# SMART INDIA HACKATHON 2025

## CREDORA

- **Problem Statement ID –** SIH25038
- **Problem Statement Title-** Blockchain-Based Blue Carbon Registry and MRV System
- **Theme-** Clean & Green Technology
- **PS Category-** Software
- **Team ID-** 75176
- **Team Name-** Credora

Credora

# Credora : Blue Carbon Registry

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Credora integrates blockchain and smart contracts to deliver a tamper-proof MRV framework for blue carbon ecosystems, recording restoration data and $CO_2$ sequestration metrics on-chain. It issues **ERC-721 tokenized carbon credits**, monitorable through **dMRV** (satellite imagery) and on-field data, ensuring transparency, and compliance. Credora enables direct benefit-sharing with coastal communities engaged in blue carbon restoration.

**C R E D O R A**

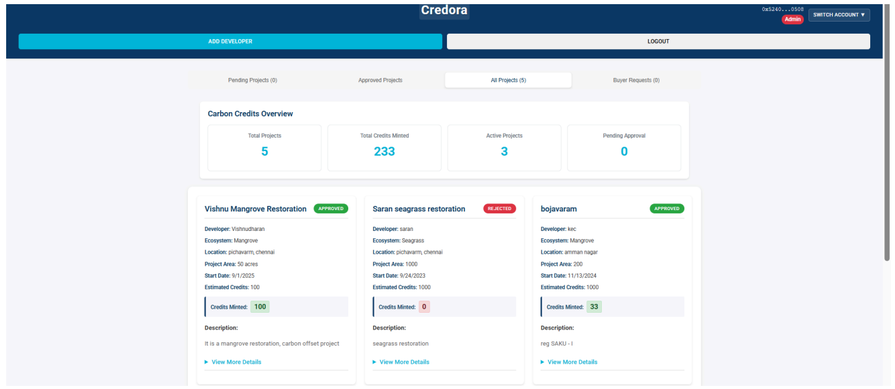
**Blockchain Registry:** Uses Ethereum (Sepolia testnet), ERC721 NFTs, Solidity smart contracts, and MetaMask, aligned with **Verra's VCS, CR-I, and Gold Standard** for regulatory compliance.

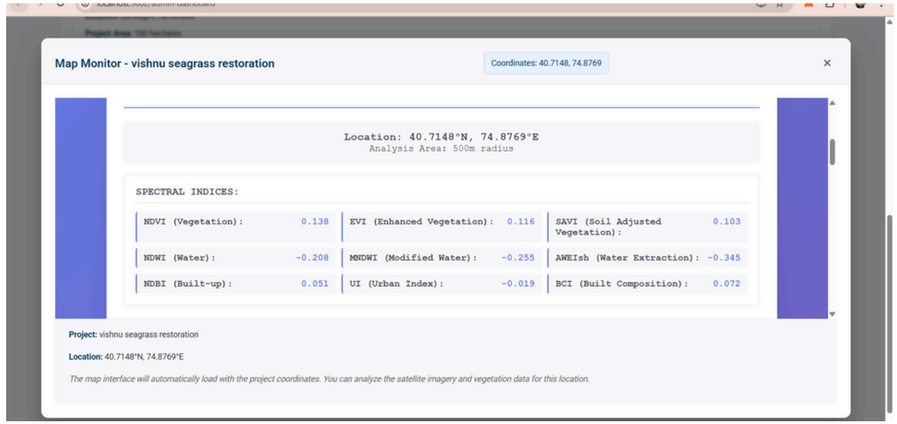
**Digital MRV System:** Does Multispectral Analysis using satellite imagery **(Harmonized Sentinel-2 MSI, Landsat-8 Extent data, Google Earth Engine)** for continuous carbon stock monitoring.
The Registry Automatically Generates Reports in the **Agreed Electronic Format (AEF) for Article 6.2 of the Paris Agreement.**

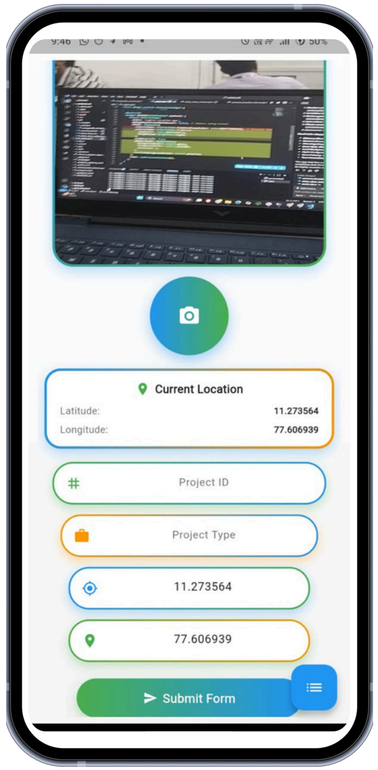
**Mobile App:** Created in Flutter; when users upload site images, **geotag data (latitude/longitude)** is auto-recorded for trustworthy field verification.

**Github Link :** https://github.com/SaranRK01/Credora

**Prototype and codebase Explanation:** https://drive.google.com/drive/folders/1nXShS5yXgotXDYe2vxWfCpaXWTe



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# TECHNICAL APPROACH

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This architecture integrates blockchain, monitoring, application, and storage layers to manage blue carbon credits with transparency. Data (GPS, images, project details) from NGOs/communities is stored via IPFS & MongoDB, verified, and converted into ERC-721 tokens on Ethereum (Sepolia). Continuous monitoring using satellite imagery ensures project validation, enabling buyers to acquire and retire credits securely.

## Technical Stack

**Blockchain Layer**
- MetaMask Wallet
- Hardhat
- Sepolia Ethereum Testnet
- Solidity
- Etherscan

**Monitoring Layer**
- Google Earth Engine(GEE) API
- SENTINAL -2 & LANDSAT - 8

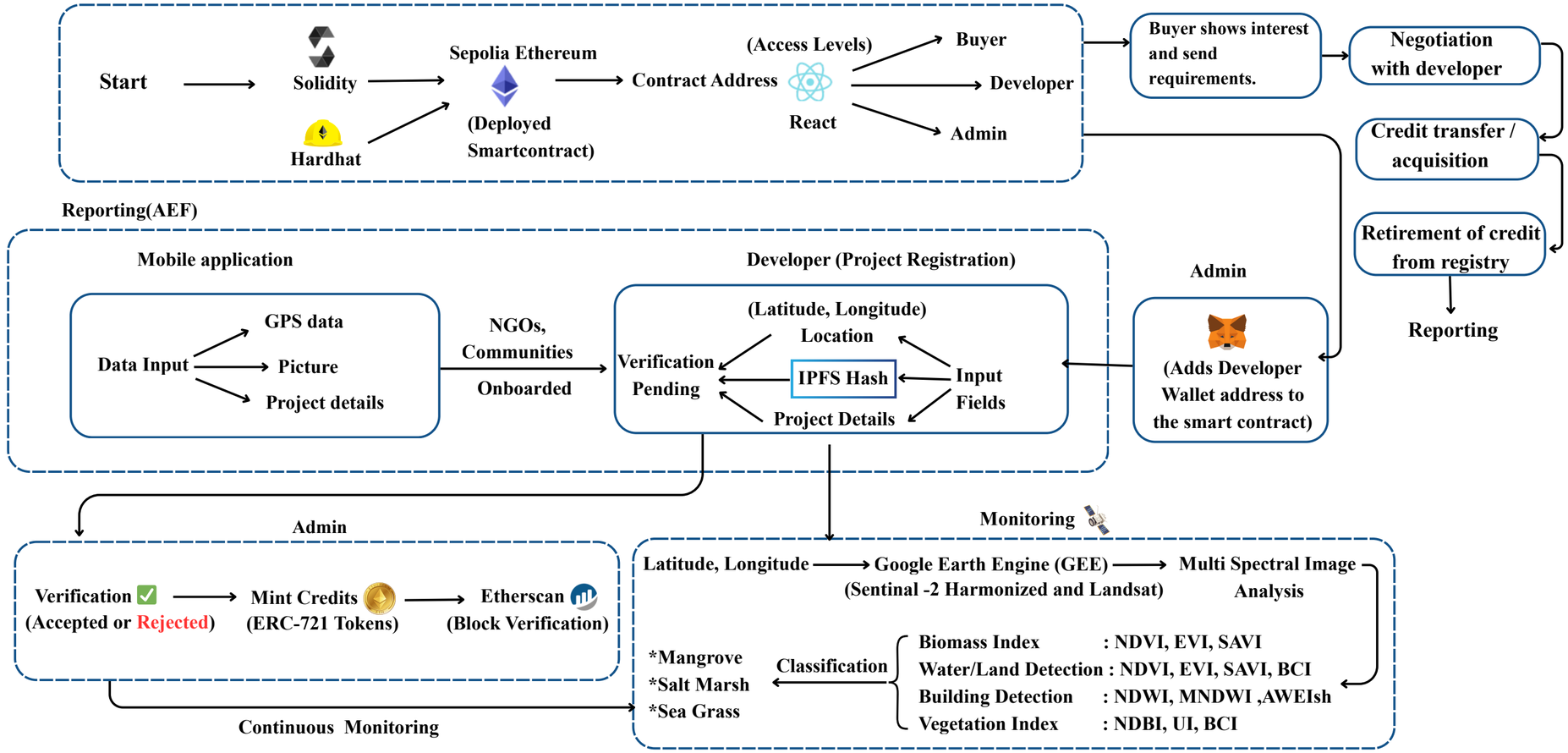
**Application Layer**
- ReactJS
- Node JS
- Ether.js
- Flutter

**Storage Layer**
- MongoDB
- IPFS

**IFPS Hash Work Flow**

Upload → Pinata API → Returns CID → generates link to access https://gateway.pinata.cloud/ipfs/

## Workflow



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# FEASIBILITY AND VIABILITY

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## Feasibility Analysis

- Leverages Sepolia Testnet for zero-cost smart contract deployment while maintaining Mainnet principles and ensuring transparency crucial for trust in the **Voluntary Carbon Market** and we use **ERC-721 NFT for tokenization; it helps prevent double-counting.**
- Utilizing **Sentinel-2 for multispectral (MSI) analysis and Landsat-8 for historical extent and trend monitoring**, based on licensed datasets from **Indian and foreign remote-sensing sensors acquired since 1986 as listed on ISRO's Bhoonidhi platform.**

## Potential Challenges and Risks

- **Higher network fee** in some blockchain networks.
- **Ensuring ground-truth accuracy** for remote sensing data
- Educating stakeholders on blockchain and decentralized frameworks

## Strategies for Overcoming Challenges

- **Operational Cost Optimization** via Easy Future Blockchain Network Migration (Smart contract written in Solidity can be converted to Rust or Go for easy network migration)
- **Use hybrid MRV** with on-site geotagged data (Credora Mobile App), on-site sensor data, and satellite imagery.
- Engage regulatory bodies early and **conduct training/outreach for communities and developers on decentralized frameworks.**

**MARKET ANALYSIS**

| Region | TAM (Total Addressable Market) | SAM (Serviceable Addressable Market) | SOM (Serviceable Obtainable Market, 3–5yrs) |
|---|---|---|---|
| Global | ₹41,500 Cr – ₹4,15,000 Cr / year (1–10% of projected $50B carbon market by 2030) | ₹41,500 Cr – ₹2,07,500 Cr / year (realistic blue carbon supply pipeline) | ₹2,075 Cr – ₹31,125 Cr / year (likely band: ₹4,150–₹12,450 Cr given supply & verification limits) |
| India | ₹747 Cr – ₹4,648 Cr / year (full ecological potential of ~470k ha mangroves at $20/credit) | ₹166 Cr – ₹2,324 Cr / year (20–50% eligible area, considering feasibility) | ₹16 Cr – ₹697 Cr / year (near-term verified & marketable credits, 3–5 yr horizon) |

## Smart Contract Features

- Role-Based Access Control
- IPFS-Backed Documentation Storage
- End-to-End Project Lifecycle
- On-Chain Credit Retirement Mechanism
- ERC-721 Blue Carbon Credit Tokenization
- Status tracking (Pending / Approved / Rejected)

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# IMPACTS AND BENEFITS

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**Tokenized Carbon Credits:** Directly mints verifiable ERC-721 tokens (Non Fungible Tokens for preventing reuse/double counting) linked to project and displayed in the dashboard.

**Credit Retirement:** Issued carbon credits can be permanently retired on-chain once claimed or sold, ensuring transparency and prevents double-counting.

**End-to-End Integration:** Combines field app, on field sensors and satellite imagery (GEE), IPFS for data storage, and smart contracts in one pipeline.

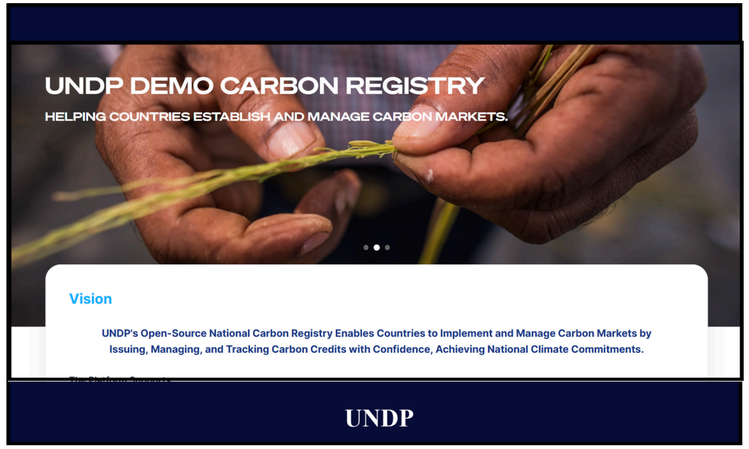
**Standards alignment:** Strengthens compliance with national(Carbon Registry India) and international carbon standards(Verra(VCS)), boosting India's climate commitments.

**Data-driven monitoring:** Tracking baseline values from field sensors and satellite imagery (via GEE) over the years ensures accurate carbon project monitoring and provides a more convenient dashboard for the admin.

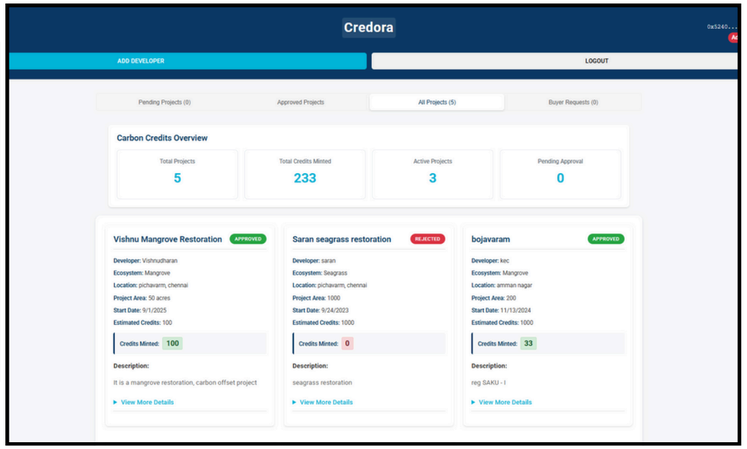
## IMPACTS

- UNDP expects costly third party auditors for MRV system but Credora automates by streamlining the satellite/drone data realtime .
- Integrating historical blue-carbon data
- Instead of PDFs or ledger entries(static certificates) in UNDP, ERC-721 Blue Carbon Credit tokens generated via Credora enable traceable, tamper-proof transfers

## Existing Solution




## Proposed Solution



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# RESEARCH AND REFERENCES

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## Tools Referred

- NASA Arsat
- UNDP's National Carbo Credit Registry
- Moss.Earth
- CarbonChain
- AirCarbon Exchange (ACX)
- Chia Blockchain Carbon Registry
- Northern Trust Carbon Ecosystem
- Global Mangrove Watch
- Satsense Solutions Ltd
- Mangrove Systems
- Pachama
- Delta Blue Carbon (DBC)
- Google Earth Engine
- Earthood
- Open Forest Protocol

## Documents Referred

- OCEAN PANEL SPECIAL REPORT
- VCS Standard
- Asia-Pacific Network for Global Change Research
- Blue Carbon Manual
- High-Quality Blue Carbon
- Paris Agreement

## Dataset Referred

- Harmonized Sentinel-2 MSI
- Global Mangrove Watch Data
- Landsat - 8
- Global approach with Google Earth Engine for mapping tidal wetlands
- Seagrass meadow structure

## Journals/Articles Referred

- Frontiers in Blockchain: Blockchain-based carbon markets
- Sustainability Science Journals on Blue Carbon and MRV
- Satellite and drone-based monitoring for blue carbon stock assessment
- Carbon Credits in India: Hopes and Challenges
- New Technologies for Monitoring Coastal Ecosystem Dynamics

## Carbon Registries Referred

- Verra Verified Carbon Standard (VCS)
- Gold Standard Registry
- CR-I (Carbon Registry India)
- Puro Earth registry
- Global Carbon Council (GCC)
- Greenhouse Gas Protocol (GHG Protocol)

## Industry Persons Referred

- Dr. Sunil Luthra, Director at AICTE
- ChembianT,AuthorAI, Sustainability
- Dr. P. Senthil Kumar, Head of Water Research at SSN Institutions
- Chinmay Shinde