

# AI-Driven Unified Data Platform for Oceanographic, Fisheries, and Molecular Biodiversity Insights

## Problem Statement

The Centre for Marine Living Resources and Ecology (CMLRE), under the Ministry of Earth Sciences, manages multidisciplinary datasets covering oceanographic, fisheries, taxonomic, morphological, and molecular biology data. However, these datasets exist in siloed systems, in multiple formats (structured, semi-structured, and unstructured), which hinders integration, cross-domain analysis, real-time visualization, and advanced analytics. This creates bottlenecks for marine scientists, policymakers, and conservationists in making data-driven decisions.

## Description

India, with its vast coastline and marine biodiversity, relies on healthy ocean ecosystems for food security, climate regulation, and economic growth. CMLRE plays a critical role in collecting, managing, and analyzing diverse marine data. However, due to fragmented storage and lack of integrated platforms, meaningful correlations between datasets (e.g., ocean parameters and biodiversity health) are challenging to derive. An AI-enabled platform is required to unify these datasets for holistic assessment and sustainable fisheries management.

## Objective

The objective is to design and develop an AI-driven unified digital platform capable of integrating heterogeneous marine datasets, automating data ingestion and standardization, and enabling advanced visualization and analytics. This platform will facilitate holistic marine ecosystem assessment, improve research efficiency, and support sustainable fisheries and conservation decision-making.

## Proposed Solution

- Modular Data Ingestion Pipelines for structured, semi-structured, and unstructured datasets.
- Automated Standardization and Metadata Tagging aligned with international standards.
- Visualization Tools for oceanographic, fisheries, and biodiversity trends.
- Integrated Modules for taxonomy management, otolith morphology visualization, and eDNA data handling for species identification and biodiversity assessment.
- Scalable Backend Architecture with APIs to support future adoption and expansion.
- Interactive Frontend Dashboard built with React + TailwindCSS, providing:
  - - Unified search bar for natural queries (e.g., "Tuna population in Pacific").
  - - Dynamic tables, charts, and maps (using Plotly.js and Leaflet.js).
  - - AI-generated insights displayed in clean, card-based layouts.
  - - Export functionality (PDF/CSV) for researchers and policymakers.
  - - Responsive design with a marine-inspired UI for accessibility across devices.

## Problems Solved by the Platform

### ■ Data Fragmentation Problem

- Currently, oceanographic, fisheries, and molecular data are stored in disconnected silos.
- The platform unifies them into a single, searchable ecosystem.

### ■ Data Accessibility Problem

- Raw scientific data is often complex and difficult for non-specialists.
- Our interactive dashboard with intuitive visuals makes insights accessible to all stakeholders.

### ■ Prediction & Insight Problem

- Policymakers and researchers lack real-time predictive tools.
- The platform integrates AI/ML models for fish stock forecasting, biodiversity resilience, and climate impact assessment.

### ■ Scalability & Collaboration Problem

- Existing systems are not cloud-ready and fail to support large-scale, multi-institution collaboration.
- Our modular, API-first architecture ensures scalability and future integration with international marine datasets.