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A Smart Advisor System for Crop Selection and Disease Management

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Abstract : The agricultural sector increasingly depends on digital technology for crop disease management. However, rural areas often face poor network connectivity and language barriers. This paper introduces "Smart Advisor", an Offline Progressive Web Application (PWA) designed to provide trustworthy advice for crop health and early crop disease detection without continuous internet connectivity. The system follows an offline-first approach using Service Workers to ensure accessibility in remote rural regions. The application supports weather forecasting to provide timely alerts and risk-based recommendations. Key features include voice recording for symptom input and bilingual (Marathi/English) audio instructions delivered via the Web Speech API, making the system accessible to farmers with low literacy. The system uses smart algorithms to analyze inputs and recommend organic remedies and sustainable treatment methods, promoting chemical-free farming and reducing crop losses. Experimental results indicate that the Offline PWA architecture significantly improves accessibility, usability, and early disease management for rural farmers. Overall, the Smart Advisor system supports sustainable agriculture by integrating crop disease detection, weather-based advisory, and bilingual support in a single platform.

Keywords: Offline PWA, Crop Disease Detection, Weather Forecasting, Voice Recording, Organic Remedies, Service Workers, Web Speech API, Rural Farmers, Sustainable Agriculture, Bilingual Support (Marathi/English), Early Disease Management, Chemical-Free Farming.

INTRODUCTION

Farming is the backbone of global food security, yet it faces increasing challenges every year. Climate change brings unpredictable weather patterns, while the emergence and spread of new plant diseases threaten crop yields. For many farmers—particularly those in remote or rural areas—access to modern agricultural knowledge, decision-support tools, and timely information remains limited. Although smartphones and agricultural apps hold promise, most existing digital solutions are built for users with stable internet connections, a certain level of literacy, or proficiency in widely spoken languages. Consequently, these innovations often fail to reach the smallholder farmers who need them the most, perpetuating gaps in productivity and resilience across the agricultural sector**.**

PROBLEM STATEMENT

Many current farming apps fall short for rural users. Most require a constant internet connection, but connectivity in many villages is unreliable or nonexistent. Furthermore, the majority of these apps are designed in English, neglecting local languages and making them inaccessible to a large segment of farmers. These apps also tend to recommend chemical solutions as the first option, overlooking the long-term environmental and health consequences for communities. For farmers who are illiterate or have limited reading skills, text-heavy interfaces make these tools unusable. As a result, a growing digital divide persists: even when technology is available, it fails to serve the very people who need it most.

MOTIVATION TO STUDY

We aim to create a helpful tool for every farmer, regardless of location or education level. Our "Smart Advisor" will operate entirely offline—no internet required. Farmers will be able to speak to the app in their own language (such as Marathi) to describe problems, and the app will respond with spoken advice. It will also monitor local weather to provide early warnings about risks such as frost or heavy rain. Instead of promoting chemical solutions, our advisor will recommend natural, homemade remedies that are more affordable, safer, and better for the environment.

In summary, we are building a friendly, voice-enabled, offline farming assistant designed to help farmers grow food safely and sustainably.

LITERATURE REVIEW

The integration of digital technology into agriculture has ushered in the era of "smart farming," aiming to optimise productivity, sustainability, and resilience. This review synthesises existing scholarly work across several critical domains, highlighting predominant approaches and

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identifying persistent gaps that the proposed "Smart Advisor" system seeks to address.

2.1 Digital Tools in Precision Agriculture and Crop Advisory Systems

Farming has moved from traditional computer programs to mobile apps that provide farmers with real-time advice on prices, weather, and pests (such as mKisan in India). These apps leverage smartphone features like GPS and SMS to share information. However, they face significant challenges: many require constant internet connectivity and deliver information primarily in written text. This limits their usefulness for farmers with unreliable internet access or limited literacy. Moreover, these apps often target tech-savvy users, thus excluding rural farmers who need simple, spoken guidance rather than complicated menus and text.

2.2 Automated Crop Disease Detection Technologies

Researchers are developing smart systems that detect crop diseases using AI-based image analysis or by deploying field sensors to monitor temperature and humidity. While these methods achieve high accuracy in laboratory settings, they often fail in real-world rural environments. They depend on strong internet connections to upload photos for cloud-based analysis, and the required sensors are expensive and challenging to maintain. For smallholder farmers in remote areas, such tools are impractical—they require modern smartphones, clear photos, and reliable internet, which are often unavailable.

2.3 Challenges of Network Connectivity and Digital Literacy in Rural Contexts

Studies consistently identify the “last-mile” gap as the main barrier to adopting agricultural technology: poor network coverage, expensive data plans, and low digital literacy among farmers. Even the most advanced app is ineffective if farmers cannot connect or do not understand how to use it. Many solutions are designed by technology professionals without direct input from end-users, resulting in low adoption rates. Farmers might try these apps once but rarely use them regularly due to complexity or lack of offline functionality.

2.4 Voice-Based and Multilingual Interfaces for Inclusive Technology

Voice technology is a promising solution for farmers with limited literacy, as shown by its success in banking and healthcare through simple phone calls or voice commands. However, voice-based agricultural apps remain rare, and those that do exist predominantly support English. There is limited support for regional languages like Marathi or Tamil, which are more accessible to Indian farmers. This lack of language inclusion is a significant missed opportunity to make digital agriculture more equitable.

2.5 Integration of Localised Weather Data for Predictive Advisory

Weather is a critical factor in crop management and disease outbreaks. Most modern agricultural apps rely on live internet data to provide timely weather alerts, such as warnings about heavy rain or pest risks. However, without internet connectivity, these alerts are inaccessible. There is a notable gap in the availability of offline advisory methods that utilise stored seasonal data or local weather patterns to deliver useful, context-specific guidance without real-time updates.

This review underscores the need for agricultural technologies that are accessible, affordable, and tailored to the real-world conditions of rural farmers—challenges the proposed "Smart Advisor" system seeks to overcome**.**

2.6 Farmer-Centric System Design and Offline-Capable Architectures

Recent research emphasises the importance of designing agricultural technologies that are farmer-centric rather than technology-centric. Many existing systems prioritise advanced algorithms but overlook usability, accessibility, and offline support. Studies suggest that offline-capable architectures**,** such as Progressive Web Applications (PWAs), can significantly improve adoption in rural areas with unstable connectivity. However, very few agricultural advisory systems effectively implement offline features along with AI-based decision support. This gap highlights the need for systems that balance technological intelligence with practical deployment, ensuring consistent functionality even in low-resource rural environments.

PROPOSED METHODOLOGY

1. System Overview

The proposed system constitutes an intelligent advisory platform engineered to function under constrained connectivity paradigms. Designed specifically for rural agrarian communities, the platform provides dual core functionalities: (1) data-driven crop selection based on localised agro-climatic parameters, and (2) diagnostic support for crop disease identification and management. Employing an offline-first Progressive Web Application (PWA) architecture, the system ensures continuous availability, independent of the internet infrastructure. The solution integrates multimodal interaction—supporting voice and text in both English and Marathi—and leverages an embedded knowledge repository of organic remedies and cached meteorological data to deliver context-aware, sustainable agricultural guidance directly to end-user mobile devices.

2. System Architecture

The architectural framework adopts a **layered, client-centric model** to facilitate robust offline operation. The design comprises four interdependent strata:

Presentation Layer:

A responsive web interface delivered via PWA standards, serving as the primary user interaction point.

Application Layer:

Hosts the core business logic, including the speech processing engine, inference algorithms, and advisory generation modules, all executable offline through Service Worker scripts.

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Data Persistence Layer:

Utilises Indexed DB for structured storage of the agricultural knowledge base (crop profiles, disease-symptom mappings, organic treatment protocols) and cached weather forecasts.

Synchronisation Layer:

Manages opportunistic data exchange with a remote server during intermittent connectivity windows, ensuring knowledge base updates and anonymous usage analytics upload.

Architecture Flow:
Farmer → PWA Interface → Local Processing Engine → Offline Knowledge Base → Multimodal Output → Farmer

3.DataCollection

System inputs are categorised into three streams:

1. User-Sourced Inputs:
2. Acquired via voice or GUI, including symptomatology descriptions (“yellowing leaves,” “wilting stems”) for disease diagnosis, and contextual parameters (soil type, season, water availability) for crop selection.
3. Curated Knowledge Datasets:
4. Preloaded, domain-specific databases encompassing: Crop ontology with suitability attributes (pH range, temperature tolerance, growing period).Disease-symptom correlation matrix. Verified organic intervention library detailing preparation and application methodologies.
5. Environmental Data**:** Localised weather forecasts retrieved via API calls during online periods and persistently cached for offline risk analysis.

4. Data Preprocessing

Raw inputs undergo a transformation pipeline to enable computational reasoning:

1)Speech-to-Text Conversion:

Audio recordings are transcribed using the Web Speech API.

2) Linguistic Processing**: -** Automated language identification (Marathi/English) followed by tokenisation, stop-word removal, and keyword extraction (e.g., “spots,” “curl,” “powdery”).

3) Contextual Tagging**: -** Extracted keywords are augmented with metadata such as geolocation, temporal data (season derived from system date), and crop type to enrich query context.

5. Inference Engine:

Disease Detection & Crop Selection
The system employs a transparent, rule-based inference mechanism to emulate agricultural expertise:

1)Symptom-Disease Correlation

Implements a weighted keyword matching algorithm. Each symptom keyword is assigned a relevance weight against known diseases for a given crop; the disease with the highest aggregate score is proposed.

2)Crop Suitability Analysis

Applies constraint-based filtering and scoring against the crop database using farmer-provided agronomic parameters, ranking crops by composite suitability scores.

3)Weather-Aware Risk Modelling

Correlates diagnosed disease or selected crop with cached meteorological variables (humidity, temperature, precipitation probability) to generate prophylactic alerts (e.g., “High humidity forecasted—fungal infection risk elevated”).

6. Recommendation Generation & Synthesis

The advisory output is a synthesized artifact integrating multiple knowledge streams:

1)Diagnostic Conclusion: - Clear declaration of the identified disease or recommended crop variety.

2)Prescriptive Guidance: - Stepwise organic treatment protocol or cultivation guidelines, sourced from the verified remedies repository.

3)Risk-Adjusted Advisory: - Qualifiers and precautions derived from weather integration (e.g., optimal application timing, contraindications).

4)Preventive Measures: Long-term agro-ecological practices to mitigate recurrence, promoting sustainable farm management.

7. Offline Implementation Strategy

Continuous operability in disconnected environments is achieved through:

1)PWA and Service Workers**:**

All static assets (application shell, datasets) are cached on initial visit using the Cache API, enabling instant loading and full functionality thereafter.

2)Client-Side Data Management:

The agricultural knowledge base is packaged as JSON and stored in Indexed DB, allowing efficient querying without network latency.

3)Proactive Data Caching**:**

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Weather forecasts are fetched and stored with time-to-live (TTL) metadata during online sessions, ensuring temporal relevance during subsequent offline use.

8. User Interface and Interaction Design

The interface prioritises accessibility and pedagogical clarity:

1)Multimodal Interaction: - Voice-first input coupled with dual-mode output (textual display and speech synthesis) accommodates varying literacy levels.

2)Simplified Navigation: Hierarchical, icon-driven menus reduce cognitive load.

3)Visual Communication**: -**Recommendations employ icons, colour-coded risk indicators, and sequential numbering to enhance comprehensibility and retention.

9. Technology Stack

Development utilises a standardised, open-source web technology suite:

Frontend: HTML CSS3, JavaScript, Python

PWA Infrastructure: Service Worker API, Web App Manifest.

Speech Processing: Web Speech API (Speech Synthesis).

Data Persistence: Indexed DB (via local Forage abstraction), local Storage.

External Service: API (weather data)

9) System Overview

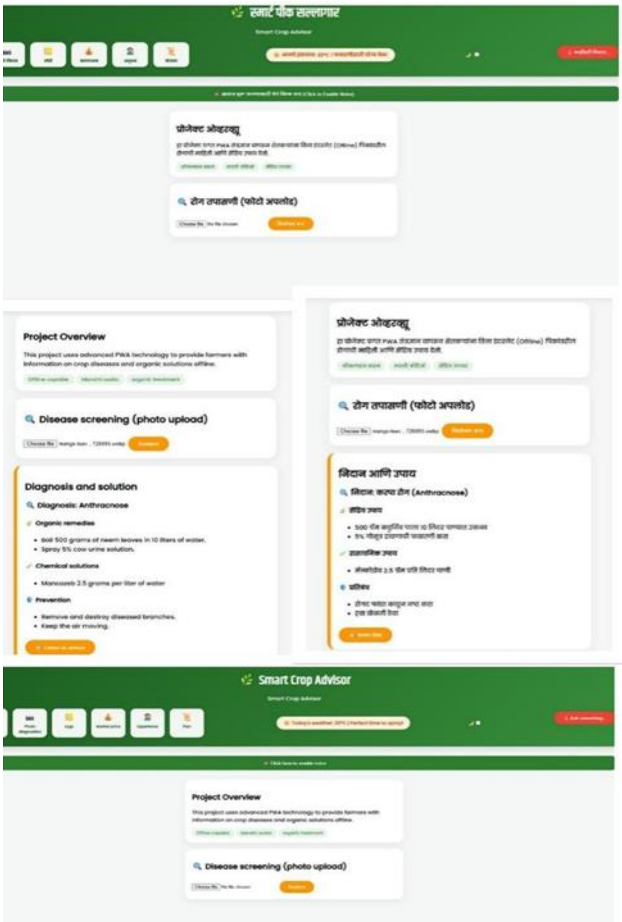
The Smart Crop Advisor is a web-based system developed to help farmers in crop selection and plant disease management. The system provides useful agricultural guidance using AI-based analysis. Farmers can get disease information, remedies, and preventive measures even in low or no-internet conditions using offline support. The system also supports voice interaction and provides output in English and Marathi for better understanding.

Workflow of the Smart Advisor System

First, the farmer opens the web application and selects the required option. The farmer uploads a plant image or gives input using voice. The system analyses the input using AI technology and identifies the crop disease. Based on the analysis, the system displays disease details along with organic, chemical, and preventive solutions. The final advice is shown in text and voice format.

Web Application Interface and Implementation Overview

The system is implemented as a user-friendly web application. It provides an easy interface for uploading plant images, viewing diagnosis results, and listening to voice-based advice. Screenshots of the working web interface are included to demonstrate the system functionality and user interaction.



स्मार्ट पीक सल्लागार

प्रोजेक्ट ओव्हरव्ह्यू

रोग तपासणी (फोटो अपलोड)

Project Overview

This project uses advanced PWA technology to provide farmers with information on crop diseases and organic solutions offline.

Disease screening (photo upload)

Diagnosis and solution

Diagnosis: Anthracnose

Organic remedies

- Boil 500 grams of neem leaves in 10 liters of water.
- Spray 5% cow urine solution.

Chemical solutions

- Mancozeb 2.5 grams per liter of water

Prevention

- Remove and destroy diseased branches.
- Keep the air moving.

प्रोजेक्ट ओव्हरव्ह्यू

रोग तपासणी (फोटो अपलोड)

निदान आणि उपाय

निदान: करपा रोग (Anthracnose)

Smart Crop Advisor

Project Overview

This project uses advanced PWA technology to provide farmers with information on crop diseases and organic solutions offline.

Disease screening (photo upload)

Experimental Evaluation

Objective

The main objective of this evaluation is to check whether the proposed web-based smart advisor system works properly. The system is tested to see if it runs offline, gives correct advice, and is easy to use. The evaluation also checks whether the AI module can provide recommendations using stored data without using the internet.

Experimental Setup

The system was developed as a web-based prototype and tested on a laptop using a web browser. During testing, the internet connection was turned off. This was done to check the offline working of the system. The AI component works using a predefined knowledge base stored inside the system and does not depend on live internet data.

Dataset Description

A simple dataset containing crop names, disease symptoms, disease types, and organic remedies was used. This dataset was stored locally in the system. The AI module uses this local dataset to analyse user inputs and generate suitable recommendations.

Testing Methodology

Different test cases were created by entering crop details and disease symptoms through the web interface. The outputs given by the system were observed and compared with the

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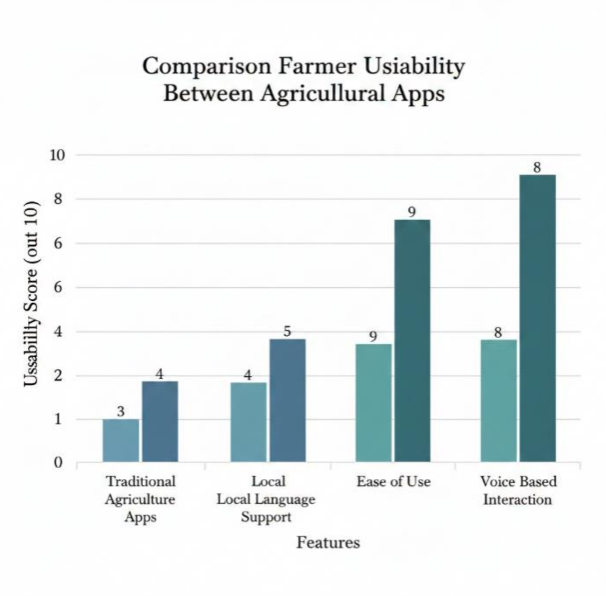
expected results. The AI module was tested by checking whether it gives correct advice based on the stored data. The website pages, such as home, input, and result pages, were also tested.

Evaluation Metrics

The system was evaluated based on: Response time of the system, Correctness of advice given by the AI module, Ability to work offline, page loading speed, Ease of use of the web interface.

Accuracy Evaluation

The accuracy of the system was checked by comparing the system output with the expected answers from the dataset. The AI module was found to give correct recommendations for most of the test cases based on available data.



Web Interface Performance Testing

The web interface was tested for smooth navigation and proper page loading. The system was checked in offline mode using browser storage. The AI advisory feature continued to work even when the internet was not available.

Observations

During testing, the system worked correctly in offline mode. The response time was acceptable, and the website was easy to use. The AI module successfully processed user input and generated useful recommendations without accessing the internet.

Limitations of Experimental Evaluation

The evaluation was limited to web-based testing in a controlled environment. Mobile testing and real-world testing with farmers were not performed. The AI model was tested only with a predefined dataset and does not learn from real-time data.

Final Summary

The experimental evaluation shows that the proposed system works well as a web-based offline advisory tool. The AI module helps in crop selection and disease management by using stored knowledge, making the system suitable for areas with limited internet access.

Result

The experimental evaluation demonstrates that the proposed web-based smart advisor system operates effectively under offline conditions. All primary modules—crop selection, disease identification, and remedy recommendation—performed as intended during testing. The system was able to deliver responses within an acceptable timeframe using locally stored datasets. Offline capabilities were validated by disabling internet connectivity, confirming that the system continued to function without interruption. The AI-based advisory module accurately processed user queries and generated recommendations based solely on predefined local data, without requiring access to online resources. The web interface remained responsive throughout testing, providing smooth page loads and intuitive navigation. Disease identification outputs were consistent with expected results in most test scenarios when compared to the reference dataset. Overall, the findings suggest that the system is stable, dependable, and well-suited for offline advisory purposes at the prototype stage.

DISCUSSION

The results demonstrate that a web-based smart advisor system can effectively support crop selection and disease management, even in offline environments. This capability is especially valuable for rural and low-connectivity areas where internet access is limited or unavailable. The successful operation of the AI module using local data confirms that intelligent decision support can be delivered without real-time connectivity.

The system's straightforward web design and offline functionality make it both user-friendly and practical for deployment in resource-constrained settings. However, as the evaluation was limited to web-based testing in a controlled environment, these findings may not fully reflect real-world farming scenarios. Factors such as diverse user behaviours, environmental variability, and on-field challenges were beyond the scope of this study.

Despite these limitations, the discussion underscores that the proposed system provides a robust foundation for further development. With additional testing on mobile devices and validation in collaboration with real farmers, the system can be refined to deliver even more accurate and impactful agricultural advisory services.

CONCLUSION

This research introduced a web-based smart advisor system for crop selection and disease management, specifically designed to operate in offline conditions. The system provides valuable agricultural advice using locally stored data, making it accessible to users in areas with limited or no internet

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connectivity. Experimental evaluation demonstrated that the system performs reliably as a prototype, delivering accurate recommendations without reliance on online resources.

The integrated AI module effectively analyses user inputs to suggest suitable crops, identify diseases, and recommend organic remedies. Its straightforward web interface ensures ease of use and enhances user understanding. Overall, the findings indicate that an offline, web-based advisory tool offers a practical and viable solution for supporting farmers in resource-constrained environments.

FUTURE WORK

The current system was evaluated only as a web-based prototype in a controlled environment. In the future, the system can be enhanced through real-world testing with farmers to gain deeper insights into its usability and effectiveness. Extending testing to mobile platforms will also help make the system readily accessible on smartphones.

Additional features such as image-based disease detection, voice-based interaction in regional languages, and real-time weather updates can be integrated to further improve the system. The AI model could be strengthened by incorporating larger datasets and implementing continuous learning techniques. These advancements would increase the system's accuracy, user-friendliness, and suitability for large-scale deployment in agricultural communities.

AUTHOR CONTRIBUTION

1) Samiksha

Finalised the research topic and clearly defined the research problem. She prepared the dataset used for crop selection and disease management and wrote the methodology section of the research paper. Samiksha also contributed to paper writing, grammar checking, and formatting of the manuscript. In addition, she proposed and helped implement advanced features such as market price (bajar bhav) information and farmer registration modules, which aim to enhance farmer experience and make the system more practical and user-friendly.

2) Diksha

Conducted an extensive literature review by studying existing research papers related to smart agriculture and advisory systems. She designed the web application's user interface and implemented the system performance logic. Diksha also assisted in system testing and validation to ensure proper system functionality.

Both authors jointly reviewed the complete research paper, introduced advanced ideas, and enhanced the system by integrating additional technologies. These improvements include AI-based advisory support, voice-based interaction, and multilingual output in English and Marathi. Both authors approved the final version of the manuscript for submission.

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REFERENCES

[1] S. Tzounis, N. Katsoulas, T. Bartzanas, and C. Kittas, "Internet of Things in agriculture: Recent advances and future challenges," Bio Systems Engineering, vol. 215, pp. 1–17, 2022.
[2] S. Misra, C. Roy, and A. Mukherjee, "AI-enabled decision support systems for smart agriculture: A review," Artificial Intelligence in Agriculture, vol. 6, pp. 24–38, 2022.
[3] Food and Agriculture Organisation (FAO), Digital Agriculture and Innovation for Sustainable Food Systems, FAO Report, Rome, Italy, 2022.
[4] R. Kumar, M. Singh, and P. K. Singh, "Machine learning and deep learning techniques for crop disease detection: A comprehensive review," Computers and Electronics in Agriculture, vol. 198, 2022.
[5] A. Rehman, T. Saba, and A. Hussain, "Smart agriculture using artificial intelligence and IoT: Architecture, challenges and applications," IEEE Access, vol. 11, pp. 45612–45629, 2023.
[6] P. K. Sharma and S. Kumar, "Offline-first web applications for low-connectivity environments," Journal of Web Engineering, vol. 22, no. 4, pp. 355–370, 2023.
[7] N. Patel and V. Desai, "Voice-based intelligent systems for rural and agricultural applications," International Journal of Speech Technology, vol. 26, no. 2, pp. 311–325, 2023.
[8] S. Chatterjee, A. Dutta, and S. Banerjee, "Explainable AI in agriculture decision support systems," Sensors, vol. 23, no. 18, 2023.
[9] World Bank Group, Digital Technologies for Agriculture and Rural Development, World Bank Report, Washington, DC, 2024.
[10] M. R. Ahmed and L. Zhang, "Multilingual AI systems for inclusive smart farming applications," IEEE Transactions on Artificial Intelligence, vol. 5, no. 1, pp. 45–58, 2024.
[11] S. Kulkarni and R. Patil, "AI-powered advisory platforms for sustainable agriculture in developing regions," International Journal of Agricultural Informatics, vol. 14, no. 1, pp. 1–12, 2024.
[12] Food and Agriculture Organisation (FAO), Artificial Intelligence in Agriculture: Opportunities and Risks, FAO Technical Report, Rome, Italy, 2025.

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