster phase. There has been lots in work done in this period. But still more to do in this sphere. We get pre-warning from IMD through TV, Radio and even smart phones. But this is only available as long as power and network are intact. In the aftermath it is not so much available at the community level.

Community prospective: -

i) DRE solutions to make continuous flow of information: There is a need to make information available all the time during the disaster. Most of the time, due to failure of the electricity and mobile network, right information is not reaching them. DRE based systems for warning dissemination will be helpful. There is a need to work to develop the **Puri Meteorology branch** (office) solar fitted, so that information can be available even there is no electricity in the aftermath.

ii) Equipping Local Responding Agencies with Satellite Phones: It is highly important that the support agencies should know about the ground situation in the aftermath of any disaster. It has been experienced in various disasters like cyclones and floods that the two-way information exchange is not possible due to disturbances occurred with power supply and mobile networking. A satellite phone can bridge this gap. The local agencies/ communities can express their vulnerabilities rightly and progressively with the out-

side support agencies (both Govt and Non-govt). This will help in developing effective respond plan.

2) Designing right shelter for the communities against multi-hazards:

Challenges: -

The houses of these clusters are made in low line areas. These houses are not capable enough to withstand wind speed during cyclones. In the summer also these houses are not helping, since it gives equal temperate as that of outside. There are less options for ventilation in a slum habitation.

Community prospective: -

Here the focus is to re-design homes and community places to face multi hazards. DRE solutions need to be added on so as to make the recovery process easier and faster. It is here noteworthy that, there are certain schemes under which urban housing can be done, with proper planning.

3) Resilient livelihood promotion:

Challenges: -

Any livelihood which can provide income soon in the aftermath of any disaster can be termed as resilient. Most of the people in these locations are engaged in different activities. Dry fish making (4000 women engaged) is one of the important activities of from the fishing community of Pethakotta. The communities in other locations depends on tourism and labour work. In the aftermath of disaster both these sectors stood incapable to give income to the community. It is important to keep women as the primary focus for this.

Community prospective: -

It can be planned to develop programmes to linkage DRE solutions for these livelihoods. Mission Shakti programme can be merged while designing such kind of interventions. Some of the examples are-

i) Climate smart dry fish making and selling.

ii) Promotion of DRE based small enterprise – tailoring units, roti-making units, kirana shops, LSK units etc.

iii) Skill building training to engage with hotels and other tourism options.

4) Educational infrastructure:

Challenges: -

Schools and angawadi remain close in the aftermath of any disaster. Not only the children's education gets affected, but also they loss the nutritional part.

Community prospective: -

Smart infrastructures is needed to develop and make these important institutions to run and provide services quickly. The Mass Education offices are also needed to run in DRE based support systems. The Anganwadi centres can be equipped with such infrastructures.

4) Resilient Health Service Facility promotion:

Challenges: -

Small health facilities are always neglected. Therefore, the immediate services which remains closer to the community needed to recover as soon as possible.

Community prospective: -

Selective health facilities needed to be covered under solar power. This will give support to the community easily, rather than going to the core health facility of the city.

5) Drinking water service:

Challenges: -

These communities are supplied with pipelines and get the benefit of fresh water for various purposes. In an aftermath situation, due to failure of electricity, the pump houses could not supply water. The community has to collect such portable water from far off places.

Community prospective: -

By designing some models such as running of motors by solar energy in the pump house would be one of the unique models. It will be resumed its services earlier.

Water logging issue in the city of Puri, Urban place to use boasts for sending the children to school.

The city of Puri, while it was affected by an urban flood in 2018. The slum houses had to remain in this situation for 20-30 days.

Conclusion:

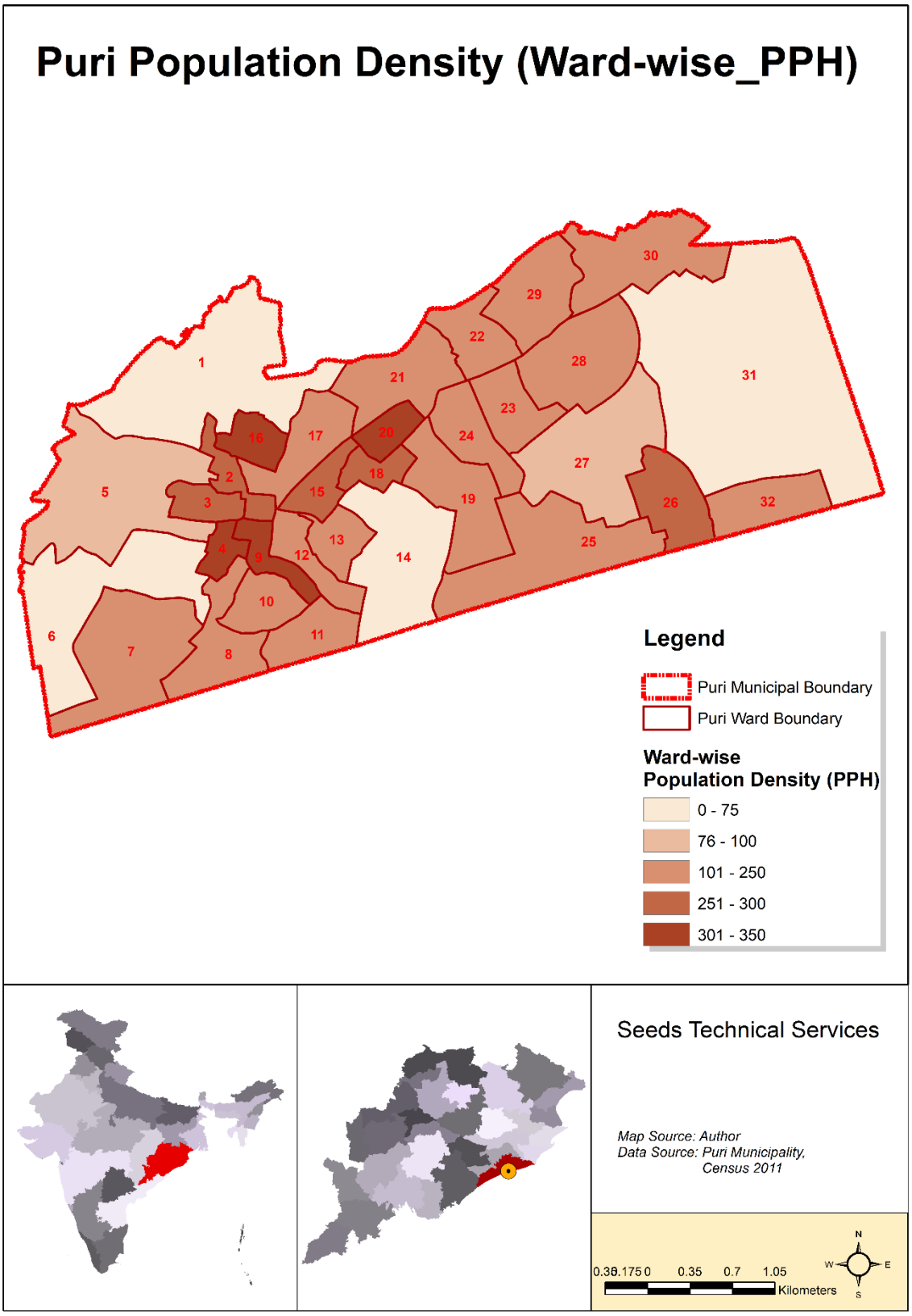
This ground truthing helped us to review several ways of reducing climate induced stress for the local urban poor communities. This can be further developed by a mapping process which may be require before any intervention. This will work as a baseline study for further planning.

10.5 Points from Field Consultations

- Houses are poorly built, especially in low-lying areas. Many cannot withstand wind pressure during cyclones.
- Relocation during extreme events is common but stressful, with inadequate support.
- Lack of ventilation and overcrowding worsens heat during summer and leads to unsafe conditions during floods.
- Tourism, fishing, vending, and daily wage labour are the dominant livelihoods.
- All income sources are severely impacted during cyclones, floods, and heatwaves.
- Fishing families lose nets and boats; tourism stalls and vendors see business shutdowns.
- Post-disaster income recovery is slow; many resort to borrowing.
- Schools and Anganwadis shut down during disasters, affecting education and nutrition.
- Electricity and water supply stop due to failure of pumping stations and wiring.
- Drainage is blocked, leading to prolonged waterlogging in Matitota, Dandimala, and Talabania.
- Snake bites and health hazards are common due to stagnant water.
- Women bear a disproportionate burden- caring for children and elderly, handling sanitation, managing food and water in crisis.
- Increased mental and physical strain post-disasters, especially in the absence of male support (many men leave for work).
- Transgender persons and people with disabilities face additional access barriers in shared shelters and public spaces.
- Cyclones (Oct–Jan), floods (July–Aug), and heatwaves (May–June) recur annually.

- Penthakota and Baliapanda face frequent coastal erosion and storm surge.
- Matitota and Talabania report frequent waterlogging.
- Communities described 2018 floods and Cyclone Fani as major turning points in their vulnerability.
- Disaster Warning Systems: Demand for solar-powered, decentralised systems for alerts. Request for local meteorology stations and backup communication tools (e.g., satellite phones).
- Climate-Resilient Housing: Stronger roofing, better ventilation, raised plinths; need for government-supported urban housing schemes tailored for multi-hazard contexts.
- Green Infrastructure: Strong demand for shaded community spaces, tree planting in high-LST zones, and improved stormwater drainage.

10.6 Maps & Visual Aids


Puri Population Density (Ward-wise_PPH)
1
2
3
4
5
6
7
8
9
10
11
12
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14
15
16
17
18
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21
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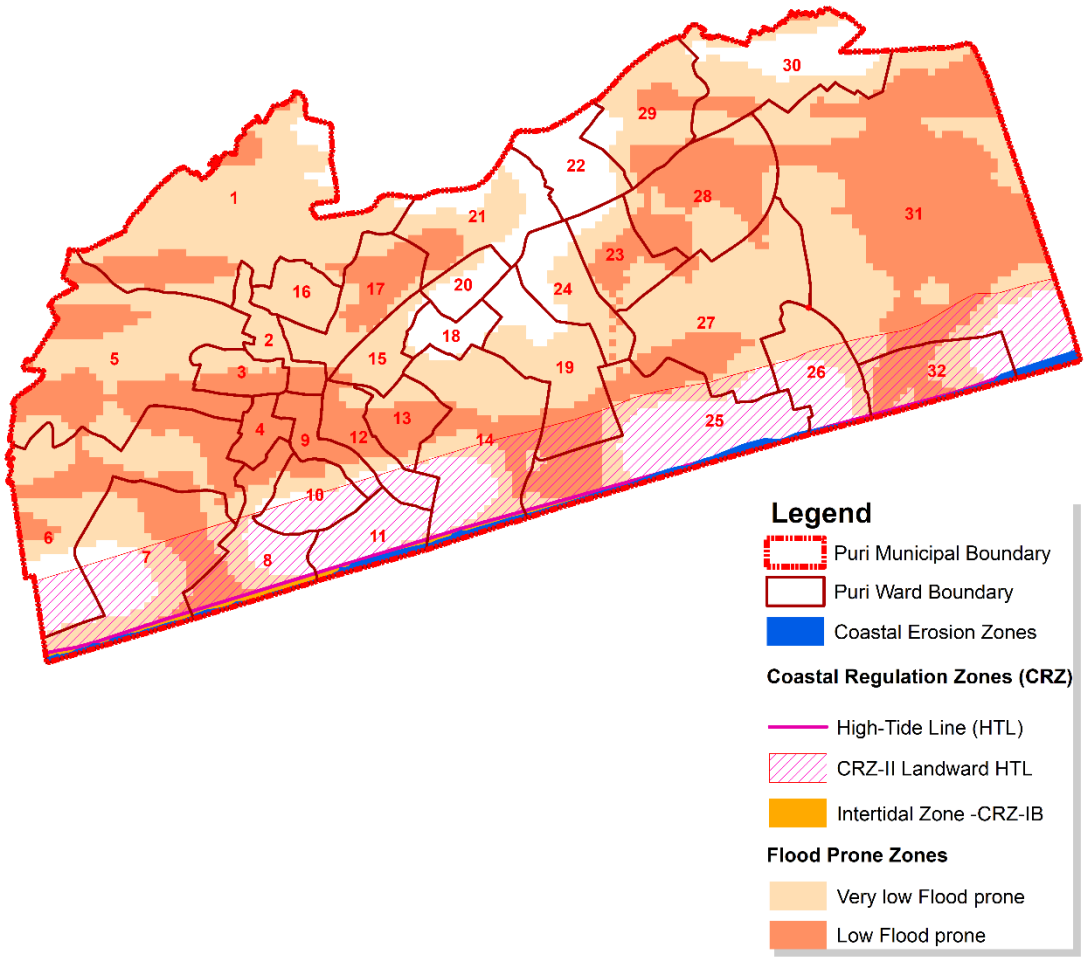
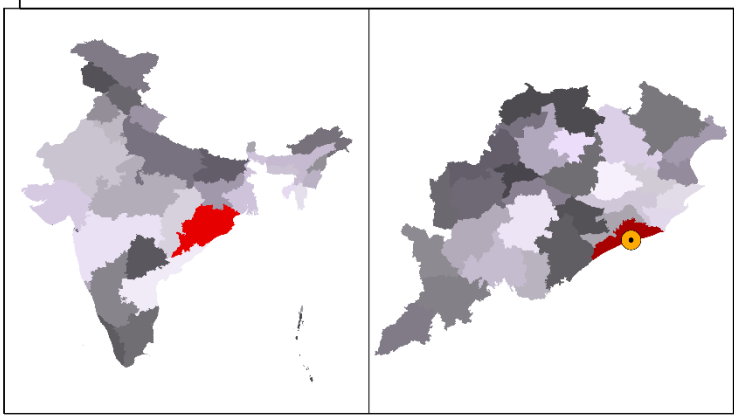
23
24
25
26
27
28
29
30
31
32
Legend
Puri Municipal Boundary
Puri Ward Boundary
Ward-wise
Population Density (PPH)
0 - 75
76 - 100
101 - 250
251 - 300
301 - 350
Seeds Technical Services
Map Source: Author
Data Source: Puri Municipality,
Census 2011
0.35 0 0.175 0.35 0.7 1.05
Kilometers
N
W
E
S

Puri Flood Prone and Coastal Erosion Zone





Seeds Technical Services

Map Source: Author
Data Source: Odisha Space Application Centre (ODSAC)
National Centre for Coastal Research, Flood Hazard Zonation Atlas - Odisha, NRSC

0.35 0 0.175 0.35 0.7 1.05
Kilometers
N
W
E
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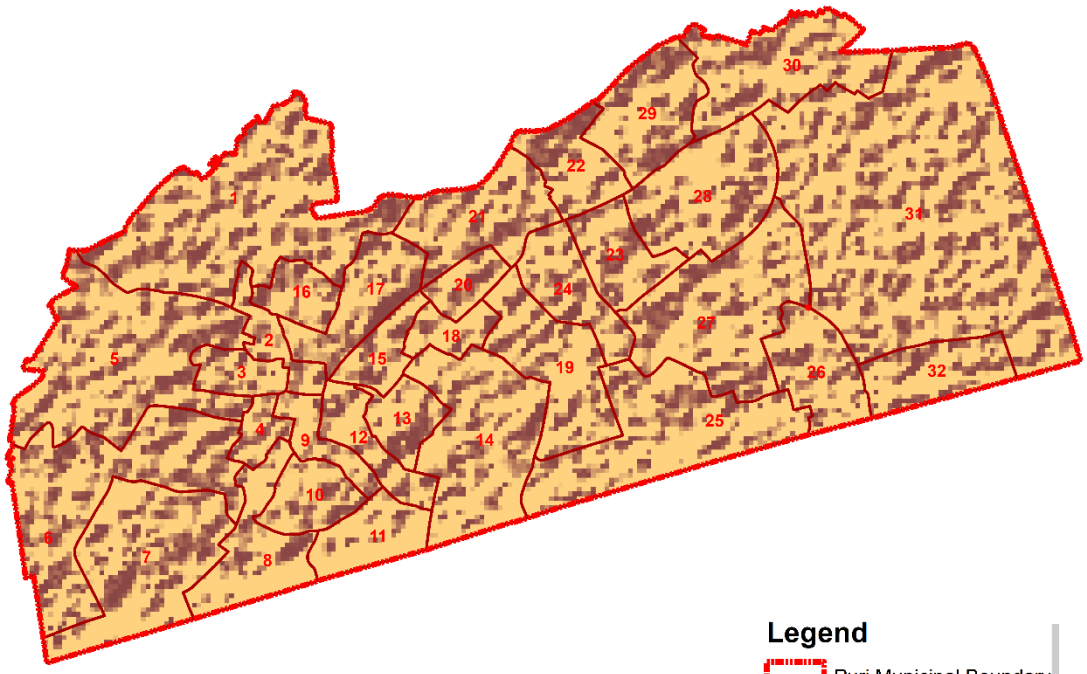
Puri Elevation



Legend

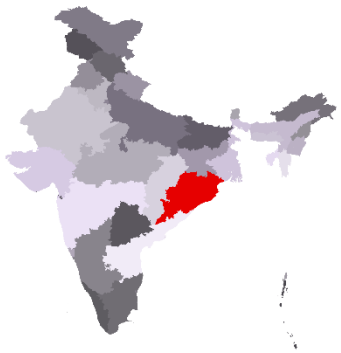
Puri Municipal Boundary

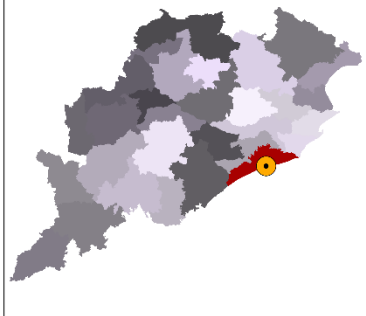
Puri Ward Boundary

Elevation

High : 180

Low : 0



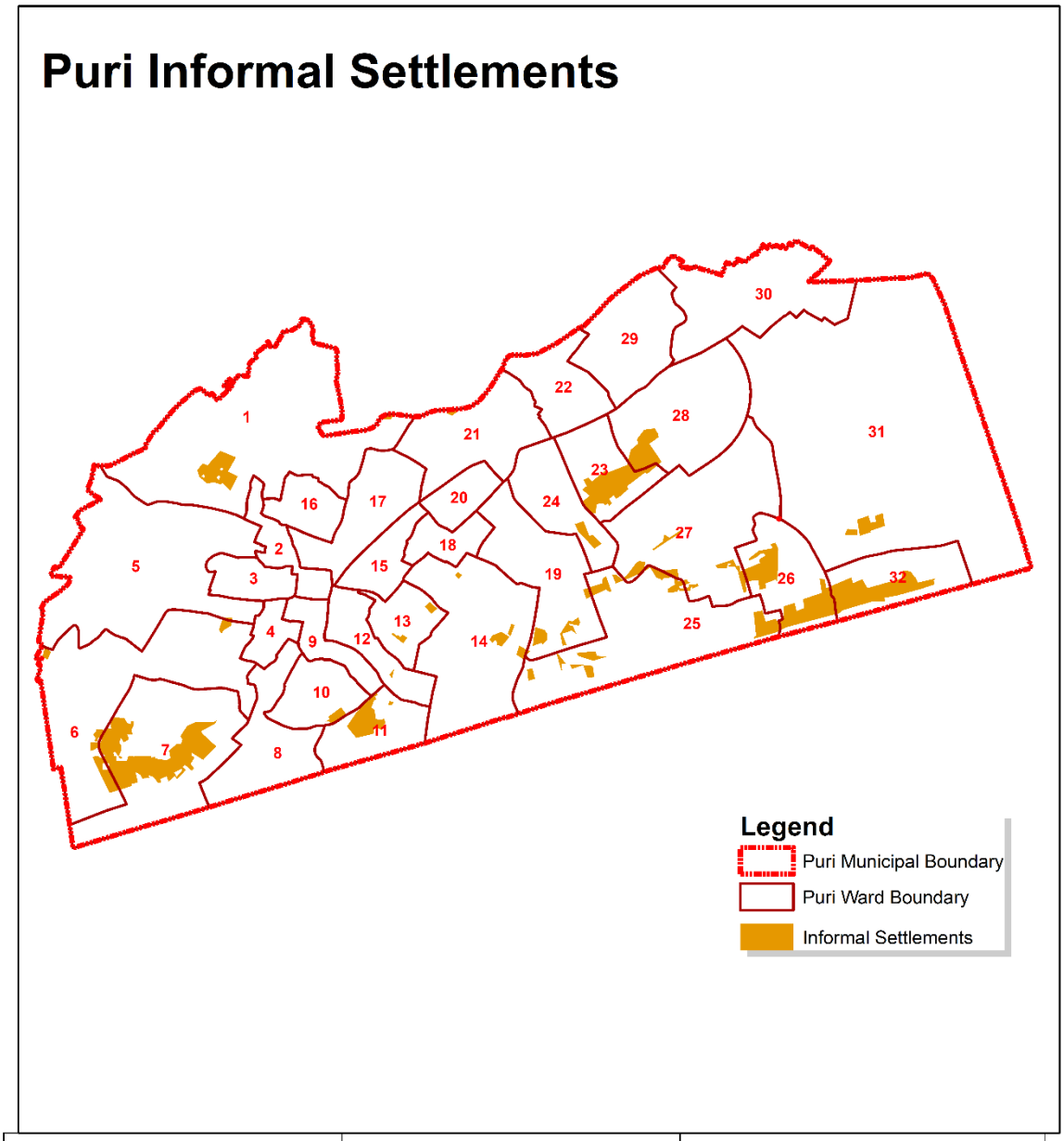


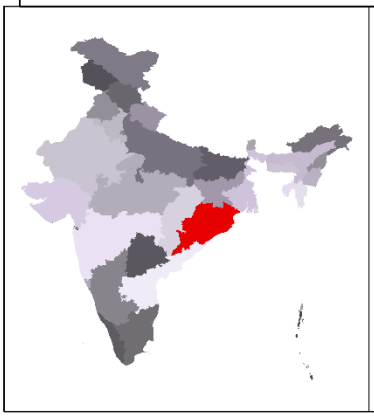
Seeds Technical Services

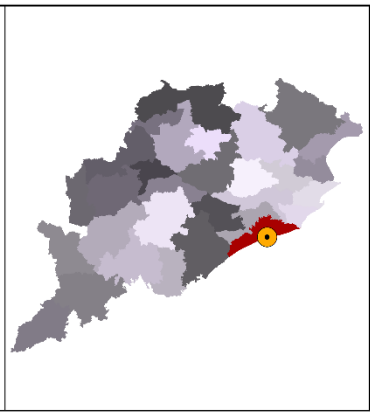
Map Source: Author
Data Source: NASA Earthdata

0.35 0 0.175 0.35 0.7 1.05
Kilometers

N
W E
S







Seeds Technical Services

Map Source: Author
Data Source:

0.35 0 0.175 0.35 0.7 1.05
Kilometers

N
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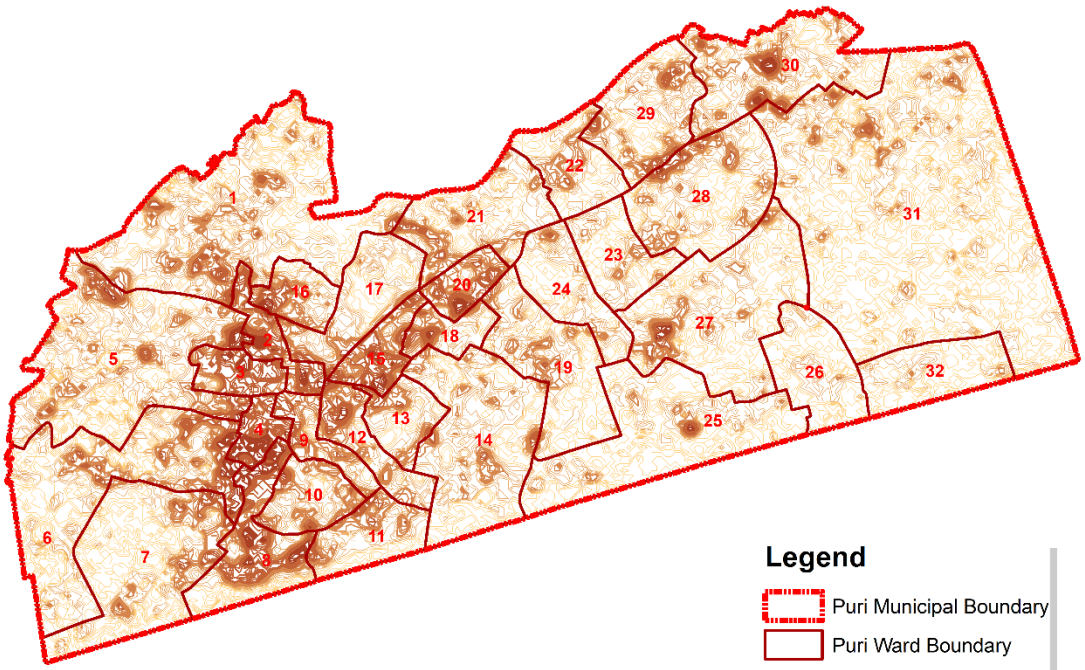
E
S

Puri Contour

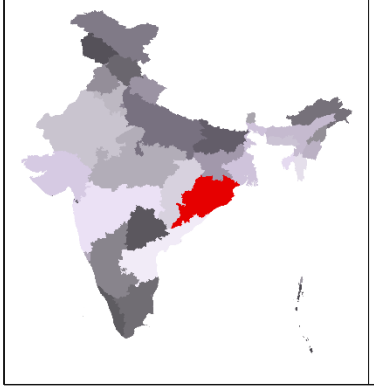


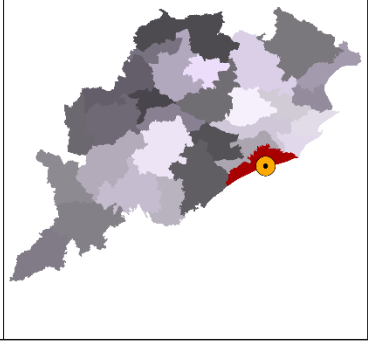
Legend

- Puri Municipal Boundary
- Puri Ward Boundary

Contour (1m)

- 1.000000 - 10.000000
- 10.000001 - 14.000000
- 14.000001 - 18.000000
- 18.000001 - 24.000000
- 24.000001 - 36.000000





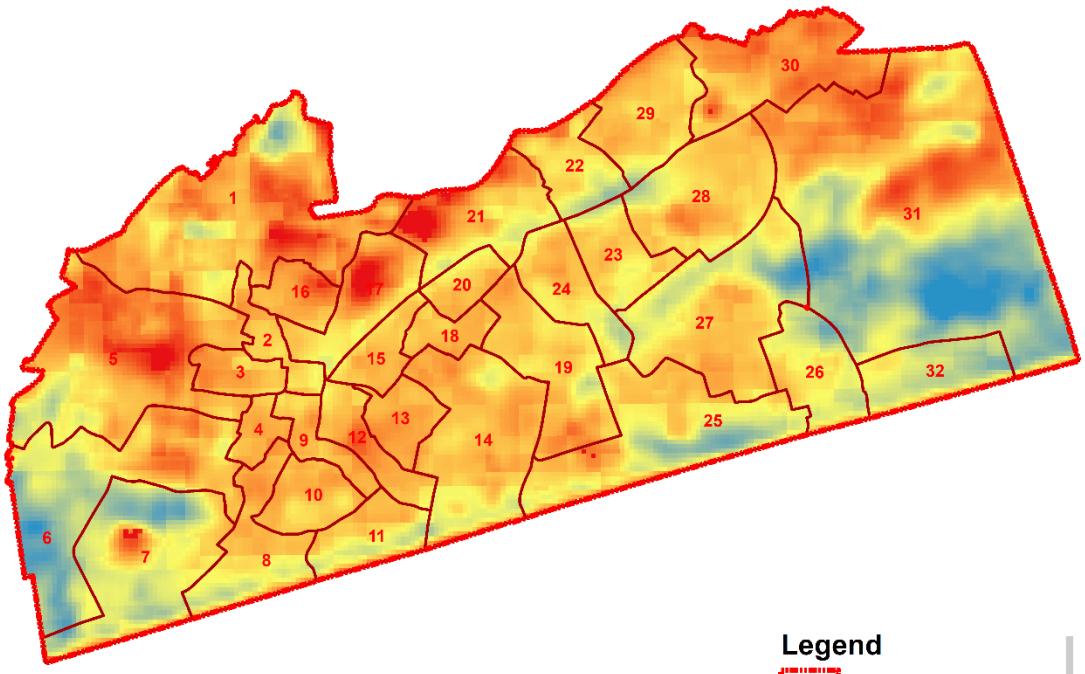
Seeds Technical Services

Map Source: Author
Data Source: NASA Earthdata

0.35 0 0.175 0.35 0.7 1.05
Kilometers

N
W
E
S

Puri Land Surface Temperature (LST)



Legend

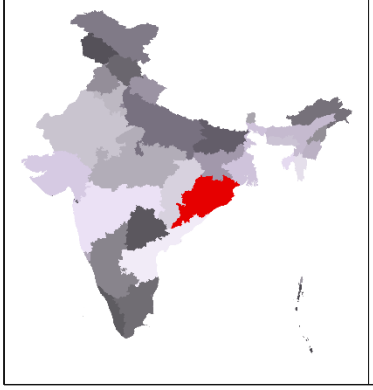
Puri Municipal Boundary

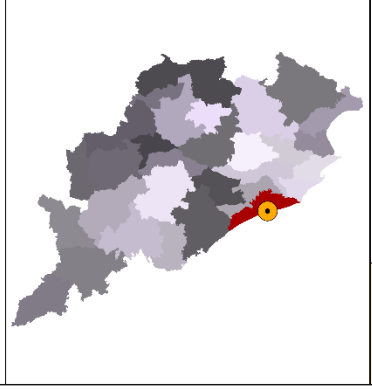
Puri Ward Boundary

Value

High : 47.2808

Low : 34.2845





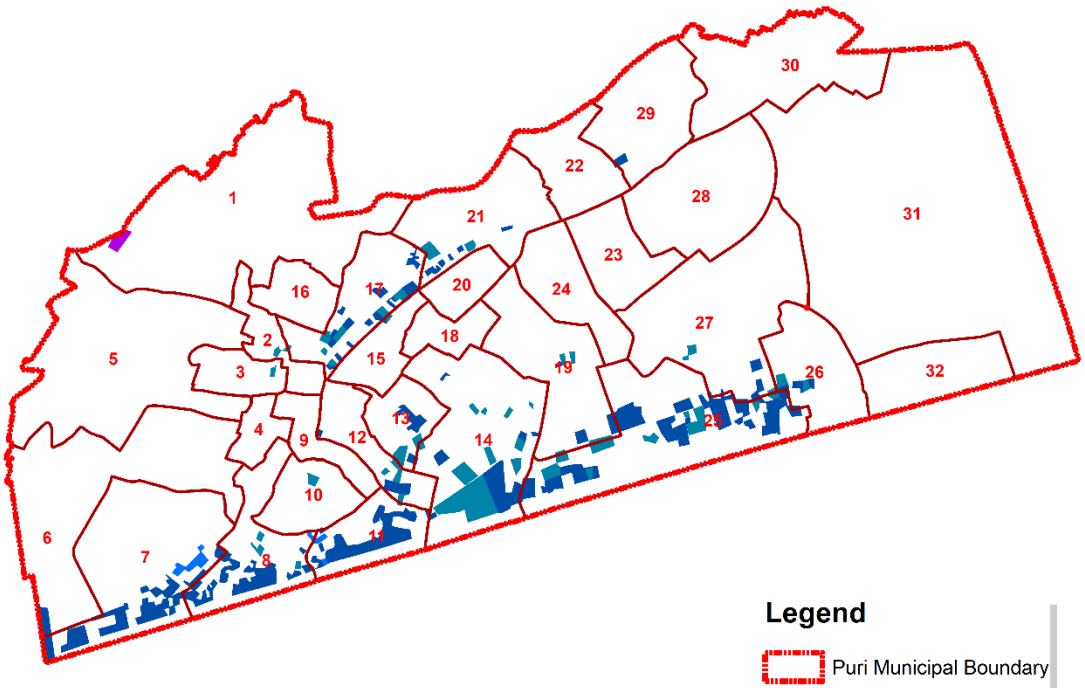
Seeds Technical Services

Map Source: Author
Data Source: USGS Earthexplorer/ Landsat 9

0.35 0 0.175 0.35 0.7 1.05 Kilometers

N W E S

Puri Occupation and Livelihood

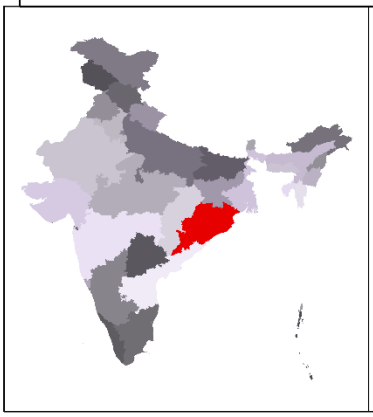


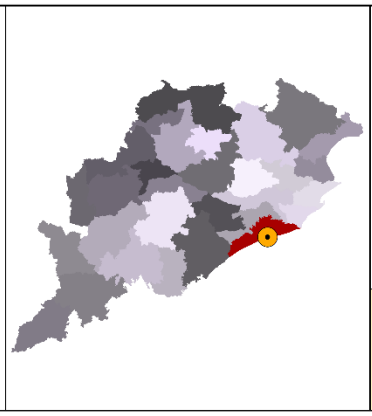
Legend

- Puri Municipal Boundary
- Puri Ward Boundary

Employment Sectors

- Dharmasala
- Hotels
- Industrial
- Market





Seeds Technical Services

Map Source: Author
Data Source: PKDA Master Plan

0.35 0 0.175 0.35 0.7 1.05
Kilometers

N
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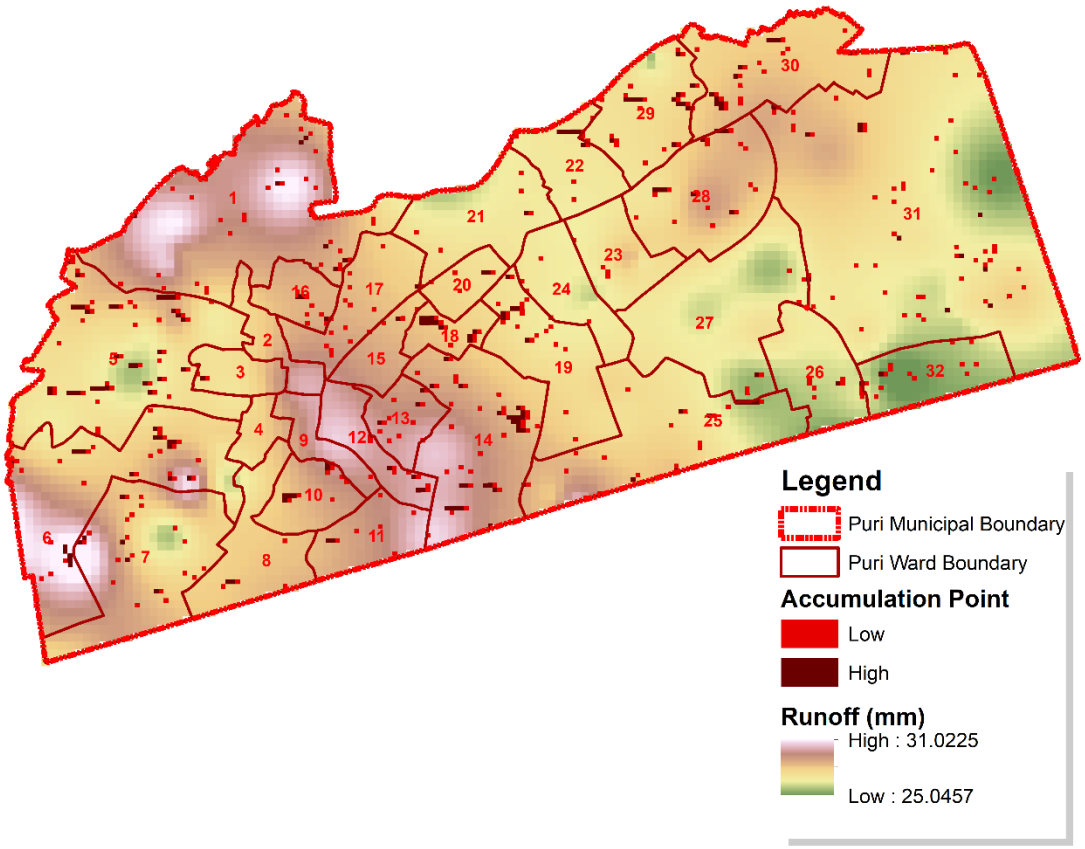
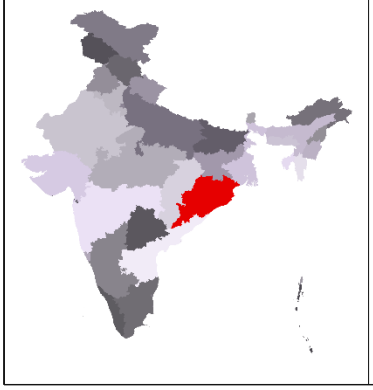
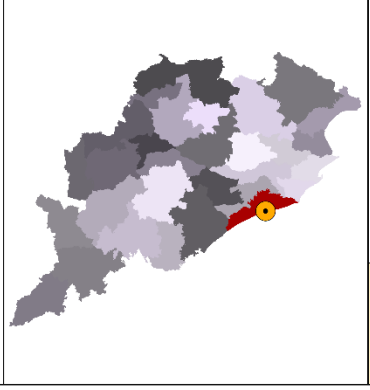
Puri Rainfall Drainage
(Run-off and Accumulation Points)







Seeds Technical Services

Map Source: Author
Data Source: CHRS,
SRTM DEM
NDEM, NRSC

0.35 0.7 1.05
Kilometers

N
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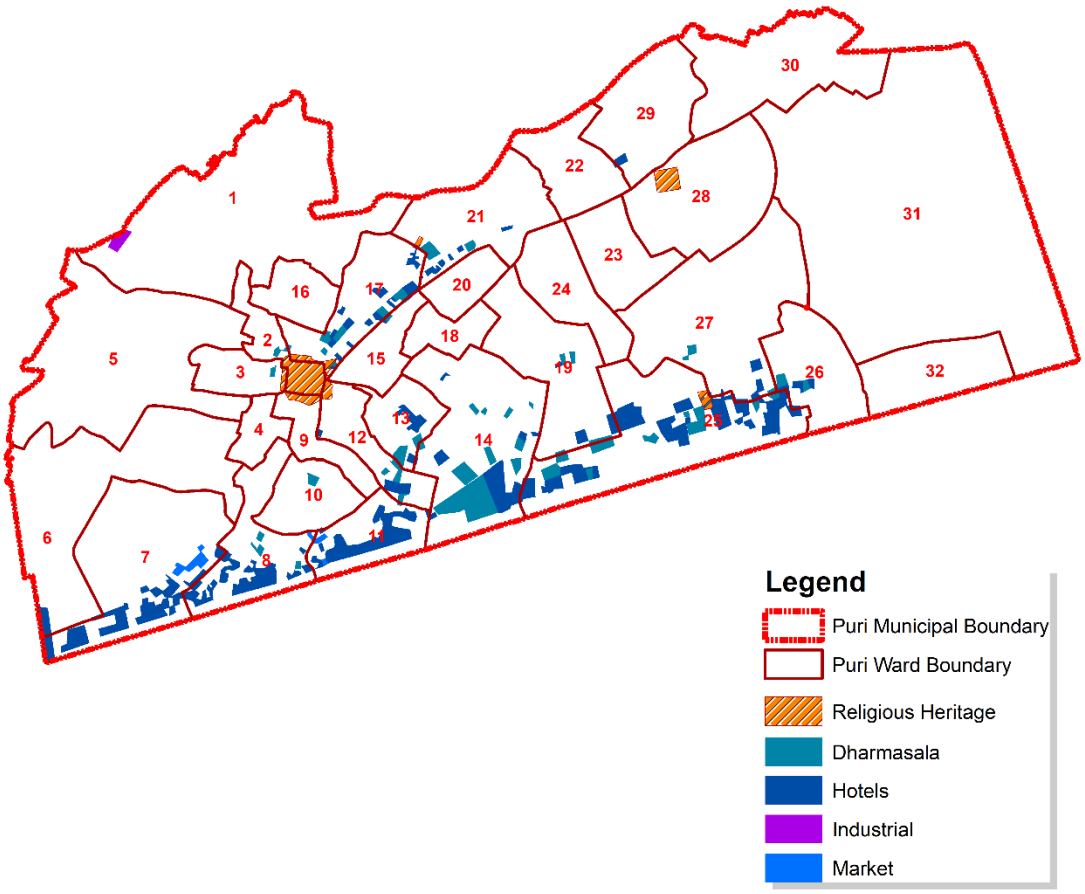
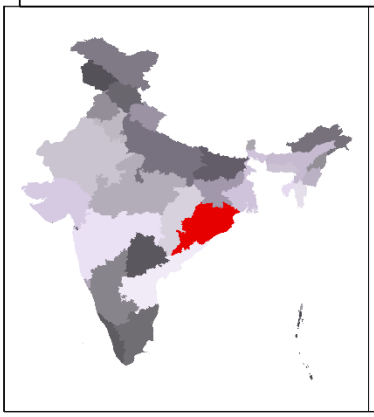
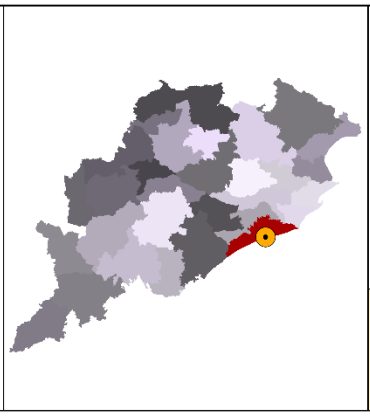
Puri Tourism Business District (TBD)

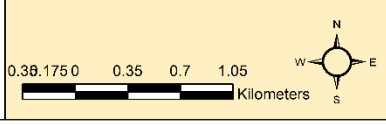




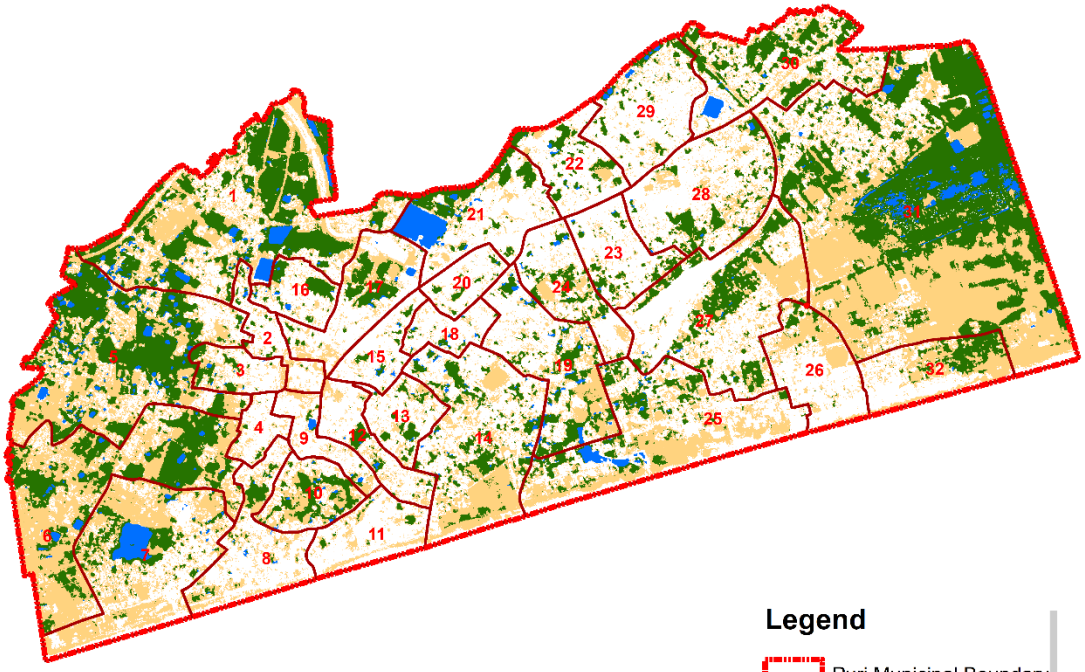


Seeds Technical Services

Map Source: Author
Data Source: PKDA Master Plan

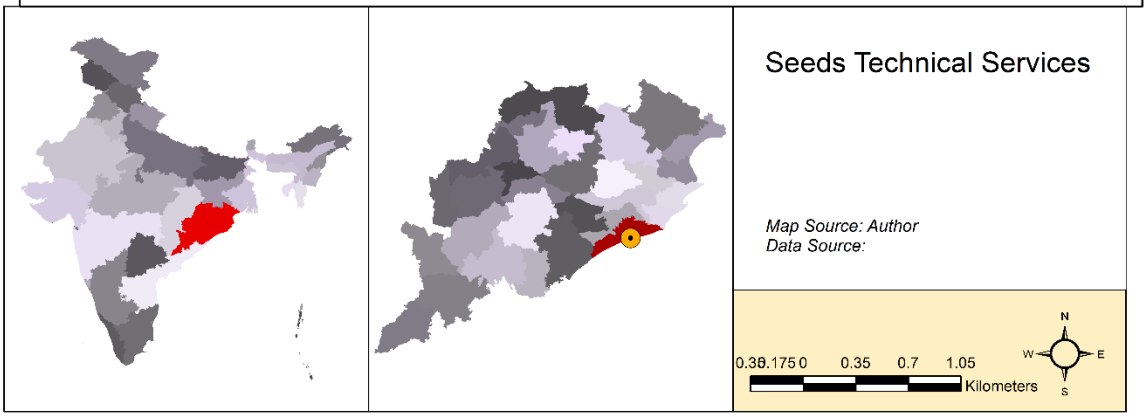


Puri Waterbody and Open Space

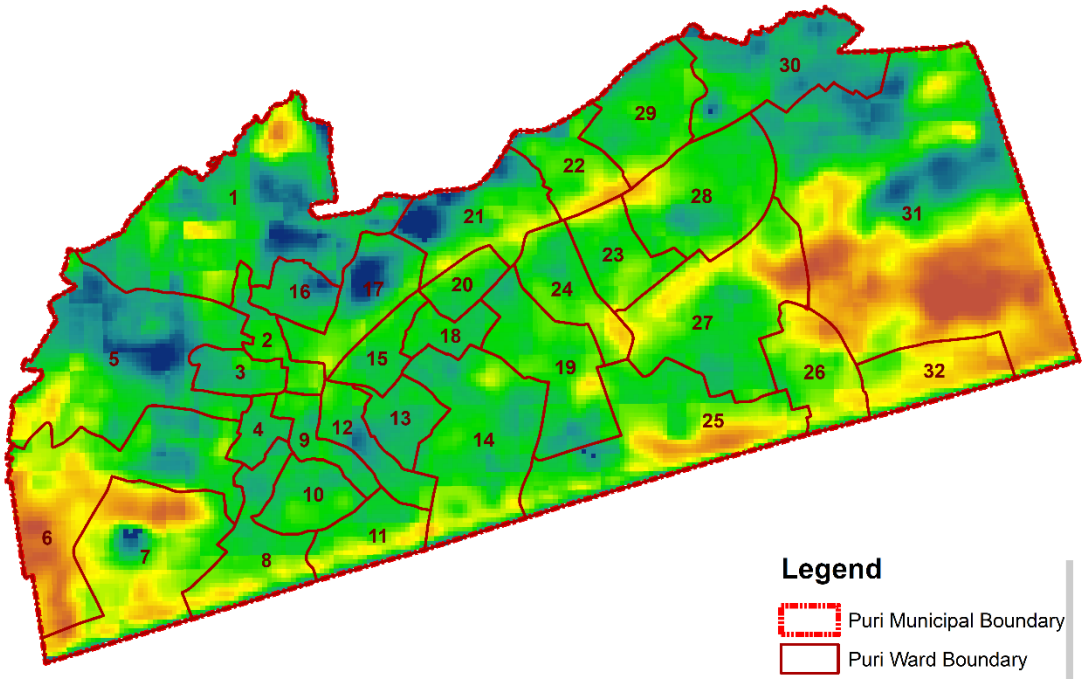


Legend

- Puri Municipal Boundary
- Puri Ward Boundary
- Waterbody
- Vegetation
- Open Space and Parks



Puri Urban Heat Island



Legend

Puri Municipal Boundary

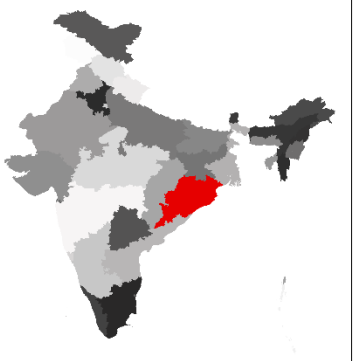
Puri Ward Boundary

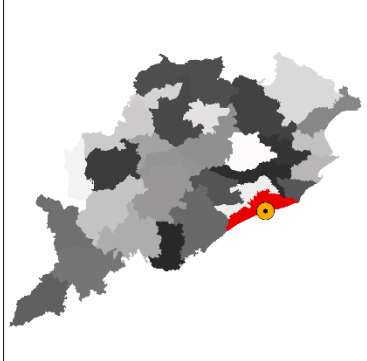
Urban Heat Island

Value

High : 3.6668

Low : -3.56302





Seeds Technical Services

Map Source: Author
Data Source:

0.35 0 0.175 0.35 0.7 1.05
Kilometers

N
W
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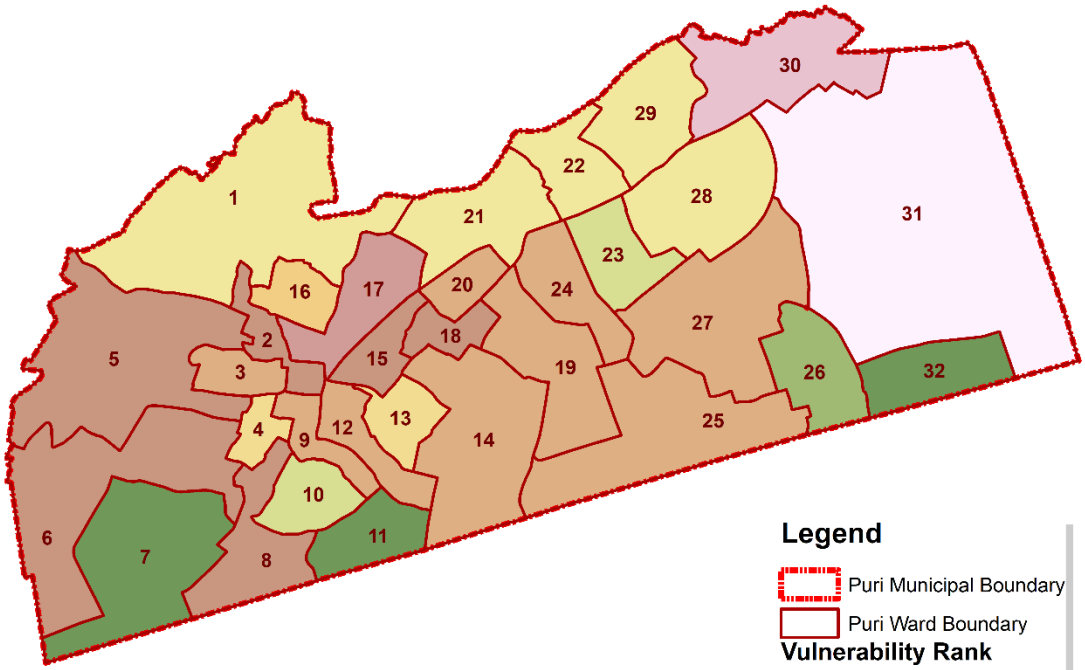
Puri Vulnerability

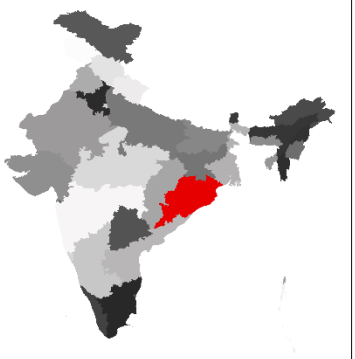


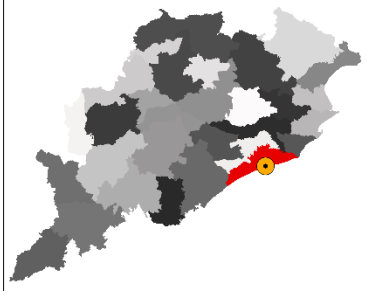
Legend

- Puri Municipal Boundary
- Puri Ward Boundary

Vulnerability Rank

1	15
4	24
5	30
7	31
12	32
14	





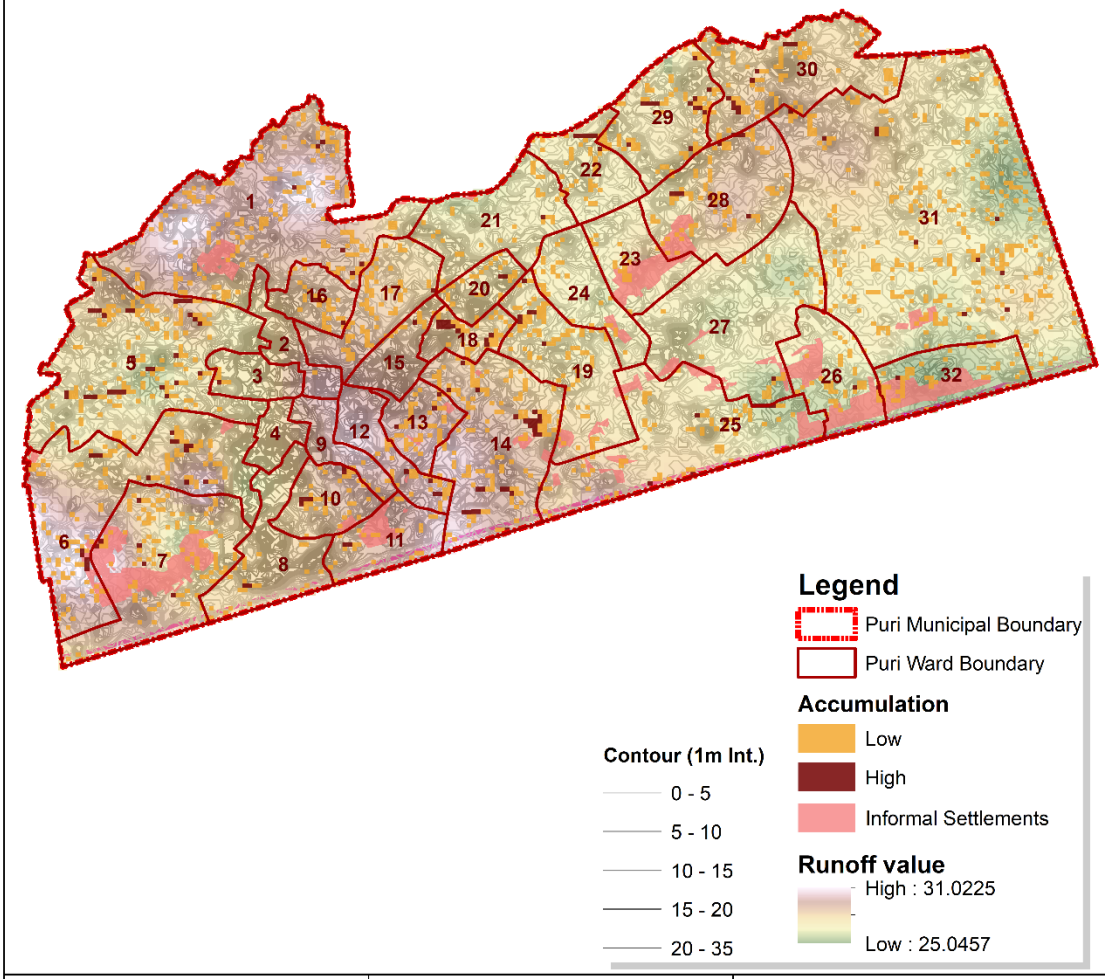
Seeds Technical Services

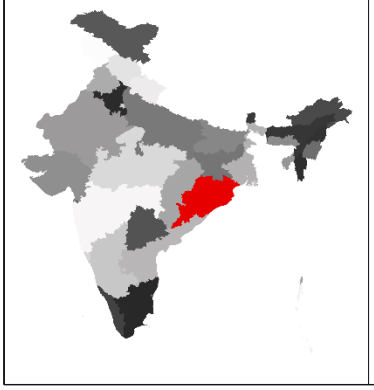
Map Source: Author
Data Source:

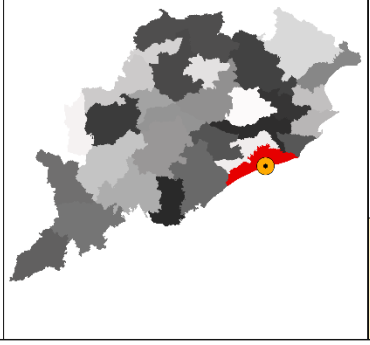
0.35 0 0.175 0.35 0.7 1.05
Kilometers

N
W
E
S

Puri Topography and Drainage







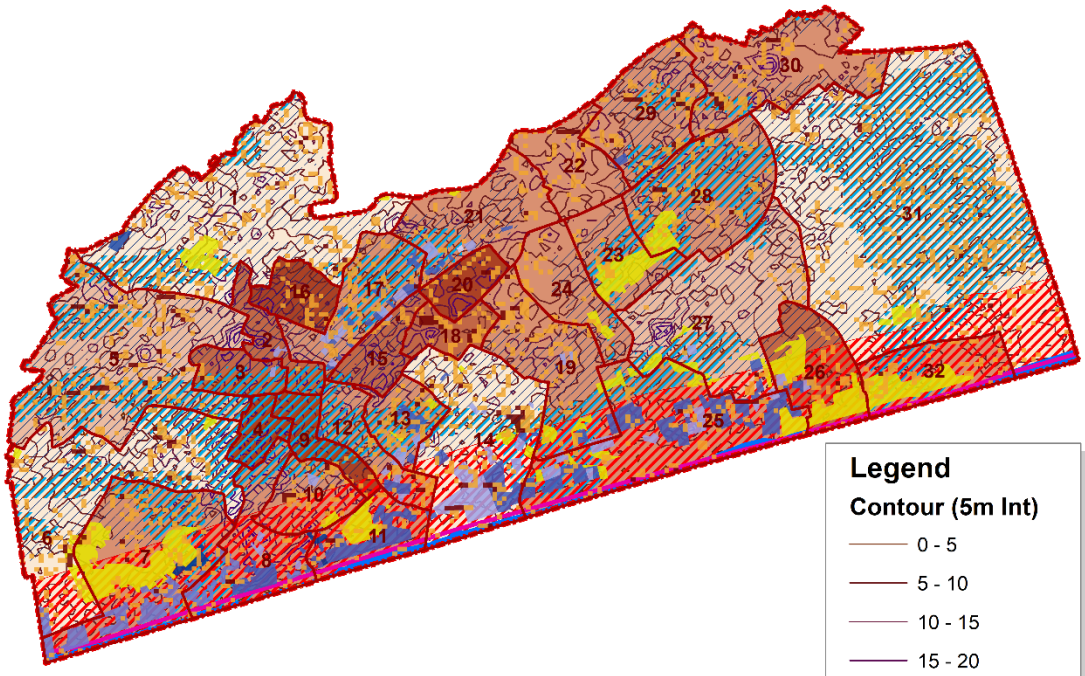
Seeds Technical Services

Map Source: Author
Data Source:

0 0.175 0.35 0.7 1.05
Kilometers

N
W
E
S

Puri Spatial Overlay Analysis



Legend

Contour (5m Int)
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 35

Pop. Density (PPH)
- 0 - 75
- 76 - 100
- 101 - 250
- 251 - 300
- 301 - 350

Flood Prone Area
- Puri Municipal Boundary
- Puri Ward Boundary

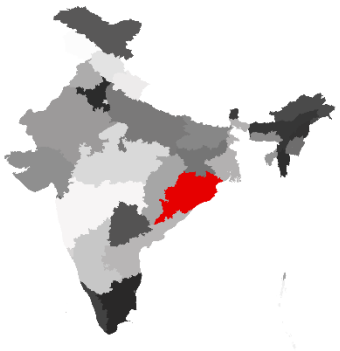
Accumulation
- Low
- High

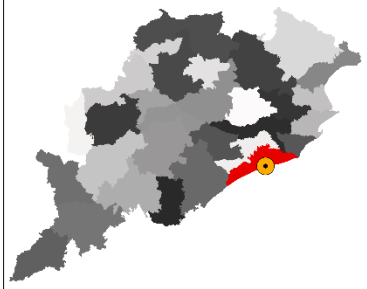
Commercial Landuse
- Dharmasala
- Hotels
- Industrial
- Market

Flood Prone Area
- Informal Settlements

Flood Prone Area
- Very Low
- Low

CRZ Guidelines
- Hightide Line (HTL)
- Coastline Erosion
- CRZ II Landward HTL





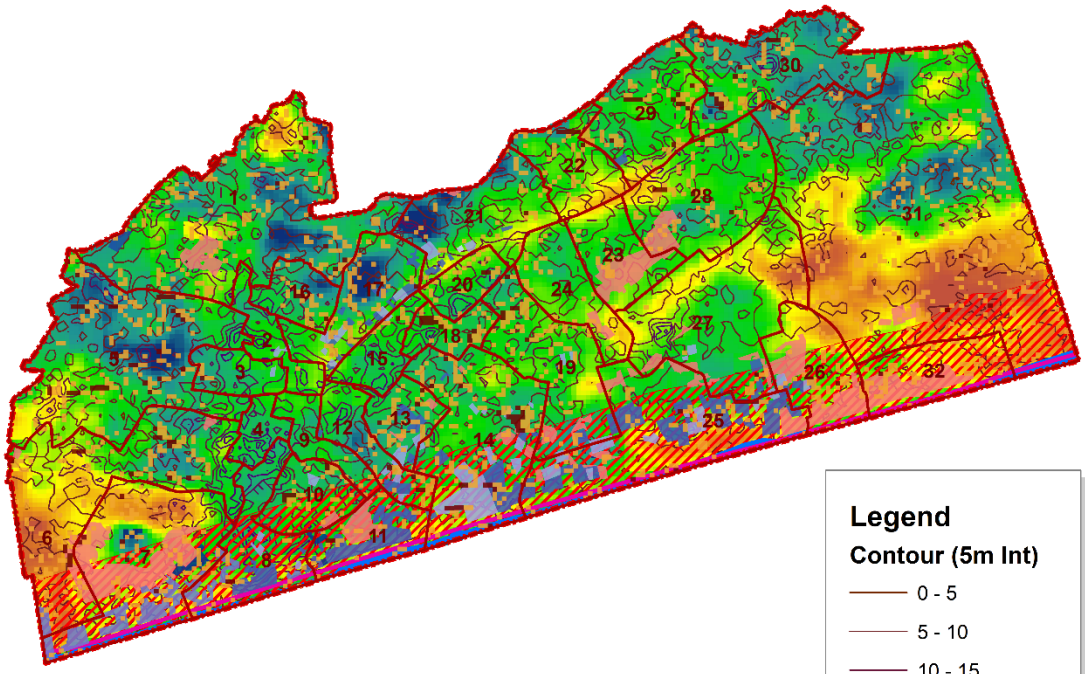
Seeds Technical Services

Map Source: Author
Data Source:

0.35 0 0.175 0.35 0.7 1.05 Kilometers

N W E S

Puri Livelihood and Economic Vulnerability



Legend

Contour (5m Int)
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 35

Urban Heat Island

Value
- High : 3.6668
- Low : -3.56302

Flood Prone Area
- Puri Municipal Boundary
- Puri Ward Boundary

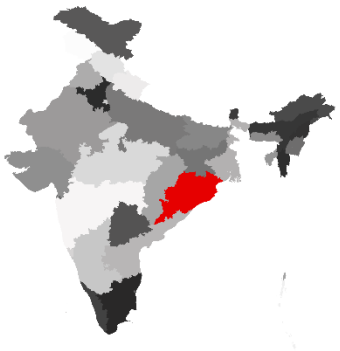
Accumulation
- Low
- High

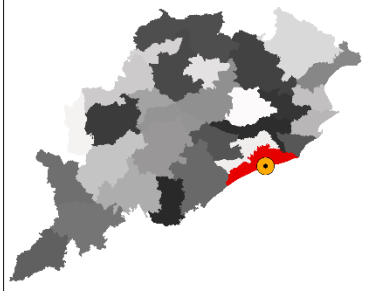
Commercial Landuse
- Dharmasala
- Hotels
- Industrial
- Market

Flood Prone Area
- Informal Settlements

Flood Prone Area
- Very Low
- Low

CRZ Guidelines
- Hightide Line (HTL)
- Coastline Erosion
- CRZ II Landward HTL



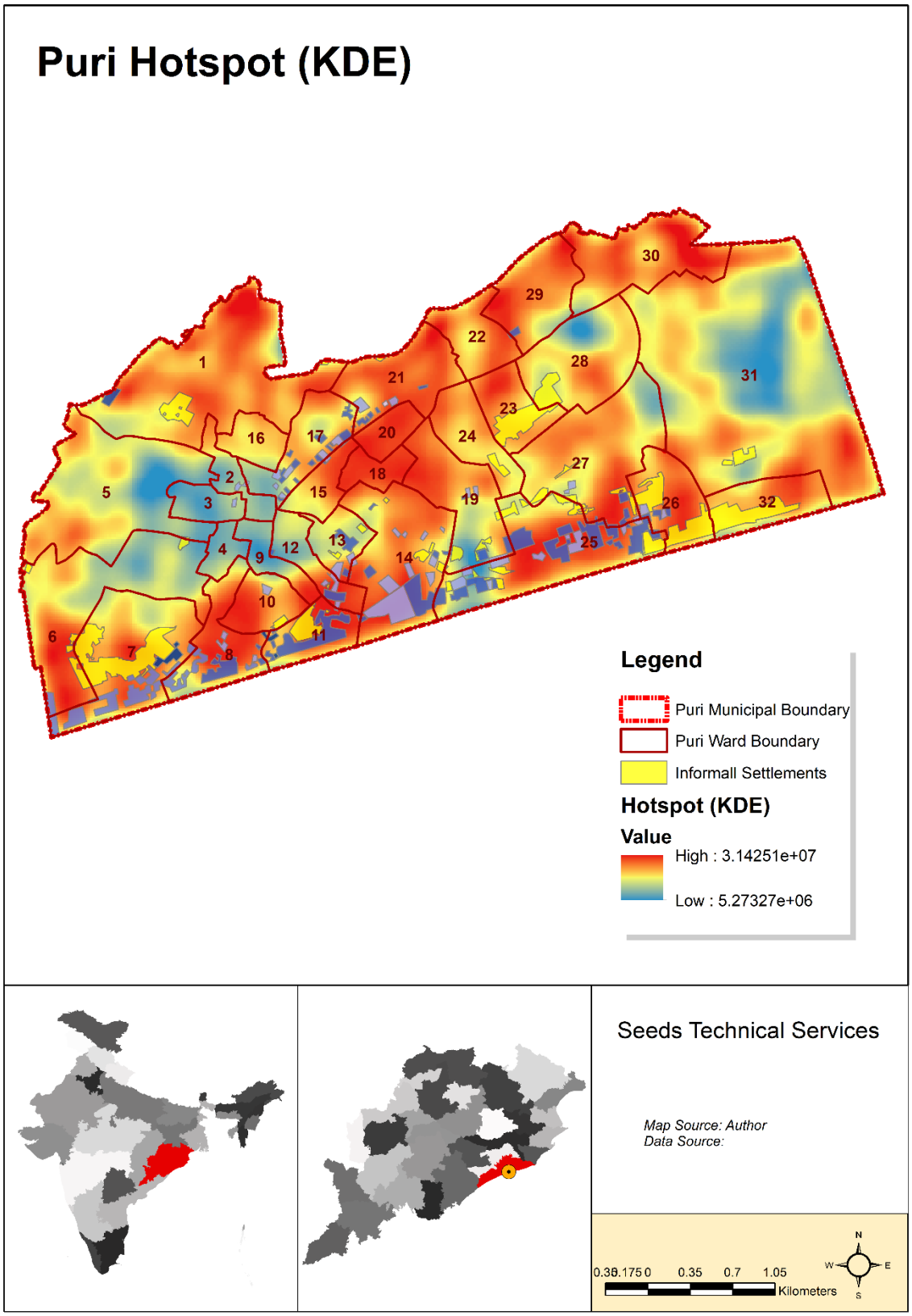


Seeds Technical Services

Map Source: Author
Data Source:

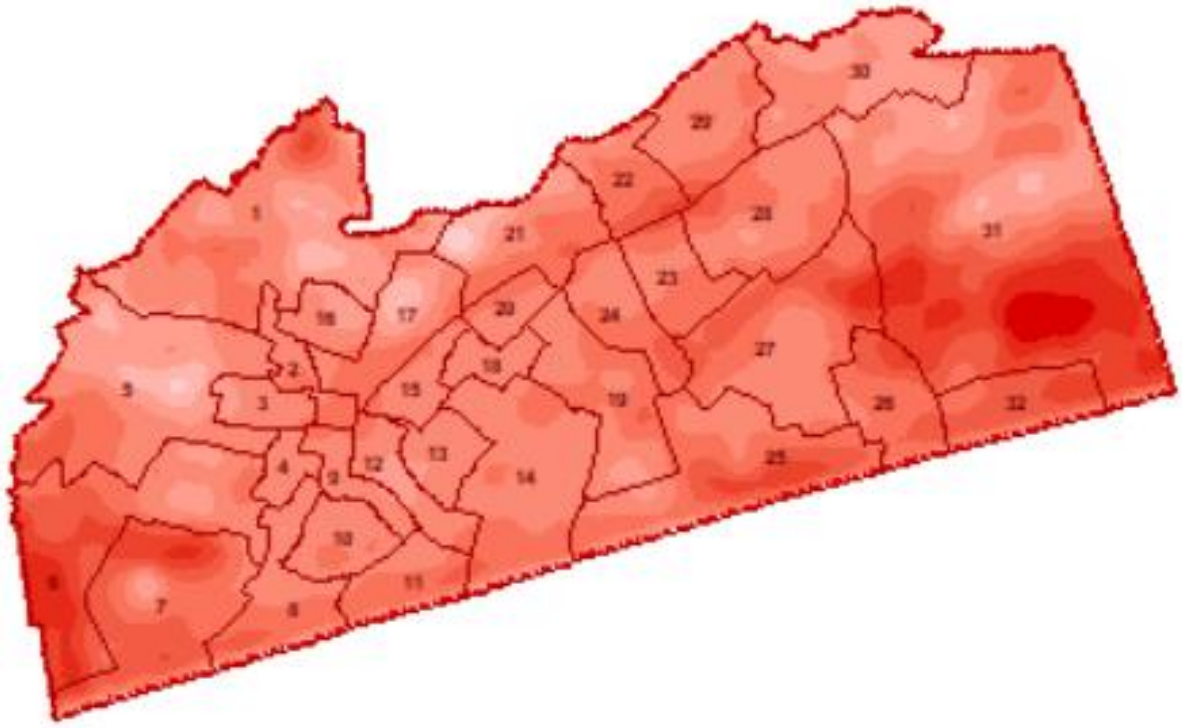
0 0.175 0.35 0.7 1.05
Kilometers

N
W
E
S

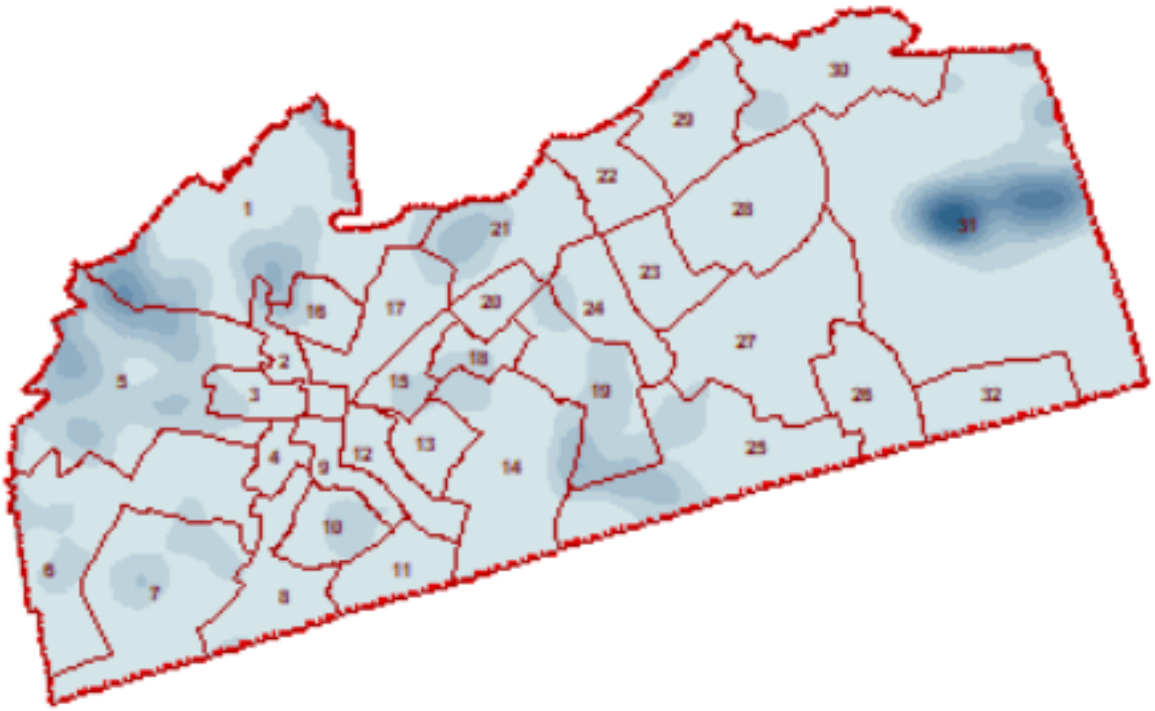


2.1.2. Supporting maps for the above maps

LST KDE



Water KDE



Vegetation KDE

Flood KDE