

The Use of Geographic Information Systems and Spatiotemporal Data Analysis to Support Decision-Making in Agriculture and Forestry

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Abstract:

Geographic Information Systems (GIS) and spatiotemporal data analysis play a key role in modern agriculture by enabling farmers to make evidence-based decisions. These technologies integrate meteorological data, satellite imagery, and local sensor measurements to provide precise and localized information for planning and executing agricultural operations. This contribution introduces the **info4agro.com** platform, which helps farmers implement decision-making workflows by providing actionable insights and tools to support key agricultural activities. Through real-world use cases, the contribution demonstrates how this platform enables efficient decision-making, enhances sustainability, and improves productivity.

Case Study: Farmer's Decision-Making Workflow

1. **Planning the Day Before (previous day)** - using the **info4agro.com** platform, the farmer reviews application maps generated from the analysis of vegetation indices (e.g., NDVI) based on the most recent satellite overpass. The platform identifies areas of the field with nutrient deficiencies and recommends how much fertilizer to prepare. For example: "The northern part of the field requires a 20% increase in nitrogen fertilizer, while the rest requires a standard dose."

System action: The farmer prepares the necessary amount of fertilizer for use the following morning.

2. **Morning Planning and Fertilization (next day, 6:00 AM–12:00 PM)**
In the morning, **info4agro.com** provides localized weather forecasts: "Light rain is expected in the afternoon (5 mm/hour), ideal for incorporating fertilizer into the soil. Dry weather is forecasted for the following days, so fertilization must be done today." The farmer applies fertilizer following the recommendations on the application map provided by the platform.

System action: Fertilizer is applied in precise doses to specific areas of the field, minimizing waste and maximizing efficiency.

3. **Planning Pest Control Sprays (morning, 8:00 AM–10:00 AM)**
Based on historical data and current weather conditions, **info4agro.com** recommends applying insecticides due to an increased risk of pest infestation. For example: "Conditions in recent days have been favorable for pest development, and the probability of crop damage has reached 85%. It is recommended to spray as soon as possible."

System action: Spraying is scheduled for the following day because the farmer cannot complete both fertilization and pest control on the same day. The weather forecast provided by the platform indicates favorable conditions for spraying the next day.

4. **Evening Evaluation and Future Fertilization Planning (6:00 PM–8:00 PM)**
Evening analysis through **info4agro.com** focuses on evaluating the day's actions and planning future activities. The farmer reviews data from local sensors, such as soil moisture and temperature, confirming that the afternoon rain effectively incorporated the fertilizer into the soil. Vegetation indices are not yet updated, as they depend on the next satellite overpass.

System action: The platform advises the farmer to review updated vegetation indices before the next planned fertilization to ensure precise identification of crop needs.

Conclusion

This case study demonstrates how GIS, spatiotemporal data analysis, and the **info4agro.com** platform enable farmers to optimize decision-making processes. The individual use cases included:

- **Fertilization Planning:** Analysis of vegetation indices from the most recent satellite overpass and meteorological data identified precise nutrient requirements for different field sections.
- **Fertilizer Application Optimization:** Weather predictions determined the ideal timing of application to leverage rainfall for soil incorporation.
- **Pest Control Planning:** A combination of historical and current data on pest development and forecasts of calm weather helped schedule insecticide application effectively.
- **Evaluation:** Monitoring sensor data confirmed the effectiveness of actions and provided feedback for future operations.

By integrating advanced data analysis with user-friendly features, **info4agro.com** provides farmers with practical tools to implement evidence-based decisions in their daily workflows. The visualization of results using cartographic methods ensures easy data interpretation and practical application in farming operations.

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