Integrating Resilient Sanitation Systems in Flood - Prone Coastal regions

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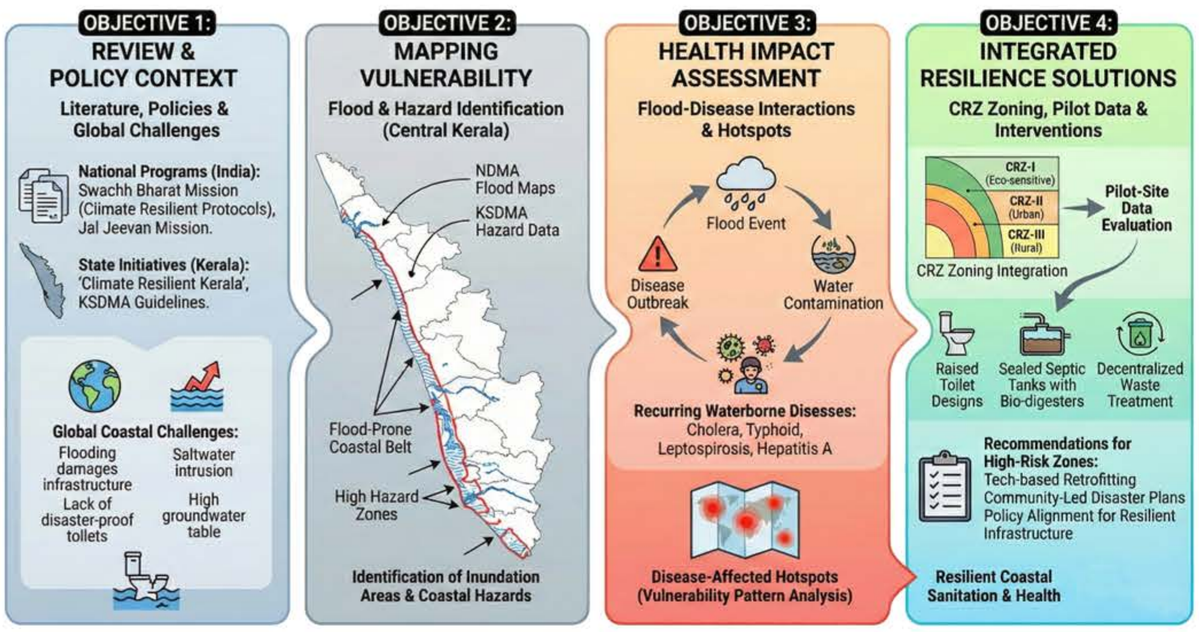
BACKGROUND & PROBLEM

- Coastal settlements face recurrent flooding, high groundwater and tidal backflow.
- Conventional on-site sanitation systems fail during inundation events
- Flood- induced sanitation failure leads to ground water contamination and public health risks.

AIM

The study integrates sanitation planning with urban planning tools like land use, zoning and flood mapping which aims on spatial planning of the sanitation system that reduces the spread of water borne diseases in coastal regions/To assess sanitation resilience in flood-prone coastal regions by integrating flood vulnerability, disease risk, and regulatory zoning (CRZ) to identify high-risk hotspots and provide recommendations for these zones.

OBJECTIVES



METHODOLOGY

KERALA'S COASTAL VULNERABILITY

Source: Kerala State Disaster Management Authority. Coastal hazard susceptibility map of Kerala.

- Ernakulam's coastal wards face frequent monsoon flooding due to high water table and backwater influence.
- Thrissur's low-lying coastal plain is highly flood-prone due to river–canal drainage, affecting CRZ areas, fishing communities, and sanitation.
- Alappuzha's low-lying coast remains flood- and waterlogging-prone despite proposed drainage measures, with persistent sanitation gaps.

Grama Panchayat	Extent of Flooding	Spatial Characteristics of Flood Extent
Kadappuram	Very High	Continuous coastal flood risk affecting majority of residential areas
Vadanappally	Moderate to High	Scattered, discontinuous inland flood pockets
Chellanam	Moderate (Spatially Limited)	High open-coast flood exposure; reduced risk in built-up areas due to seawalls
Elamkunnapuzha	Moderate	Widespread inland and backwater-adjacent flood-prone zones beyond the coast

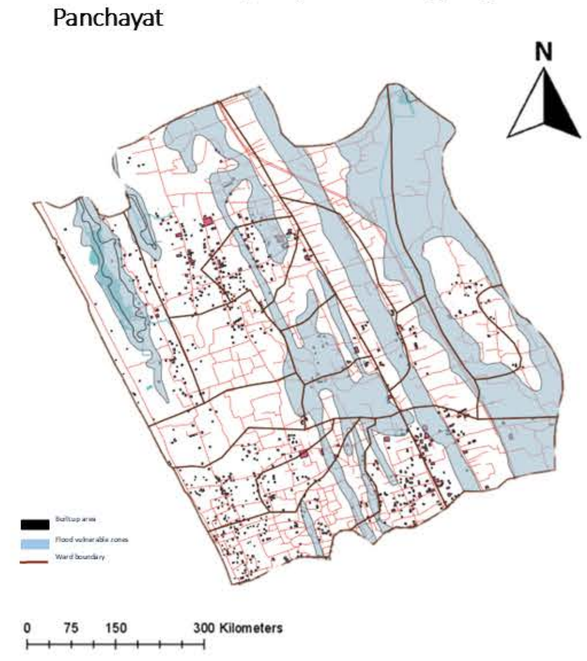
Flood Vulnerability Map of Kadappuram Grama Panchayat

CRZ Overlay and Settlement Vulnerability Map of Kadappuram Grama Panchayat

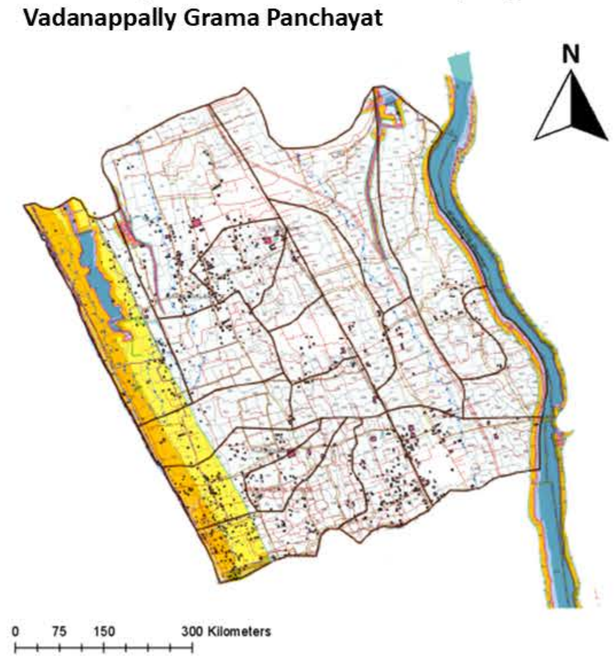
- Continuous coastal flood-prone belt
- High exposure due to CRZ-I & CRZ-III residential areas
- Frequent inundation and prolonged waterlogging
- Ribbon development obstructing drainage
- Limited flood-control options due to CRZ restrictions

Source: Author generated from GIS

Flood Vulnerability Map of Vadanappally Grama Panchayat



CRZ Overlay and Settlement Vulnerability Map of **Vadanappally Grama Panchayat**



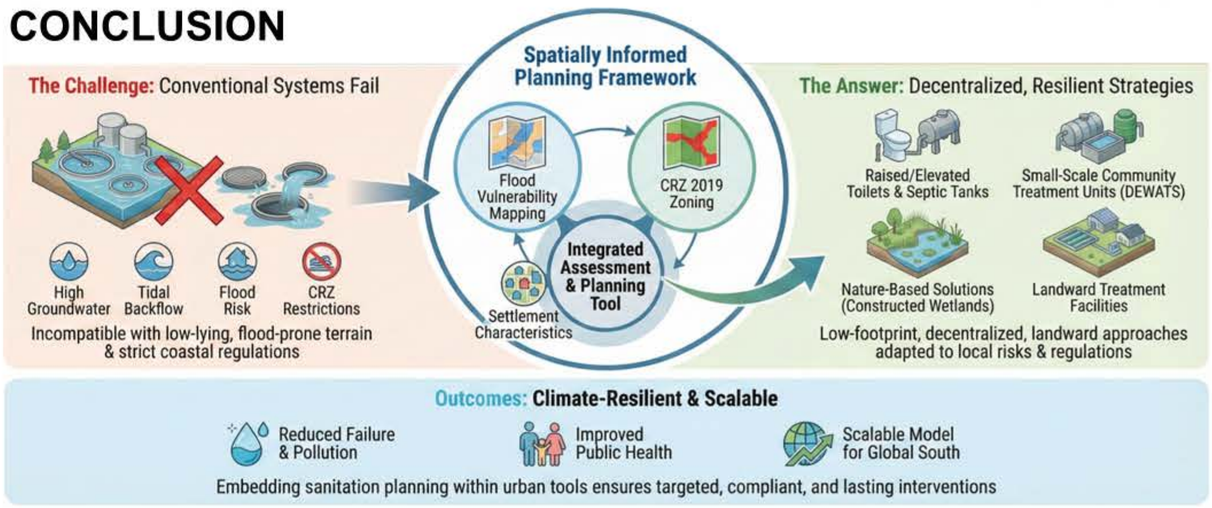
- Vadanappally shows moderate flood risk with scattered flood-prone pockets in interior wards
- Flooding is mainly rainfall- and drainage-driven, with limited coastal CRZ influence
- Seasonal inundation causes short-duration waterlogging in low-lying residential areas

Source: Author generated from GIS

RECOMMENDATIONS

Recommendation / Technology	Suitable CRZ Zone
Low-footprint / above-ground / modular sanitation solutions (e.g. container-based toilets, portable toilets, modular packaged treatment units)	CRZ-I & CRZ-III A (NDZ portion)
Decentralized, off-site / landward treatment (e.g. treatment ponds located outside CRZ-I/IIIA buffer, with pipelines conveying waste from coast)	CRZ-I / CRZ-III A (waste origin zone) → Treatment facility outside buffer (non-CRZ land)
Pool-based / pond-based natural treatment systems (e.g. high-rate algal ponds — HRAP)	CRZ-II (built-up coastal urban zone)
Semi-centralized or decentralized treatment + reuse (e.g. treatment plants, constructed wetlands, polishing ponds)	CRZ-II; possibly CRZ-III (outside NDZ buffer)

CONCLUSION



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