Requirements

1. Functional Requirements

ID	Requirement	Description	Priority
FR1	User registration	Allow farmers, technicians, and administrators to create an account using email or third-party login providers.	High
FR2	Authentication and access control	Provide secure login with differentiated access levels based on user roles.	High
FR3	Continuous data ingestion	Incorporate weather data in near real time from open or authorized sources, ensuring constant availability.	High
FR4	Distributed data storage	Store and access climate and agricultural data efficiently from any location with low latency.	High
FR5	Weather data queries	Enable users to consult and visualize current and historical weather data relevant to their agricultural zone.	High
FR6	Climate risk prediction	Offer reliable predictions about droughts, frosts, or heavy rainfall to support preventive decision-making.	High
FR7	Agricultural recommendations	Generate personalized recommendations for planting, irrigation, and fertilization based on local microclimates.	Medium
FR8	Report generation	Allow users to create customized reports for farmers and institutions to support strategic decisions.	Medium
FR9	Administrative panel	Provide administrative tools to manage users, roles, and global system statistics.	High

2. Non-Functional Requirements

ID	Requirement	Description	Priority
NFR1	Performance	The system must respond to queries and predictions within acceptable times for the expected data volumes.	High
NFR2	Horizontal scalability	Must support efficient scaling as the number of users or data ingestion volume increases.	High
NFR3	High availability	Must minimize downtime through automatic recovery mechanisms, ensuring operational continuity.	High
NFR4	Multi-region access	Must provide reasonable load times to geographically distributed users, regardless of physical location.	Medium
NFR5	Interoperability	Must integrate with external weather and agricultural data sources using standardized protocols.	Medium
NFR6	Usability	The interface should be intuitive, responsive, and usable on various devices, even with limited connectivity.	Medium
NFR7	Maintainability	The system should have a modular and well-documented architecture to support updates and scaling.	Medium

3. Prioritization Strategy — Applied Criteria

- **Impact on the end user**: Requirements that directly affect the farmer's or institution's ability to make critical decisions are marked high.
- **Operational dependencies**: Requirements that are prerequisites for other functions (e.g., authentication before access) are rated high.
- **Expected frequency of use**: Frequently used features (like queries or forecasts) are prioritized over occasional ones (like reporting).
- **Strategic value**: Features that support the business model or provide competitive advantage are prioritized.
- **Incremental benefit vs. complexity**: Important but less urgent or more complex features are marked as medium to be planned in later stages.

Priority levels (High or Medium) result from evaluating these criteria collectively with the development team and potential pilot users.

4. Performance and Capacity Analysis

System Dimensioning Assumptions

- Registered users: 2,000 in year one.
- Peak concurrent users: 500 (25%).
- Data sources: 1,200 sensors / 1 reading per minute → 1.7M records/day.
- Peak usage windows: 5:00–8:00 AM and 6:00–9:00 PM.
- Rural limitations: 2–5 Mbps connections, unstable latencies.

Target Metrics

Target Metric	**Value**	**Source of Estimate**
Response latency (p95)	3 seconds	Based on rural bandwidth tests + UI load tolerance for 150 KB responses.
Response latency (p99)	5 seconds	Ensures smooth UX for almost all users during peak hours.
Data update delay	2 minutes	1 min of emission + 1 min of ingestion/processing.
Ingestion throughput	2,000 rec/s sustained (6,000 peak)	Derived from 1.7M daily recs × peak load factor × 3.
Availability	99.5% (3.6 h downtime/month)	Balanced cost-benefit for mid-tier infrastructure.
Payload size	150 KB	Suitable for 3G/4G connections to ensure ¡ 0.5s load.
Scalability	Double capacity in ¡ 1 hour	Tested via auto-provisioning in pilot environment.

Source of Numbers

- Demographic and usage patterns came from interviews with local agricultural associations and two pilot tests (n 50 users).
- Network performance was measured with tools like Speedtest in three rural municipalities.
- Peak values include safety factors ×3–5 over observed averages to cover climate emergency scenarios and system growth.
- These metrics will be reviewed semiannually based on production monitoring and adjusted as system adoption increases.

Sizing Methodology

- **Anticipated volume:** 2,000 accounts in the first year, with peaks of 500 concurrent users during planting season.

- **Sensors/weather sources:** 1,200 stations (owned or open) sending 1 data/minute 1.7 million records/day.
- **Usage patterns:** Most frequent queries: 05:00–08:00 and 18:00–21:00 (day planning and alert verification). On average, a user executes 3 queries per session.
- **Limitations:** Rural connectivity: 2–5 Mbps links and unstable latencies.