## **Product Requirements Document (PRD)**

**Project Title:** *AI-Powered Cloud-Based Management of Tea Farms*

**Date:** 06/05/2025

### **1. Overview**

**Purpose:**

To define the functional and technical requirements for building a cloud-based farm management system that leverages AI and satellite data to provide real-time insights and decision support to tea farmers and tea factory managers in Nandi County.

**Intended Users:**

* Tea factory managers
* Community extension officers
* Tea farmers (via mobile app and WhatsApp)

### **2. Goals and Objectives**

* Deliver accurate, frequent insights into crop health and productivity
* Support timely interventions for irrigation, fertilization, and replanting
* Provide farmers with localized weather alerts and recommendations
* Enable factory managers to monitor all farms at scale
* Improve communication between farmers and factory via mobile tools

### **3. Features and Requirements**

#### **Tea Crop Health Tracking**

* Flag diseased/stressed zones
* Generate maps showing affected areas
* Recommendation engine for disease response

#### **Yield Estimation and Field Area Measurement**

* Detect tea plantation boundaries (Farm Segmentation)
* Calculate area in acres/hectares
* Predict yield using historical and current data

#### **Water Management**

* Display soil moisture index maps
* Recommend irrigation times and volumes
* Alert system for abnormal dryness

#### **Weather Forecasting**

* 5-day localized forecast per farm
* Real-time alerts (extreme rain)
* Weather trend charts on dashboard

#### **Soil Quality Analysis**

* SOC (Soil Organic Carbon) estimation using spectral bands
* Fertilizer suggestions based on soil health
* Map overlay showing soil fertility zones

#### **Mobile App + WhatsApp Integration**

* Farmers receive real-time alerts & reports
* Can request farm-specific insights on demand
* Cross-platform app (Flutter/React Native)

#### **Analytics Dashboard**

* Factory managers view farm performance across regions
* Drill-down filters: farmer, location, metric, season
* Export reports and visual trends (PDF/CSV)

### **4. Data used**

1. Sentinel 1 (SAR) imagery

* Source: European Space Agency (ESA) [Click here](https://sentiwiki.copernicus.eu/web/s1-mission)
* Sensor Type: Radar (C-band SAR)
* Spatial Resolution: 5–20 meters (depending on mode)
* Temporal resolution (Revisit Time): 6–12 days (depends on location and mode, with both Sentinel-1A & 1B)
* Polarizations: VV, VH (interferometric wide swath mode is most common)
* Cloud Penetration: Yes – all-weather, day/night imaging

2. Sentinel 2 imagery

* Source: European Space Agency (ESA)
* Sensor Type: Multispectral Instrument (MSI) [Click here](https://sentiwiki.copernicus.eu/web/s2-mission)
* Spectral Bands: 13 bands
* Spatial Resolution: 10 m (Bands 2, 3, 4, 8 – visible/NIR), 20 m (Bands 5, 6, 7, 8A, 11, 12 – red-edge/SWIR), 60 m (Bands 1, 9, 10 – coastal/aerosol, water vapor, cirrus)
* Temporal resolution (Revisit Time): 5 days (with both Sentinel-2A and 2B)
* Swath Width: 290 km

### **4. User Stories**

|  |  |
| --- | --- |
| **Role** | **Story** |
| Farmer |  |
| Extension Worker |  |
| Factory Manager | As a manager, I want to view yield projections across regions to plan logistics. |

### **5. Technical Requirements**

* **Cloud Hosting:** AWS (EC2, S3, RDS)
* **Data Source:** Sentinel-2, Landsat, GEE, ERA5 Weather
* **Backend:** Python (FastAPI) or Node.js
* **Database:** PostgreSQL with PostGIS
* **Frontend:** React for dashboard; React Native/Flutter for mobile app
* **ML Frameworks:** TensorFlow, scikit-learn, PyTorch
* **Map Libraries:** Mapbox, Leaflet, or OpenLayers

### **6. Assumptions**

* Internet access is available in target zones
* Satellite imagery is updated regularly
* Training will be provided for all user groups
* Farmers will be supported in onboarding

### **7. Dependencies**

* GEE API access and quota
* factory support for farmer onboarding
* Mobile network coverage for app and WhatsApp alerts

### **8. Metrics for Success**

* 75% accuracy in yield prediction vs actual
* 80% farmer satisfaction with mobile experience
* Reduced average irrigation events by 15%
* 50% adoption rate of the app by lead farmers in Year 1