



# **Software Requirements Specification for AgriSmart: Sustainable Organic Farming with Smart Irrigation System.**

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# 1. Introduction

## 1.1 Purpose of the document

The purpose of this document is to define a comprehensive set of requirements for the **AgriSmart: Sustainable Organic Farming with Smart Irrigation System**. It outlines both functional and non-functional requirements, as well as the constraints, assumptions, and dependencies that influence the system's development.

This document serves as a formal agreement between the development team, agricultural experts, IoT engineers, and other stakeholders, ensuring a shared understanding of what the system will deliver. It will guide design, development, testing, and deployment while serving as a baseline for validation and verification.

The goal is to ensure **AgriSmart** meets the needs of organic farmers by providing:

- **Automated, sensor-driven irrigation**
- **Soil and crop health monitoring**
- **Organic farming compliance management**
- **Sustainable water and resource usage**

## 1.2 Scope of the project

**AgriSmart** is a smart farming platform designed to help organic farmers monitor soil conditions, optimize irrigation, and comply with organic farming standards. It integrates **IoT-based soil sensors**, **weather forecasting APIs**, and **smart irrigation controllers** to automate water usage and reduce waste.

The system will be accessible via:

- **Web dashboard** for administrators and agricultural officers
- **Mobile application** (Android & iOS) for farmers in the field

**Key features include:**

- **Real-time soil moisture and nutrient monitoring** via IoT sensors
- **Smart irrigation scheduling** based on soil, weather, and crop type
- **Manual irrigation control** through the mobile app
- **Crop growth tracking** with historical data and analytics
- **Organic certification compliance tracking** with required documentation

- **Alerts and notifications** for abnormal soil conditions, irrigation events, and compliance deadlines

The project will follow the Agile methodology with iterative development over an estimated **12-month** timeline.

### 1.3 Stakeholders involved

1. **Farmers (Primary Users)** – Use the mobile app to monitor fields, control irrigation, and manage crop plans.
2. **Agricultural Experts** – Provide guidance on crop-specific irrigation requirements and organic farming best practices.
3. **System Administrators** – Manage platform settings, user accounts, and integration with IoT devices.
4. **IoT Hardware Providers** – Supply and maintain soil sensors and irrigation controllers.
5. **Government/Organic Certification Bodies** – Use compliance data for auditing and certification.
6. **Development Team** – Responsible for design, implementation, testing, and deployment.

### 1.4 Overview of the AgriSmart System

AgriSmart will consist of:

- **IoT Sensor Network** – Deployed across farmland to collect soil moisture, temperature, humidity, and nutrient data.
- **Smart Irrigation Controller** – Automates water flow based on sensor readings and schedules.
- **Web & Mobile Application** – Interfaces for farmers and administrators to monitor and control irrigation, view reports, and manage compliance.
- **Analytics Engine** – Processes sensor and weather data to provide recommendations for sustainable farming.
- **Compliance Module** – Tracks and stores documentation for organic certification audits.

## 2. Overall Description

### 2.1 Product perspective

The **AgriSmart** system will be a **standalone smart farming solution** that integrates IoT hardware, cloud-based data processing, and multi-platform user interfaces.

It will interact with multiple external systems to provide real-time agricultural insights and irrigation control:

### 2.1.1 IoT Sensor Network

- Collects **soil moisture, pH, nutrient levels, temperature, and humidity**.
- Transmits data to the central cloud server via LoRaWAN/Wi-Fi/GSM.

### 2.1.2 Smart Irrigation Controller

- Automates water flow based on predefined rules or AI-driven recommendations.
- Supports both **automatic and manual** irrigation modes.

### 2.1.3 Weather Forecasting API

- Integrates with trusted weather data providers.
- Adjusts irrigation schedules based on upcoming rainfall or temperature changes.

### 2.1.4 Organic Certification Database

- Stores and retrieves organic compliance records.
- Allows exporting compliance data for audits.

### 2.1.5 Web & Mobile Applications

- **Farmer interface:** Monitor field data, manage crops, control irrigation, and receive alerts.
- **Admin interface:** Manage users, IoT devices, compliance data, and generate reports.

## 2.2 Product functions

### For Farmers

1. **Real-time Monitoring** – View live soil moisture, temperature, and nutrient readings.
2. **Smart Irrigation** – Automatic scheduling based on crop type, weather, and soil conditions.
3. **Manual Override** – Turn irrigation on/off manually from the app.
4. **Crop Growth Tracking** – Record planting dates, expected harvest, and yield predictions.
5. **Alerts & Notifications** – Receive warnings for abnormal soil conditions or missed irrigation events.

### For Administrators

6. **User Management** – Create, edit, and manage farmer accounts.
7. **Device Management** – Register and monitor IoT sensors and irrigation controllers.
8. **Compliance Tracking** – Upload and store certification documents.
9. **Data Analytics** – Generate reports on water usage, crop performance, and soil health.

## 2.3 User characteristics

- **Farmers:**
  - Varying levels of technical knowledge.
  - Mostly mobile app users; some may have limited internet access.
  - Require multilingual support and offline data caching.
- **Administrators & Experts:**
  - Comfortable with web dashboards.
  - Require access to advanced analytics and device configuration tools.

## 2.4 Constraints

- **Technology limitations:** IoT devices must be compatible with existing farm infrastructure.
- **Power & Connectivity:** Some farms may have limited electricity or internet access.
- **Timeframe:** Project delivery within 12 months.
- **Budget:** Fixed allocation for development, hardware procurement, and deployment.
- **Regulatory compliance:** Must follow organic farming standards and data privacy laws (e.g., GDPR).
- **Environmental conditions:** Devices must withstand extreme heat, humidity, and dust.

## 2.5 Assumptions and dependencies

### Assumptions:

- Farmers will have access to smartphones.
- IoT devices will be installed and maintained by certified technicians.
- Weather API providers will supply reliable and updated forecasts.

### Dependencies:

- Availability of IoT sensors and irrigation controllers.
- Third-party weather and compliance database services.
- Stable cloud hosting infrastructure.

## 2.6 Apportioning of requirements

### Phase 1 – Core Smart Irrigation

- IoT sensor network deployment
- Mobile app for real-time monitoring
- Automatic irrigation control
- Basic alert system

### Phase 2 – Advanced Features

- Weather API integration
- Crop growth analytics
- Compliance documentation module
- Multilingual support

### Phase 3 – Optimization & Scaling



- AI-based irrigation recommendations
- Offline data caching for poor connectivity areas
- Multi-farm management for cooperatives

## 3. Specific Requirements

### 3.1 Functional Requirements

#### 3.1.1 Real-time Field Monitoring

The AgriSmart system shall allow farmers to monitor real-time soil and environmental conditions from IoT sensors.

**Requirements:**

- The system shall display live readings of **soil moisture, temperature, humidity, pH, and nutrient levels**.
- Data shall refresh every 5 minutes by default, with an option to configure the update interval.
- The system shall provide a **graph view** for historical sensor data over daily, weekly, and monthly intervals.
- The system shall send alerts if readings go outside predefined optimal ranges.
- Farmers shall be able to select a field/plot and view sensor data specific to that area.

**Example:**

A farmer can open the app and see that **Field 2** has soil moisture at 15%, which is below the threshold of 25%. An alert is displayed, recommending irrigation.

#### 3.1.2 Smart Irrigation Control

The AgriSmart system shall automate irrigation scheduling based on sensor data, weather forecasts, and crop requirements.

**Requirements:**

- The system shall allow **automatic irrigation** based on configurable thresholds for soil moisture.
- The system shall allow **manual override** via the mobile app or web dashboard.
- Irrigation duration and frequency shall adjust dynamically based on:
  - Crop type

- Weather forecast (rainfall, temperature, humidity)
- Soil conditions
- Farmers shall be able to create **custom irrigation schedules**.
- The system shall log all irrigation events for future reference.

**Example:**

If the weather API predicts 30mm of rain in the next 24 hours, scheduled irrigation will be postponed to save water.

### **3.1.3 Crop Growth Tracking**

The AgriSmart system shall help farmers manage crop lifecycle and yield expectations.

**Requirements:**

- Farmers shall be able to record planting dates, crop variety, and expected harvest dates.
- The system shall provide growth stage reminders and best practice tips.
- Farmers shall be able to upload photos of crops to track progress.
- The system shall generate estimated yield forecasts based on past data and current conditions.

### **3.1.4 Organic Compliance Management**

The AgriSmart system shall help maintain and track records for organic farming certifications.

**Requirements:**

- Farmers shall be able to upload compliance documents (e.g., organic fertilizer receipts, pesticide usage logs).
- The system shall store compliance records securely.
- The system shall notify farmers of upcoming certification renewal dates.
- The compliance module shall allow exporting of data in formats required by certification bodies.

### **3.1.5 Alerts and Notifications**

The AgriSmart system shall notify farmers of important events and conditions.

**Requirements:**

- Alerts shall be sent via **push notification, SMS, or email**.
- Notification types include:
  - Low soil moisture alert
  - Irrigation event completed
  - Abnormal sensor reading
  - Weather warnings
  - Certification reminders
- Farmers shall be able to configure which alerts they receive.

### 3.1.6 User and Device Management

The AgriSmart system shall allow administrators to manage accounts and IoT devices.

#### Requirements:

- Admins shall be able to create, update, and deactivate farmer accounts.
- Admins shall be able to register new IoT devices and assign them to farms or fields.
- Device status (online/offline, last sync time) shall be visible in the dashboard.
- The system shall log device maintenance activities.

## 3.2 Non-functional Requirements

### 3.2.1 Performance Requirements

- The system shall update sensor data within **5 seconds** of receiving it from the IoT gateway.
- The system shall support **up to 5,000 connected devices** and **10,000 concurrent users**.
- Irrigation control commands shall be executed within **10 seconds** of user confirmation.
- The system shall remain functional in low-bandwidth conditions, with a minimum supported speed of **128 kbps**.

### 3.2.2 Usability Requirements

- The mobile app shall support **offline data caching** for later synchronization.
- The interface shall be available in **multiple languages** (English, Hindi, Telugu, etc.).
- The system shall use icons and visual cues for low-literacy users.
- Navigation shall require **no more than 3 clicks/taps** to access any major feature.

### 3.2.3 Security Requirements

- All communication between devices and the cloud shall use **SSL/TLS encryption**.
- User authentication shall include **two-factor authentication (2FA)**.
- Role-based access control shall restrict sensitive features to authorized users.
- All compliance documents shall be stored with **AES-256 encryption**.

### 3.2.4 Compatibility Requirements

- Mobile app compatibility:
  - Android 9+
  - iOS 12+
- Web dashboard compatibility:
  - Chrome, Firefox, Safari, Edge (latest versions)
- IoT device compatibility:
  - LoRaWAN 1.0.3 or later
  - Wi-Fi 802.11 b/g/n
  - GSM/4G modules

### 3.2.5 Availability Requirements

- The system shall have **99.9% uptime** annually.

- Scheduled maintenance windows shall be announced at least 48 hours in advance.
- In case of downtime, system recovery shall occur within **30 minutes**.

## 4. Use Cases

### 4.1 Real-time Field Monitoring Use Case

#### Description:

This use case describes how a farmer monitors real-time soil and environmental data from the AgriSmart system.

#### Actors:

- **Farmer** – Primary user monitoring field data.
- **System** – AgriSmart platform retrieving and displaying sensor readings.

#### Pre-conditions:

- IoT sensors are installed and connected.
- The farmer has internet access or cached offline data.
- The farmer is logged into the AgriSmart mobile app.

#### Post-conditions:

- The farmer can view real-time and historical sensor readings for their fields.
- Alerts are generated for abnormal readings if thresholds are exceeded.

#### Basic Flow:

1. The farmer opens the AgriSmart mobile app.
2. The farmer selects the field or plot they wish to monitor.
3. The system retrieves live sensor data from the IoT network.
4. The system displays readings for soil moisture, temperature, humidity, pH, and nutrients.
5. The farmer can switch to historical view for daily, weekly, or monthly trends.

**Alternative Flows:**

- **3a:** If internet is unavailable, the system displays cached readings with a timestamp.
- **4a:** If a sensor is offline, the system shows “No recent data” and suggests troubleshooting.

**Exceptions:**

- If the IoT gateway is offline, live updates are unavailable until the connection is restored.

## 4.2 Smart Irrigation Control Use Case

**Description:**

This use case describes how a farmer automates or manually controls irrigation.

**Actors:**

- **Farmer** – Controls irrigation schedules.
- **System** – AgriSmart platform managing irrigation rules and sending commands to controllers.
- **Smart Irrigation Controller** – Executes water flow commands.

**Pre-conditions:**

- Smart irrigation hardware is installed and connected.
- The farmer has defined crop type and soil thresholds.
- The farmer is logged into the app.

**Post-conditions:**

- Irrigation starts or stops based on user action or automation rules.
- The system logs the irrigation event.

**Basic Flow (Automatic):**

1. The system checks soil moisture and weather forecast.
2. If moisture is below threshold and no rain is predicted, the system starts irrigation.
3. The irrigation controller turns on water flow for the required duration.

4. The system stops irrigation and logs the event.

#### **Basic Flow (Manual):**

1. The farmer navigates to the irrigation control panel.
2. The farmer selects a field and chooses “Start Irrigation” or “Stop Irrigation.”
3. The system sends a command to the irrigation controller.
4. The controller executes the action and sends confirmation.

#### **Alternative Flows:**

- **2a:** If rain is predicted, the system postpones irrigation and notifies the farmer.
- **3a:** If manual override is triggered, automation for that day is suspended.

#### **Exceptions:**

- If the controller is offline, irrigation cannot be executed and an error message is displayed.

### **4.3 Crop Growth Tracking Use Case**

#### **Description:**

This use case describes how a farmer records and tracks crop lifecycle data.

#### **Actors:**

- **Farmer** – Records crop data.
- **System** – Stores, analyzes, and presents growth information.

#### **Pre-conditions:**

- The farmer has created at least one farm profile in the system.
- Crop templates or custom crop details are available.

#### **Post-conditions:**

- Crop growth history is saved and accessible.
- Growth stage reminders are generated.

**Basic Flow:**

1. The farmer navigates to the “Crop Management” section.
2. The farmer selects “Add New Crop” and enters planting date, crop type, and variety.
3. The system calculates estimated harvest date.
4. The farmer uploads periodic crop photos.
5. The system sends reminders for fertilization, irrigation adjustments, and harvest.

**Alternative Flows:**

- **2a:** The farmer selects from pre-loaded best practice templates for common crops.
- **4a:** The farmer skips photo uploads but can still receive stage reminders.

## 4.4 Organic Compliance Management Use Case

**Description:**

This use case describes how farmers manage organic certification requirements.

**Actors:**

- **Farmer** – Uploads compliance records.
- **System** – Stores and organizes certification documents.
- **Certification Body** – Accesses compliance records if shared.

**Pre-conditions:**

- Farmer has a valid AgriSmart account.
- Compliance module is active for their farm.

**Post-conditions:**

- All compliance data is securely stored and exportable.

**Basic Flow:**

1. The farmer navigates to “Compliance Management.”



2. The farmer uploads documents (e.g., receipts, usage logs).
3. The system categorizes documents by certification criteria.
4. The system sends renewal reminders before expiration.

**Alternative Flows:**

- **2a:** The farmer can scan and upload a document directly from the mobile app camera.
- **4a:** If no upcoming renewal, reminders are skipped.

## 4.5 Alerts and Notifications Use Case

**Description:**

This use case describes how the system sends notifications to farmers.

**Actors:**

- **System** – Generates and sends alerts.
- **Farmer** – Receives and responds to alerts.

**Pre-conditions:**

- Alerts are configured in user preferences.
- Contact methods (SMS, email, push) are verified.

**Post-conditions:**

- Alerts are delivered successfully.
- Farmer can acknowledge or dismiss the alert.

**Basic Flow:**

1. A trigger event occurs (e.g., low soil moisture).
2. The system generates an alert.
3. The alert is sent via chosen channels.

4. The farmer views the alert and takes action if needed.

#### **Alternative Flows:**

- **3a:** If primary channel fails, fallback delivery method is used.

## **5. Appendices**

### **5.1 Glossary of Terms**

- **AgriSmart** – The sustainable organic farming and smart irrigation system described in this document.
- **IoT (Internet of Things)** – A network of physical devices that communicate and exchange data over the internet.
- **Soil Moisture Sensor** – A device that measures the amount of water present in the soil.
- **pH Sensor** – A sensor that measures the acidity or alkalinity of the soil.
- **Smart Irrigation Controller** – An automated device that controls water flow to crops based on sensor readings and schedules.
- **Organic Certification** – An accreditation process confirming that farming practices meet organic standards.
- **Compliance Record** – Digital storage of organic certification documents and related records.
- **Weather API** – An external service that provides weather forecasts and conditions to the AgriSmart system.
- **Alert** – A notification sent to farmers about conditions requiring attention.
- **Offline Data Caching** – A system feature that stores data locally on the device when internet access is unavailable, synchronizing once connectivity is restored.

### **5.2 List of Acronyms and Abbreviations**

- **API** – Application Programming Interface
- **IoT** – Internet of Things
- **SSL** – Secure Sockets Layer
- **TLS** – Transport Layer Security

- **AES** – Advanced Encryption Standard
- **GDPR** – General Data Protection Regulation
- **LoRaWAN** – Long Range Wide Area Network
- **UI** – User Interface
- **UX** – User Experience
- **pH** – Potential of Hydrogen (soil acidity/alkalinity measure)

### 5.3 References and Resources

- IEEE Recommended Practice for Software Requirements Specifications:  
<https://ieeexplore.ieee.org/document/830737>
- FAO Guidelines on Sustainable Agricultural Practices:  
<https://www.fao.org/sustainability>
- Organic Farming Standards (India):  
[https://apeda.gov.in/apedawebsite/organic/Organic\\_Products.htm](https://apeda.gov.in/apedawebsite/organic/Organic_Products.htm)
- LoRaWAN Technical Specifications:  
[https://lora-alliance.org/resource\\_hub/lorawan-specification/](https://lora-alliance.org/resource_hub/lorawan-specification/)
- OWASP Security Guidelines:  
<https://owasp.org/Top10/>