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SMART Framework-POLICY

Sustainable Marine and Resilient Tribal Fisheries Framework for Climate-Resilient Coastal Governance

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Executive Summary

Car Nicobar Island represents a strategically important yet climate-vulnerable small island ecosystem in the Bay of Bengal. Despite rich marine biodiversity and strong traditional knowledge systems, the fisheries sector remains under-optimized due to fragmented governance, limited technology adoption, weak market systems, and inadequate integration of science and policy. Evidence from the implementation of an integrated Coastal Fisheries Information Hub (CFIH) model demonstrates that combining technology deployment, citizen science, institutional convergence, and community participation can significantly enhance livelihoods, strengthen conservation outcomes, and improve coastal governance. This policy brief proposes a scalable, community-centric framework for coastal fisheries management aligned with national priorities including Blue Economy, Digital India, Disaster Risk Reduction (DRR), and Tribal Empowerment. It provides actionable recommendations for institutional reform, technology integration, and policy convergence for replication across island and coastal ecosystems. Institutions may consider adopting and scaling the SMART Framework as a model for integrated coastal fisheries governance in tribal areas and vulnerable coastal ecosystems of Nicobar Islands.

2. Core Challenges Identified

- Fragmented coastal governance and weak inter-agency coordination
- Limited integration of traditional ecological knowledge with scientific systems
- Low access to modern fishing technologies and safety infrastructure
- High exposure to climate and disaster risks without adaptive planning
- Limited institutionalisation of community participation
- Increasing environmental pressures and biodiversity risks
- Limited access to institutional services and support

3. The SMART Solutions

The SMART Framework integrates **Science, Management, Adaptation, Resilience, and Technology** to deliver a comprehensive coastal fisheries governance model.

Key Pillars:

1. Technology-Driven Fisheries Modernization

- Deployment of FRP boats, GPS navigation, and safety systems; Improved offshore access, efficiency, and fisher safety

2. Community-Led Governance and Citizen Science

- Tribal Council-led co-management; Citizen science-based coastal monitoring and conservation

3. Digital Fisheries Infrastructure

- Establishment of Coastal Fisheries Information Hub (CFIH)

4. Climate-Resilient Coastal Planning

- GIS-based coastal risk assessment and hazard-informed zoning; Integration of climate projections and ecosystem conservation

5. Knowledge Integration and Capacity Building

- Integration of Local Ecological Knowledge (LEK) with scientific systems; Large-scale training; skill development across communities; popularization of NICMIS app for awareness on conservation

4. Evidence of Impact

Small Island Coastal Management Plan: Developed a science-based framework integrating shoreline dynamics, climate risk (sea-level rise, tsunami exposure), and ecosystem mapping to support evidence-based coastal planning and sustainable livelihoods in small island ecosystems.

Community-led conservation outcomes: Citizen science initiatives resulted in the protection of over 1,000 turtle hatchlings and identification of new nesting habitats, reflecting strong ecological stewardship.

Substantial productivity and income gains: Fish catch increased by over 230%, with fisher incomes rising by nearly 300%, driven by improved access to offshore fishing grounds and efficient operations using FRP fishing boats.

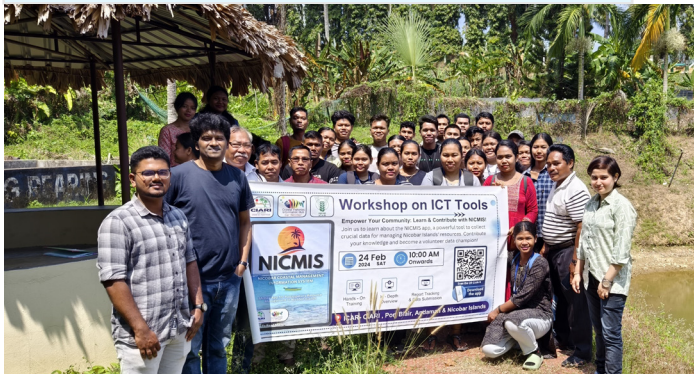
Technology-driven income enhancement: Adoption of GPS-enabled fishing systems generated additional earnings exceeding ₹16,000 per trip, demonstrating strong techno-economic viability.

Enhanced economic efficiency: Travel time reduced by over 80% and fuel costs lowered by 50–80%, significantly improving profitability and operational sustainability.

Strengthened safety and operational confidence: Integration of GPS, DAT, and VHF systems enabled safer offshore fishing and improved decision-making under risk-prone marine conditions.

Scalable capacity building and institutional impact: More than 700 stakeholders trained and a network of 150+ citizen science volunteers identified, strengthening long-term governance and knowledge systems.

NICMIS (Nicobar Coastal Management Information System): Mobile application developed for training and awareness has increased understanding on ecological significance of the Car Nicobar coasts.



5. Policy Recommendations

Immediate (0-2 Years)

- Access to GPS-enabled navigation and marine safety systems for tribal fishers
- Establish Coastal Fisheries Information Hubs (CFIH) across priority island clusters
- Launch citizen science-based coastal monitoring programmes in remote islands of Nicobar

Medium-Term (3-5 Years)

- Institutionalize Tribal Council-led co-management frameworks
- Develop integrated coastal zone management plans using GIS and climate data

Long-Term (5+ Years)

- Establish a framework for island and coastal fisheries governance
- Integrate citizen science into formal policy and data systems
- Scale the SMART Framework across the island ecosystems of Andaman and Nicobar

6. Implementation Pathways

A phased approach is recommended:

- **Phase 1:** Expansion across Nicobar Islands (pilot scaling)
- **Phase 2:** Integration with national schemes (PMMSY, Blue Economy, Digital India)
- **Phase 3:** Replication in coastal and island regions of Andaman and Nicobar

Institutional convergence, dedicated funding support, and continued technical backstopping will be critical for scaling.

7. Strategic Significance

- Aligns with Blue Economy, Digital India, DRR, and Tribal Empowerment priorities
- Demonstrates a replicable, low-cost, high-impact model
- Integrates technology, traditional knowledge, and governance systems
- Strengthens climate resilience and sustainable livelihoods in remote small islands

8. Way Forward

The Car Nicobar model demonstrates that integrating technology, community participation, and scientific evidence can transform vulnerable coastal systems into resilient, productive, and sustainable ecosystems. Adoption of this framework at large-scale offers a viable pathway for achieving inclusive growth, ecological sustainability, and climate resilience in coastal and island regions of Andaman and Nicobar.

9. Important Publications

- Kiruba-Sankar, R., et al. (2023). Record of a hawksbill sea turtle at Car Nicobar Island, Andaman and Nicobar Archipelago. Indian Ocean Turtle Newsletter, 38, 17–19.
- Kiruba-Sankar, R., et al. (2023). First report of marine debris in Car Nicobar, a remote oceanic island in the Nicobar archipelago, Bay of Bengal. Regional Studies in Marine Science, 61, 102845.
- Kiruba-Sankar, R. et al. (2024). Release of a hawksbill turtle caught live in a ghost net-an outcome of citizen science initiatives at Car Nicobar. Indian Ocean Turtle Newsletter, No. 40.
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10. Acknowledgments

The work was done under the project 'Augmenting livelihood resilience and knowledge generation through coastal fisheries information hub for Nicobar tribes of Car Nicobar'. The authors gratefully acknowledge the SEED Division, Department of Science and Technology (DST), New Delhi, for providing financial support for this study. We extend our sincere thanks to the Director, ICAR-Central Island Agricultural Research Institute (CIARI), for institutional support, guidance, and facilitation of field activities. We also express deep appreciation to the nicobarese tribal community of Car Nicobar for their cooperation, traditional ecological knowledge, and active participation in field surveys and citizen science initiatives, which were invaluable to the successful completion of this work.