SMART INDIA HACKATHON 2025

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- **Problem Statement ID-** SIH12508
- **Problem Statement Title-** AI-powered FRA Atlas & WebGIS-based Decision Support System
- **Theme-** Miscellaneous
- **PS Category-** Software
- **Team ID-** 56931
- **Team Name-** Code-A-Cola

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AI-POWERED FRA ATLAS & DSS

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IDEA/SOLUTION

- **Digital FRA Repository:** Uses **OCR + NLP (NER)** to digitize and standardize legacy FRA claims & pattas into a centralized AI-powered archive.
- **FRA Atlas (WebGIS): Real-time cadastral GIS layers** with filters for IFR, CR, CFR claims, granted titles & progress tracking across all administrative levels.
- **AI & Remote Sensing Asset Mapping:** Satellite imagery via **Sentinel 2 & ML models** to detect & classify land-use assets with added layers of environmental and infrastructure data.
- **Decision Support System (DSS): Rule-based AI engine** to link FRA patta holders with eligible CSS schemes like PM-KISAN, Jal Jeevan Mission, MGNREGA, DAJGUA.
- **Interactive Analytics Dashboards:** AI-driven predictive insights to **visualize trends, FRA progress, scheme impacts.**
- **Integration with National Databases:** Secure APIs to link with PM-KISAN, MGNREGA & land record databases for **real-time validation.**
- **Containerization & Deployment: Docker + Kubernetes** for scalable, secure cross-ministry use.

PROBLEM RESOLUTION

- Empowers tribal communities with **timely access** to FRA rights and CSS scheme benefits.
- Provides a **generalised platform** for government officials to take data-driven policy decisions.
- Consolidates FRA records into a **central archive** with real-time tracking.
- Supports **evidence-based interventions** by highlighting villages with unmet needs or resource gaps.
- Solves missing asset visibility via **AI-based mapping** of land, water & forests.

UNIQUE VALUE PROPOSITION (UVP)

- **End-to-end FRA ecosystem** covering digitization, mapping, claim tracking, scheme linkage, and monitoring.
- **Geospatial analytics** enables targeted development by prioritizing interventions & optimizing resources for marginal FRA farmers.
- **Scalable, future-ready architecture** with real-time satellite feeds, IoT sensors and eco-friendly operations.
- **Community feedback** integration for updates, grievances, and verification.

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TECHNICAL APPROACH

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Digitising Forms

Scanned FRA Forms

OCR

Structured FRA DB (PostGIS)

Cadastrial Shape File

Asset Mapping

WebGIS Portal (Frontend)

DSS Engine (Scheme Recommendations)

Stakeholder & Users

Asset Mapping

Satellite Imagery (Sentinel-II)

Processing

Index Calculation: NDVI, NDWI, NDBI

ML Classification + Object Detection

Extracted Layers

Export

DSS Engine

WebGIS Layer

Rule Based Python Engine + AI Module

Eligibility Rules

Asset Based Scoring

Recommendation Schemes Per Patta

WebGIS Overlay

Reports for Stake Holders

DATA FLOW → VISUALISATION → PROCESSING/AI

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FEASIBILITY AND VIABILITY

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Technical Feasibility

- **AI/ML + Satellite Imagery:** OCR/NLP, CNN remote sensing for digitization & asset mapping.
- **Interactive WebGIS:** Real-time, multi-layered visualization of FRA data.
- **Cloud & IoT Ready:** Scalable cloud architecture with future IoT integration.
- **Modular Design:** Easy addition of schemes & datasets in real-time.

Market Feasibility

- **Government Adoption:** Useful for ministries, tribal welfare and district authorities.
- **Cross-Sector Utility:** Extendable to NGOs, researchers, and rural development programs.
- **Policy Demand:** Meets growing need for transparent, data-driven governance.
- **Scalable Reach:** Extendable across states and land rights.

Financial Feasibility

- **Cost Efficiency:** Open-source tools and automation reduce expenses.
- **Government & PPP Funding:** Supports e-governance initiatives and partnerships.
- **Leakage Reduction:** DSS ensures precise scheme targeting, minimizing fund misuse.
- **Long-term ROI:** Sustainable monitoring lowers overheads and maximizes impact.

⚠ CHALLENGES

- Low-quality or incomplete satellite imagery
- Resistance from officials to adopt new digital systems
- Large volume of data leading to slow processing
- Errors in automated scheme recommendations
- Connectivity issues in remote tribal areas
- Data security and privacy concerns

SOLUTIONS

- Using AI-enhanced **multi-source imagery** for better resolution & accuracy.
- Providing training modules, **intuitive UI**, and dashboards for easy adoption.
- Implementing **cloud storage** & scalable architecture for faster data handling.
- Rule-based AI decision engine with **periodic manual audits** for accuracy.
- Implementing **Offline-first** mobile/web interface with periodic synchronization.
- Secure **JWT API** providing token-based access to WebGIS and DSS.

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IMPACT AND BENEFITS

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POTENTIAL IMPACTS

- **Data-Driven Policy & Monitoring:** Provides the **Ministry of Tribal Affairs** with real-time insights for informed policy design and progress tracking.
- **Efficient Resource Allocation:** Enables **District Welfare & DAJGUA Departments** to prioritize villages, deploy schemes, and cut paperwork through automation.
- **Better Land & Forest Management:** Equips **Forest and Revenue Departments** with AI-based mapping for accurate resource management and less disputes.
- **Evidence-Based Planning:** Strengthens **Planning Authorities** with spatial intelligence to optimize resources and deliver targeted infrastructure.
- **Enhanced Community Engagement:** Supports **NGOs** with actionable data and multilingual tools to improve outreach and welfare delivery.
- **Rights Assurance:** Ensures timely delivery of FRA entitlements and welfare benefits to **tribal communities**.
- **Inter-Departmental Coordination**: Brings **multiple government agencies** onto a common data platform.
- **Long-Term Planning**: Builds a **reliable, digitized knowledge base** for future policy, research, and climate adaptation.

BENEFITS

SOCIAL

- **Trust Building:** Increases transparency and accountability in FRA processes for tribal communities.
- **Rights Awareness:** Improves access to information on entitlements and government schemes.

ECONOMIC

- **Livelihood Planning:** Optimizes land, water, and forest resources for better income generation.
- **Cost Efficiency:** Cuts administrative burden via digitization and automation.

ENVIRONMENTAL

- **Resource Management:** Promotes sustainable use of forests, water, and farmland.
- **Disaster Preparedness:** Provides real-time data for resilience against natural disasters.

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RESEARCH AND REFERENCES

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PRODUCT STATUS: The web application is fully built, deployed, and tested in real-time, achieving 90% accuracy. It is containerized for scalability, ensuring seamless integration across ministries.

LIVE LINK

Web App: **LINK**

GITHUB LINK

Repository: **LINK**

RESEARCH LINKS:

- **Sentinel-2 Satellite Data for Assets**
  https://sentinels.copernicus.eu/web/sentinel/copernicus/sentinel-2
- **WebGIS Information and References: BhuNaksha**
  https://bhunaksha.cg.nic.in/
- **Ministry of Tribal Affairs - Government of India**
  https://tribal.nic.in/
- **Forest Rights**
  https://forestrights.nic.in/