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**Subtopic: Weather-Based Alerts and Predictive Insights**

**🧑‍🌾 Under Main Theme: Smart Crop Advisory for Small and Marginal Farmers**

**✅ 1. Overview**

**Objective:**  
To develop a module that delivers **real-time weather-based alerts** and provides **predictive insights** to small and marginal farmers, helping them make informed decisions about sowing, irrigation, pest control, and harvesting.

This ensures **risk mitigation**, better **resource management**, and improved **crop yields**, especially in areas with unpredictable climatic conditions.

### . Key Features

#### A. Weather-Based Alerts

* Real-time alerts based on weather forecasts.
* Types of alerts:
  + Rainfall warnings (light, moderate, or heavy)
  + Pest/disease risk due to humidity
  + Ideal sowing or harvesting windows
  + Extreme temperature or wind conditions
  + Spraying advisories (e.g., don’t spray before rain)

#### B. Predictive Insights

* Historical weather + forecast data used to:
  + Predict optimal sowing time
  + Recommend irrigation schedule
  + Forecast pest/disease outbreaks
  + Estimate yield trends based on growing conditions

## Key Features with Conditions/Triggers

| **Feature** | **Description** | **Trigger/Condition Example** |
| --- | --- | --- |
| **Rainfall Alerts** | Notify farmers about upcoming rain events to help them plan activities like spraying or harvesting. | Forecast rainfall > 10 mm within next 24-48 hours |
| **Frost Warning** | Alert farmers to protect crops from frost damage during cold snaps. | Night temperature forecast < 2°C |
| **Heatwave Alert** | Inform farmers about extreme heat to adjust irrigation and protect crops. | Day temperature forecast > 40°C for 2+ consecutive days |
| **Wind Advisory** | Warn against pesticide spraying during strong winds to avoid chemical drift. | Wind speed forecast > 25-30 km/h during spraying window |
| **Pest/Disease Risk Alert** | Predict pest or disease outbreaks based on weather conditions favorable to pests/diseases. | High humidity + warm temperature sustained over 3 days |
| **Optimal Sowing Window** | Recommend best time for sowing crops based on weather and soil conditions. | Soil moisture adequate + temperature within crop range |
| **Irrigation Advisory** | Suggest irrigation scheduling depending on rainfall forecast and soil moisture levels. | No rain forecast for 7 days + soil moisture below threshold |
| **Harvesting Advisory** | Notify ideal harvesting time based on dry weather conditions to reduce crop loss. | Forecast dry weather for next 5-7 days |
| **Cold Wave Alert** | Alert for sudden cold waves that could damage seedlings or sensitive crops. | Drop in temperature > 5°C below normal within 48 hours |
| **Custom Voice/SMS Alerts** | Deliver alerts via multiple channels including voice messages for illiterate farmers. | Triggered by any of the above alerts |

## Integration Conditions

| **Integration Type** | **Condition / Requirement** | **Purpose / Practical Note** |
| --- | --- | --- |
| **Weather API Access** | API keys valid and rate limits sufficient to cover all farmer locations (e.g., thousands of requests/day) | Ensure uninterrupted weather data retrieval |
| **Data Freshness** | Weather data updates at least once every 6 hours (preferably 3 hours) | Timely alerts depend on fresh data |
| **Communication APIs** | SMS/WhatsApp/TTS gateway supports local language messaging and bulk messaging | Reach all farmers, including those with limited literacy |
| **Government Data Sync** | Access to farmer registries or beneficiary databases (with privacy compliance) | Automate user onboarding and update farmer profiles |
| **Fallback Mechanism** | Backup API or offline data cache in case primary weather API is down | System resilience, avoid data blackout |
| **Security & Authentication** | Secure API calls (HTTPS, OAuth) and data encryption when exchanging sensitive info | Protect farmer data and system integrity |

## 2. Administrative Conditions

| **Admin Feature** | **Condition / Requirement** | **Purpose / Practical Note** |
| --- | --- | --- |
| **User Role Management** | Clear roles (Admin, Field Officer, Farmer) with permissions tailored to edit/view functions | Control system access and safeguard sensitive settings |
| **Alert Rule Management** | Admins can define, update, or disable alert rules without developer intervention | Flexibility to adapt rules to changing conditions |
| **Farmer Registration Approval** | System supports manual or automated approval workflows | Verify authenticity, maintain data quality |
| **Message Monitoring** | Real-time view of sent messages and delivery status (success/fail) | Track communication effectiveness |
| **Audit Logs** | All admin actions logged with timestamps and user info | Accountability and traceability |
| **Data Privacy Compliance** | Compliance with data protection laws (e.g., GDPR, local laws) | Protect user privacy |

## 3. GIS Conditions

| **GIS Feature** | **Condition / Requirement** | **Purpose / Practical Note** |
| --- | --- | --- |
| **Accurate Geo-Tagging** | Farmers’ locations captured within ±10 meters accuracy via GPS or verified address mapping | Precise alert targeting and spatial analysis |
| **Geo-Fencing Capabilities** | Ability to define alert zones based on administrative boundaries, weather impact radius, or crop regions | Target alerts to only affected farmers |
| **Spatial Data Integration** | Overlay weather maps, soil types, crop distributions, irrigation zones | Provide context-rich, location-specific advisories |
| **Real-Time Map Updates** | GIS layers refresh with each new weather update or farmer location change | Keep the system data current and relevant |
| **Offline GIS Support** | Basic location functionalities available without internet (for remote areas) | Support farmers with limited connectivity |
| **Scalability** | System handles thousands of geo-located farmers without lag |  |