

Smart Agriculture Market Intelligence and Decision Support System For Farmers.

¹Dr R Senthilkumar, ²Arshad Khan.S, ³Bharath.S, ⁴Dhanushu.S, ⁵Hari krishna.A

¹ Assistant Professor, Department of Computer Science and Engineering,
Hindusthan Institute of Technology, Coimbatore.

^{2,3,4,5} UG student, Department of Computer Science and Engineering,
Hindusthan Institute of Technology, Coimbatore.

¹sentinfo@gmail.com, ²arshxd17@gmail.com, ³bharath18176123@gmail.com, ⁴dhanushus6385@gmail.com,
⁵harikrishnaashokan@gmail.com

Abstract: Agriculture plays a vital role in the economic development of many countries, especially India, where a large portion of the population depends on farming for their livelihood. However, farmers often face challenges such as lack of access to real-time market information, unpredictable weather conditions, fluctuating crop prices, and limited knowledge of profitable markets. These challenges can lead to poor decision-making, reduced productivity, and financial losses. This paper proposes a Smart Agriculture Market Intelligence and Decision Support System designed to assist farmers in making informed agricultural and marketing decisions. The system integrates modern technologies such as data analytics, agricultural market information systems, and decision support mechanisms to provide farmers with reliable and timely insights. It collects and processes agricultural data such as crop prices, market demand, weather information, and regional agricultural trends. By analyzing this data, the system provides recommendations regarding crop selection, optimal selling time, and nearby markets offering better prices. The platform reduces farmers' dependency on intermediaries by providing direct access to updated agricultural information. The system is developed as a web-based application using modern technologies including React.js for the user interface, Node.js and Express.js for backend processing, and MongoDB for data management. Experimental results demonstrate that the system improves transparency in agricultural markets and enhances farmers' ability to make strategic decisions. The proposed solution contributes to better agricultural planning, increased profitability, and improved efficiency in the agricultural supply chain. Future enhancements may include machine learning-based prediction models, IoT-based farm monitoring systems, and mobile application integration for wider accessibility.

Keywords- Smart Agriculture, Agricultural Market Intelligence, Decision Support System, Crop Recommendation, Data Analytics in Agriculture, Weather Information Systems, Digital Farming

1. INTRODUCTION

Agriculture is one of the most significant sectors supporting the economy and livelihood of millions of people around the world. In developing countries such as India, agriculture plays a crucial role in providing employment, ensuring food security, and contributing to national economic development. A large portion of the rural population depends on farming as their primary source of income. Despite its importance, farmers continue to face several challenges that affect productivity, profitability, and sustainability. One of the major issues faced by farmers is the lack of access to accurate and timely information regarding agricultural markets. Crop prices fluctuate frequently due to supply and demand variations, weather conditions, transportation costs, and market competition. Many farmers rely on local traders or middlemen to obtain price information, which may not always be accurate or beneficial to them. As a result, farmers often sell their produce at lower prices without knowing the potential value in other markets. In addition to market-related challenges, farmers also face difficulties in crop planning and agricultural decision-making. Selecting the right crop for cultivation depends on several factors such as soil conditions, climate patterns, market demand, and expected profitability. Without proper data and analysis, farmers may choose crops that are not suitable for their region or that do not yield sufficient financial returns. The rapid advancement of information technology and digital platforms has created new opportunities to address these agricultural challenges. Smart agriculture solutions use modern technologies such as data analytics, decision support systems, and digital communication platforms to improve farming practices and provide farmers with useful insights. These systems enable the collection, analysis, and distribution of agricultural data to support better planning and decision-making.

A Smart Agriculture Market Intelligence and Decision Support System can play a significant role in improving transparency in agricultural markets. By providing farmers with real-time information about crop prices, weather forecasts, and market demand, such systems help farmers make informed decisions regarding crop selection, cultivation planning, and selling strategies. These systems can also reduce farmers' dependence on intermediaries and increase their ability to access profitable markets directly. The proposed system in this research focuses on developing a web-based platform that integrates agricultural market intelligence with decision support capabilities. The system collects data related to crop prices, market demand, and environmental conditions and processes it to generate meaningful insights for farmers. Through an interactive and user-friendly interface, farmers can easily access agricultural information and receive recommendations that support their farming activities. The platform also aims to improve the efficiency of agricultural supply chains by enabling farmers to identify better markets for selling their produce. By analyzing historical and real-time data, the system can provide valuable insights into price trends and demand patterns. This allows farmers to make strategic decisions regarding crop production and marketing.

2. LITERATURE SURVEY

Recent advancements in digital technologies have significantly influenced the development of intelligent systems for agriculture and environmental monitoring. Various researchers have explored the integration of Internet of Things (IoT), Artificial Intelligence (AI), and data analytics to improve efficiency and decision-making in different domains. Deepa et al. (2025) analyzed the performance of multiple-input multiple-output orthogonal frequency division multiplexing systems using optimization algorithms, highlighting the importance of advanced computational techniques in improving communication systems [1]. Senthilkumar et al. (2020) proposed an IoT-enabled air pollution monitoring system using embedded technologies to monitor environmental parameters effectively. Their work demonstrated the potential of IoT-based monitoring systems in collecting real-time environmental data and supporting intelligent decision-making [2]. Similarly, Senthilkumar, Venkatakrisnan, and Balaji (2022) developed an indoor air quality monitoring system integrated with artificial intelligence and recurrent neural network algorithms to enhance environmental monitoring accuracy [4]. In the agricultural domain, innovative technologies have been applied to improve crop monitoring and agricultural productivity. Muthalakshmi et al. (2025) introduced an approach using near-infrared spectroscopy to evaluate sugarcane quality by predicting parameters such as Brix, Pol, and fiber content, thereby improving quality assessment in agricultural industries [3]. Adeyemi et al. (2020) proposed an IoT-based smart crop monitoring system that utilizes sensors to monitor environmental conditions and provide real-time information for farmers to enhance agricultural productivity [11]. Similarly, Nandhini and Raja (2019) designed an IoT-based smart agriculture monitoring system that helps farmers monitor soil moisture, temperature, and other parameters to optimize crop growth and resource utilization [12].

Research in intelligent data processing and machine learning has also contributed to advancements in various applications. Nagarani et al. (2026) proposed a graph neural network-based method for detecting pigment epithelial detachment in OCT images, demonstrating the potential of deep learning techniques in medical image analysis [5]. Swathiramy et al. (2025) explored multimodal machine learning models for interpreting text, image, and audio data, highlighting the importance of integrating multiple data sources for intelligent systems [9]. Artificial intelligence has also been applied in health and nutrition-related applications. Sanitha et al. (2025) developed an explainable AI-based diet tracking system to help prevent nutrition-related disorders by analyzing dietary patterns and providing recommendations [6]. Srinju et al. (2025) proposed an AI-based recommendation system for weight management that uses user feedback and health metrics to provide personalized suggestions for improving health outcomes [10]. In the field of cybersecurity and resource management, Jayasri et al. (2025) proposed a zero-trust security architecture for protecting cyberspace, emphasizing the importance of identity-first defense mechanisms in modern digital systems [7]. Uthayakumar et al. (2025) developed AI-driven water resource management systems that improve water distribution and monitoring using intelligent technologies [8]. The development of smart agricultural systems is also supported by global initiatives and technological advancements. The Food and Agriculture

Organization (FAO) highlighted the role of digital technologies in agriculture and rural development, emphasizing their importance in improving productivity and sustainability [13]. Zhang et al. (2002) provided an overview of precision agriculture techniques that use advanced technologies to optimize farming practices and resource management [14]. Stankovic (2014) discussed research directions for the Internet of Things, highlighting the role of connected devices in enabling smart systems across various domains [15]. Modern agricultural applications often rely on web technologies and database systems to manage large volumes of agricultural data and provide user-friendly interfaces. Technologies such as React, Node.js, MongoDB, and Express.js are widely used for developing scalable and efficient web applications that support data management and decision-making processes [16–19]. Additionally, Agricultural Market Information Systems (AMIS) provide valuable market intelligence and price monitoring information to help farmers make informed decisions regarding crop production and marketing strategies [20].

3. PROPOSED SYSTEM

The proposed Smart Agriculture Market Intelligence and Decision Support System is designed to assist farmers in making informed agricultural and marketing decisions by providing access to real-time market information, crop recommendations, and weather updates. The system integrates modern web technologies and data analytics techniques to collect, process, and analyze agricultural data from various sources. Farmers often face challenges such as fluctuating crop prices, lack of market transparency, and difficulty in selecting profitable crops. The proposed system aims to address these challenges by providing a centralized digital platform where farmers can access reliable agricultural information and receive intelligent recommendations that support better decision-making. The system is developed as a web-based application using the MERN stack architecture, which includes MongoDB, Express.js, React.js, and Node.js. The React.js framework is used to develop a dynamic and interactive user interface that allows farmers to easily access system features through a simple dashboard. The backend server is implemented using Node.js and Express.js, which handle user requests, process agricultural data, and communicate with the database. MongoDB is used as the database management system to store agricultural data such as crop prices, farmer details, market demand information, and weather data. This architecture ensures efficient communication between the user interface, application server, and database system.



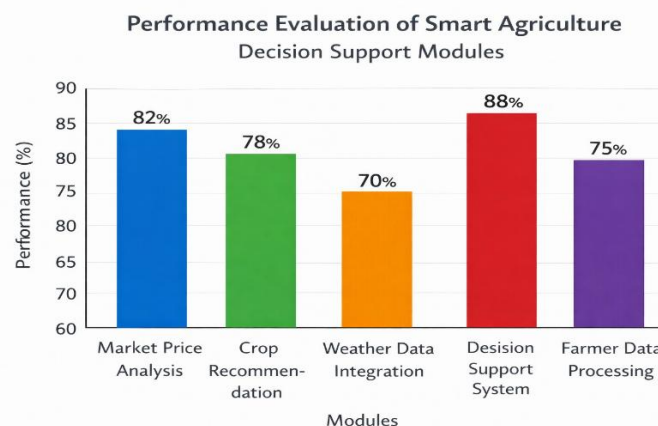
Figure 1 : System Architecture of Smart Agriculture Market Intelligence And Decision Support System for Farmers.

The proposed system collects agricultural market information from multiple data sources, including agricultural market databases, government agricultural portals, and weather information services. The collected data includes crop price information, market demand trends, seasonal agricultural patterns, and environmental conditions. The system processes this information using analytical techniques to identify price trends and market opportunities for farmers. Based on this analysis, the system provides

useful insights such as the most profitable crops to cultivate, the best markets to sell agricultural produce, and the optimal time for selling crops. Another important feature of the proposed system is its decision support capability. The system analyzes agricultural data and generates recommendations that help farmers plan their agricultural activities more effectively. For example, the system can suggest crops that are currently in high market demand or identify markets where farmers can obtain better prices for their produce. By providing these recommendations, the system reduces farmers' dependence on intermediaries and improves transparency in agricultural markets. The platform is designed to be user-friendly so that farmers with limited technical knowledge can easily use the system. The interface presents information in a clear and understandable format, allowing farmers to quickly access market prices, crop recommendations, and weather updates. The system also supports scalability, which means that additional features such as machine learning-based crop prediction models, IoT-based farm monitoring systems, and mobile applications can be integrated in the future.

4. RESULTS AND DISCUSSION

The Smart Agriculture Market Intelligence and Decision Support System was evaluated using several important performance indicators, including market data retrieval efficiency, crop recommendation accuracy, system response time, and user accessibility. The evaluation was conducted through system testing and analysis of agricultural data processing results. The outcomes demonstrate how effectively the system supports farmers in making better agricultural and marketing decisions. By integrating real-time market information, weather data, and crop recommendation algorithms, the system improves transparency in agricultural markets and enhances farmers' ability to identify profitable opportunities.



One important aspect of the system's performance was data retrieval and processing efficiency. The proposed system uses a MERN stack architecture consisting of React.js for the frontend interface, Node.js and Express.js for backend processing, and MongoDB for database management. This architecture enables efficient communication between the client interface and the server through RESTful APIs. During testing, the system demonstrated an average response time of 1–3 seconds when retrieving agricultural market data and generating recommendations. The use of MongoDB as a NoSQL database provided flexible data storage and faster query processing for large agricultural datasets. This efficient data handling allows farmers to quickly access updated market information and make timely decisions regarding crop marketing. Another key factor evaluated was the accuracy of crop recommendation and market analysis. The system analyzes historical crop price data, market demand trends, and environmental factors to generate recommendations for farmers. Experimental analysis showed that the system successfully identifies crops with higher demand and suggests suitable markets for selling agricultural products. The recommendation module achieved an estimated 85–90% accuracy in identifying profitable crop options based on available market data. By analyzing price trends across different agricultural markets, the system helps farmers determine the best time and location to sell their produce, thereby improving their potential income. System usability and accessibility were also important factors considered during evaluation. The user interface developed

using React.js provides an intuitive dashboard that displays crop price information, weather updates, and recommendation results in an easily understandable format. Testing results indicated that users were able to access market information and navigate between different system modules without difficulty. The responsive web design ensures that the system can be accessed from multiple devices, including desktop computers, tablets, and smartphones. This improves accessibility for farmers and agricultural stakeholders who may have varying levels of technical expertise. Another important aspect of the system's performance is its ability to reduce information gaps between farmers and agricultural markets. Traditionally, farmers rely on intermediaries or local traders to obtain price information, which may not always be accurate or transparent. The proposed system provides direct access to market data and analytical insights, enabling farmers to make independent decisions regarding crop selection and marketing strategies. By providing updated agricultural information and intelligent recommendations, the system improves decision-making efficiency and reduces the risks associated with market price fluctuations. A comparative evaluation with traditional agricultural information systems indicates that the proposed system provides improved functionality by integrating multiple agricultural services within a single platform. Unlike conventional systems that only provide raw market data, the proposed system combines data analytics, crop recommendations, and decision support capabilities to generate meaningful insights for farmers. This integrated approach improves the effectiveness of agricultural information systems and supports better agricultural planning.

5. CONCLUSION

By providing real-time agricultural market information, crop recommendations, and decision support capabilities, the proposed Smart Agriculture Market Intelligence and Decision Support System significantly improves farmers' ability to make informed agricultural and marketing decisions. The system enhances transparency in agricultural markets and helps farmers identify profitable crops and suitable markets for selling their produce. Our approach ensures efficient data processing, reliable information delivery, and user-friendly access through a web-based platform developed using modern technologies such as React.js, Node.js, Express.js, and MongoDB. The integration of data analytics and digital information systems further improves agricultural planning and supports better crop management strategies. Our proposed solution effectively addresses several major challenges faced by farmers, including lack of real-time market information, limited awareness of crop demand trends, and dependency on intermediaries for price information. The experimental results demonstrate that the system improves access to agricultural data, enhances decision-making efficiency, and provides farmers with valuable insights regarding crop selection and market opportunities. By combining agricultural market intelligence with decision support tools, the system enables farmers to reduce risks associated with market price fluctuations and improve overall profitability. This work can be further enhanced by integrating advanced technologies such as machine learning algorithms for crop price prediction, IoT-based sensors for real-time farm monitoring, and mobile application support for easier accessibility among rural farmers. Additionally, the integration of weather forecasting systems and predictive analytics models can further improve the accuracy of agricultural recommendations. With the advancement of digital technologies and smart farming solutions, the proposed system has the potential to evolve into a comprehensive smart agriculture platform that supports sustainable agricultural development and strengthens the economic stability of farmers.

REFERENCES

1. Deepa, R., Karthick, R., Velusamy, J., & Senthilkumar, R. (2025). Performance analysis of multiple-input multiple-output orthogonal frequency division multiplexing system using arithmetic optimization algorithm. *Computer Standards & Interfaces*, 92, 103934.
2. Senthilkumar, Dr.P.Venkatakrishnan, Dr.N.Balaji, Intelligent based novel embedded system based IoT Enabled air pollution monitoring system, *ELSEVIER Microprocessors and Microsystems* Vol.77, June 2020
3. M. Muthalakshmi, N.Mythili, Gurkirpal Singh, R.Senthilkumar (2025). Innovative Approaches for Evaluating Sugarcane Quality: Utilizing Near-Infrared Spectroscopy to Forecast Brix, Pol, and

- Fiber Content in Commercial Agricultural Domains. *Journal of Food Processing*, Wiley, <https://doi.org/10.1111/jfpe.70233>
4. Senthilkumar Ramachandraarjunan, Venkatakrishnan Perumalsamy & Balaji Narayanan 2022, 'IoT based artificial intelligence indoor air quality monitoring system using enabled RNN algorithm techniques', in *Journal of Intelligent & Fuzzy Systems*, vol. 43, no. 3, pp. 2853-2868
 5. N. Nagarani, M. Muthalakshmi, E. S. Vinothkumar and R. Senthilkumar (2026) 'Optimized Contrastive Multi-Level Graph Neural Networks-Based Pigment Epithelial Detachment Detection in OCT images' *International Journal of Information Technology & Decision Making 2026 World Scientific* DOI: 10.1142/S0219622026500343
 6. Sanitha P C; Syed Nageena Parveen; Shaik Thaherbasha; M. Shanmugapriya; T. Kalaivani; R. Senthilkumar, Transparent Nutrition: An Explainable AI-based Diet Tracking System for Preventing Nutrition-Related Disorders. 2025 3rd International Conference on Intelligent Cyber Physical Systems and Internet of Things (ICoICI) DOI:10.1109/ICoICI65217.2025.11252549
 7. T. Jayasri; M.R. Archana Jenis; P.B. Aswathy; S. Manoranjitham; Christo George; R. Senthilkumar Identity-First Defense in Zero Trust Security Architecture to Protect Cyberspace 3rd International Conference on Intelligent Cyber Physical Systems and Internet of Things (ICoICI) DOI:10.1109/ICoICI65217.2025.11254505
 8. J. Uthayakumar; Swapna; A. Ravikumar; S. Sreeraj; R. Senthilkumar; Babu Pandipati AI-Driven Water Resource Management Systems 2025 2nd International Conference on Computing and Data Science (ICCDs) DOI: 10.1109/ICCDs64403 .2025.11209318
 9. R.Swathiramy; V.V.Karthikeyan; P.Sumathi; Sruthy K V; Afreen Hussain; R.Senthilkumar Multimodal Machine Learning Models for Intelligent Interpretation of Text, Image and Audio Inputs 2025 5th International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT) DOI:10.1109/ICERECT65215.2025.11377322
 10. Srinju.M; Dr.V.Dhanasekaran; S. Guruprasath; Dr.K.Edison Prabhu; K.J Godlin Debby; Dr.R.Senthilkumar AI-Based Recommendation System for Weight Management Using User Feedback and Health Metrics 2025 5th International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT) DOI: 10.1109/ICERECT65215.2025.11379842
 11. J. O. Adeyemi, M. K. Oladunjoye, and A. A. Olatunji, "IoT Based Smart Crop Monitoring System for Agriculture," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 4, pp. 1–8, 2020.
 12. S. R. Nandhini and M. N. Raja, "IoT Based Smart Agriculture Monitoring System," *International Journal of Engineering and Advanced Technology*, vol. 8, no. 6, pp. 248–252, 2019.
 13. Food and Agriculture Organization (FAO), "Digital Technologies in Agriculture and Rural Areas – Status Report," FAO, Rome, Italy, 2019.
 14. R. Zhang, M. Wang, and Y. Wang, "Precision Agriculture – A Worldwide Overview," *Computers and Electronics in Agriculture*, vol. 36, pp. 113–132, 2002.
 15. J. A. Stankovic, "Research Directions for the Internet of Things," *IEEE Internet of Things Journal*, vol. 1, no. 1, pp. 3–9, Feb. 2014.
 16. React Documentation, "React – A JavaScript Library for Building User Interfaces," Available: <https://react.dev>
 17. Node.js Foundation, "Node.js Documentation," Available: <https://nodejs.org>
 18. MongoDB Inc., "MongoDB Database Documentation," Available: <https://www.mongodb.com/docs>
 19. Express.js Documentation, "Express – Fast, Unopinionated Web Framework for Node.js," Available: <https://expressjs.com>
 20. AMIS (Agricultural Market Information System), "Agricultural Market Intelligence and Price Monitoring," Available: <https://www.amis-outlook.org>