SMART INDIA HACKATHON 2025

Problem Statement ID: 25044

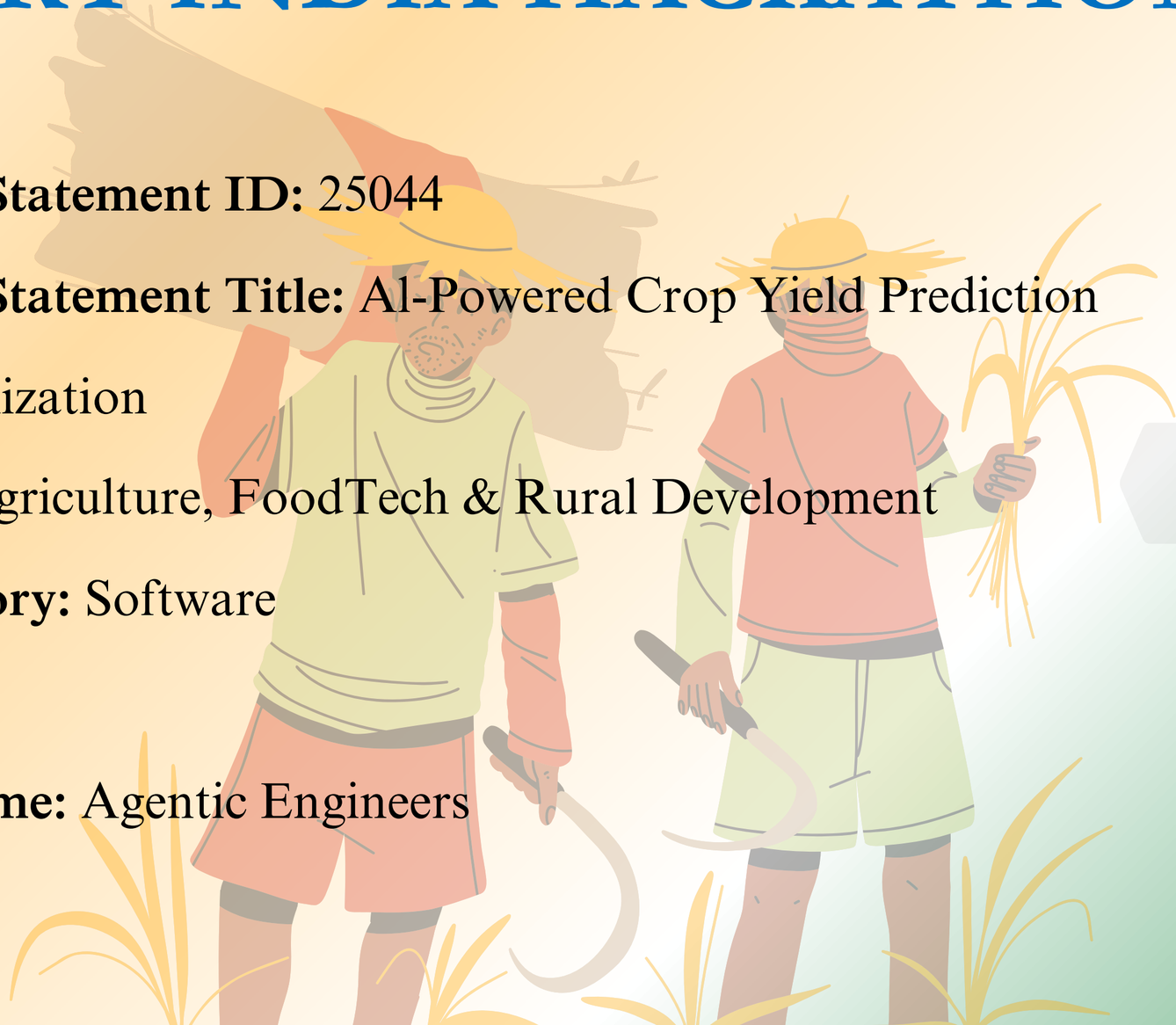
Problem Statement Title: Al-Powered Crop Yield Prediction and Optimization

Theme: Agriculture, FoodTech & Rural Development

PS Category: Software

Team ID:

Team Name: Agentic Engineers



AGRISENSE

A Climate-Resilient Agronomic Intelligence Platform for Odisha's Farmers

PROPOSED SOLUTION:

We provide farmers with a powerful, easy-to-use web application that delivers hyper-local, data-driven insights. By combining a predictive AI model with a generative LLM, AGRISENSE transforms soil data and real-time environmental factors into clear, actionable advice in both English and Odia.

Farmer's Journey:

1. **INPUT:** The farmer provides their plot location (GPS) and Soil Health Card data.
2. **PREDICT:** A unified Scikit-learn model instantly generates a baseline crop yield prediction.
3. **ENRICH & RECOMMEND:** The system fetches live weather (OpenWeatherMap) and supplementary soil data (SoilGrids). An LLM then processes all this information to generate tailored recommendations.
4. **PROSPER:** The farmer makes confident decisions, increasing yield and profitability.

KEY FEATURES:

- **Unified Yield Prediction:** A single, robust Scikit-learn model predicts yield for multiple crops, making the system highly scalable.
- **LLM-Powered Advisory:** A cutting-edge LLM synthesizes yield predictions with real-time weather and soil data to provide dynamic advice on fertilizer, pesticide, and irrigation.
- **Dual-Language Interface:** All insights are presented in a simple dashboard, accessible in both English and Odia to maximize usability.

TECHNICAL APPROACH

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USER INPUT

- SOIL DATA (GPS/MANUAL)
- CROP DATA

FastAPI BACKEND SERVER

DATA INGESTION & APIs

ML MODEL

OpenWeatherMap API

SoilGrid API

PREDICTED YIELD

RECOMMENDATION ENGINE

A HYBRID LLM & RULE BASED LOGIC

PESTICIDE, FERTILIZER, IRRIGATION & TRACKER

PostgreSQL DB → **AWS**

REACT FRONTEND

- PREDICTED YIELD
- DAILY WEATHER & IRRIGATION
- SOIL HEALTH SUMMARY
- RECOMMENDATIONS
- TRACKER (PESTICIDE/FERTILIZER)

Tech-Stack:

Frontend:

React.js

TailwindCSS

Backend:

FastAPI

Database:

PostgreSQL

Firebase

Deployment:

AWS

Machine Learning:

- Scikit-learn
- Pandas
- Numpy
- LLM Integration

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FEASIBILITY AND VIABILITY

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FEASIBILITY :

- **Modern Data Strategy:** Leverages the power of combining user-provided ground-truth data (SHC) with robust, real-time APIs (OpenWeatherMap, SoilGrids).
- **Proven & Advanced Tech Stack:** Built on scalable open-source technologies and a state-of-the-art LLM for recommendations.
- **Rapid Implementation:** A structured development plan ensures a pilot-ready product can be built quickly.

VIABILITY :

- **Radical Accessibility:** A free, simple, dual-language (English & Odia) design ensures adoption by farmers with basic smartphones.
- **High Impact Model:** Directly addresses the critical needs of farming families facing climate and economic distress.
- **Institutional Partnership:** Plan includes collaboration with agricultural universities and their extension networks (KVKs) for pilot testing and rollout.

USE CASES :

- **Farmers:** As end-users receiving timely advice to increase yield, reduce input costs, and mitigate climate risks.
- **Government Agencies:** As enablers for data-driven policy making, resource allocation, and evaluating the impact of agricultural schemes.
- **Agribusinesses:** As stakeholders using yield predictions for risk assessment (credit/insurance) and market planning (input supply).

CHALLENGES & SOLUTIONS :

1. **Risk:** Low farmer adoption due to tech unfamiliarity or lack of trust.
→ **Solution:** A simple, dual-language UI and KVK-led training to build trust.
2. **Risk:** Poor rural connectivity makes the web app unusable.
→ **Solution:** A lightweight, low-bandwidth design with offline data caching.
3. **Risk:** Outdated farmer data or skepticism towards AI recommendations.
→ **Solution:** Enrich user data with live APIs and provide simple explanations for AI advice.
4. **Risk:** High operational costs from frequent LLM API calls at scale.
→ **Solution:** A hybrid engine (rules + LLM) with intelligent caching to manage costs.

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IMPACT AND BENEFITS

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IMPACTS:

1. **Climate Resilience:** Empowers farmers to make adaptive decisions based on real-time weather and soil conditions.
2. **Sustainable Agriculture:** Promotes optimized use of fertilizers and water, protecting long-term soil health.
3. **Data-Driven Governance:** Provides valuable insights for agricultural planning and increases the ROI on government data initiatives like the SHC scheme.

BENIFITS:

1. **Increased Farmer Income:** Higher yields and lower input costs directly boost profitability.
2. **Reduced Financial Risk:** More accurate yield forecasts can improve access to credit and crop insurance.
3. **Knowledge Empowerment:** The LLM translates complex data interactions from Soil Health Cards and APIs into simple, conversational instructions.

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RESEARCH AND REFERENCES

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DETAILED PROJECT DOCUMENTATION:

Scan the QR code to access our comprehensive project plan: Link

UI/UX Mockup: AgriSense (Link)