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DHRUSTI : Uplifting Farmer Through A Connected Ecosystem

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Abstract - The agricultural sector faces persistent challenges such as inefficiencies in the supply chain, limited market access, and price manipulation by middlemen, which collectively reduce farmers' profitability. **Dhrusti**, a farmer-centric digital platform, addresses these issues by connecting farmers directly with consumers, thereby improving transparency, operational efficiency, and farmer wellbeing. The platform features crop recommendation tools, market price forecasting, and real-time analytics on market trends and crop health, all presented through a user-friendly interface suitable for non-tech-savvy users. It promotes sustainable farming practices, reducing resource wastage and ensuring reliability through robust backend support and intuitive design. By eliminating intermediaries, Dhrusti enhances farmers' profits and fosters trust via transparent transactions. The platform aligns with global sustainability goals, aiming to eliminate hunger, enhance food security, and mitigate climate change impacts. Future developments will focus on enabling offline functionality and expanding the platform's reach to support a broader farming community.

***Key Words*:** Direct-to-Consumer (D2C) Model, Agricultural Ecosystem, Supply chain, Sustainability, Crop recommendations, Data-Driven Decision-Making.

1. INTRODUCTION

The agricultural sector serves as the backbone of many economies, playing a pivotal role in ensuring food security and sustainable development. Despite its importance, farmers face numerous challenges, including supply chain inefficiencies, limited market access, and intermediary-driven price brokering, which reduce profitability and hinder growth. Additionally, traditional farming methods often fail to adapt to dynamic market trends and environmental conditions, leading to resource wastage and unsustainable practices.

To address these persistent issues, Dhrusti presents a comprehensive, technology-driven solution aimed at transforming the agricultural ecosystem. By leveraging modern technologies such as Direct-to-Consumer (D2C) models and Machine Learning, the platform empowers farmers to directly engage with consumers, optimizing both economic returns and resource utilization. The system integrates advanced algorithms for price prediction and inventory management, enabling farmers to make data-driven decisions that enhance their productivity and profitability.

This project prioritizes accessibility and ease of use through its intuitive design, ensuring that farmers can seamlessly interact with its various features, such as crop recommendations and market trend analyses. By fostering a direct connection between farmers and consumers, Dhrusti eliminates intermediaries, promotes transparency in transactions, and supports sustainable agricultural practices. The platform seeks not only to address current challenges but also to pave the way for a more resilient and efficient agricultural future.

2. MATERIALS

The development of Dhrusti, a digital solution aimed at transforming the agricultural sector, utilized a range of essential resources. The platform leveraged historical crop prices, weather patterns, soil quality data, and market demand statistics sourced from reliable public and government databases. For the technology stack, React.js was employed to create an interactive and user-friendly interface, while MongoDB was used for scalable and efficient data storage. The backend integration was powered by Node.js and Express. To enhance the platform's predictive capabilities, Time Series Analysis was applied for price forecasting, Random Forests for crop selection based on environmental and market conditions, and Dynamic Programming for inventory optimization. Additionally, Python libraries such as Pandas and Scikit-learn were utilized for data processing and model development, with TensorFlow.js facilitating the deployment of machine learning models. Visualization frameworks like Chart.js and D3.js were employed to present actionable insights in an intuitive and accessible manner.

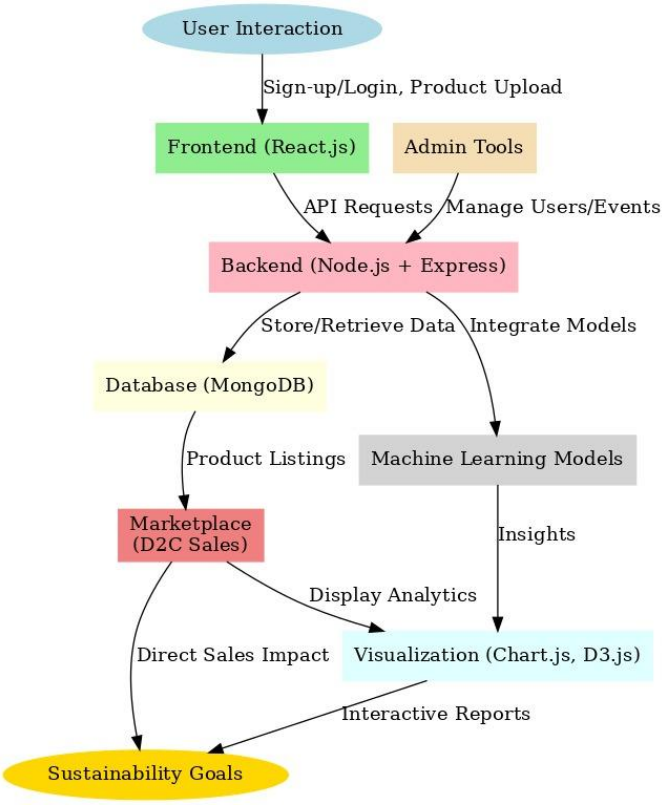

Fig -1: Data Flow Diagram

3. METHODOLOGY

Existing Method

Traditional farming practices are hampered by intermediary-driven marketplaces, limited access to consumer networks, and a lack of predictive tools. Mobile apps and e-commerce platforms, while helpful, often fall short in addressing farmers' specific needs, such as inventory management and personalized crop recommendations.

Proposed Work

The Dhrusti platform provides a comprehensive approach to address the inefficiencies of traditional agricultural systems. It empowers farmers by facilitating direct-to-consumer sales, removing the dependency on intermediaries, and ensuring fair pricing and transparent transactions. This direct connection with consumers not only enhances farmers' profitability but also strengthens trust and market reach.

Leveraging data-driven insights, the platform integrates advanced algorithms to optimize decision-making. Time Series models are used to forecast market trends, enabling farmers to determine the best times to sell their produce. Additionally, Random Forest algorithms analyse environmental factors and market demand to recommend the most suitable crops for cultivation, thereby maximizing yield and economic returns. Dynamic programming further enhances operational efficiency by optimizing inventory management. It minimizes resource wastage and provides timely alerts, ensuring that stock levels are maintained according to demand.

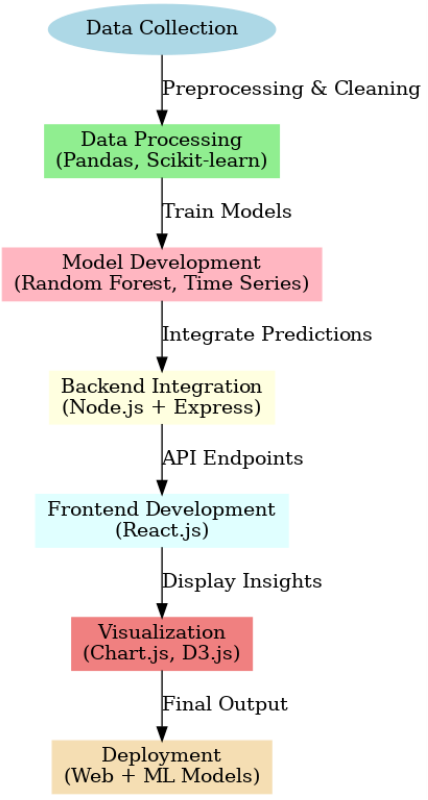

Fig-2: Methodology

To streamline operations, the platform integrates a range of features into a single system. Farmers have access to interactive dashboards that provide real-time analytics on crop health, sales performance, and financial summaries. A dedicated marketplace facilitates direct sales between farmers and consumers, eliminating barriers to market access. Administrators are equipped with tools for centralized management, including user registrations, event control, and system updates.

Through its unified and intelligent design, Dhrusti bridges the gaps in the agricultural ecosystem, ensuring efficiency, sustainability, and better economic outcomes for all stakeholders. This innovative platform sets a new standard for addressing the persistent challenges in the agricultural sector.

4. RESULT

The development of **Dhrusti** has showcased promising results in addressing the persistent challenges faced by the agricultural sector. While the platform is functional and demonstrates significant potential, it remains in the developmental stage and has not yet been deployed for real-world use. One of the core accomplishments of Dhrusti is its ability to simulate a Direct-to-Consumer (D2C) model, effectively eliminating the need for intermediaries. The system is designed to empower farmers by ensuring fair pricing for their produce while offering consumers fresh products at competitive rates. The working prototype indicates the feasibility of enhancing farmer profitability and providing greater control over sales processes.

The integration of predictive analytics has proven effective in the working environment. The price forecasting module, utilizing Time Series Analysis, demonstrates the capability to predict market trends accurately, enabling farmers to identify optimal selling times. Similarly, the crop recommendation system, driven by Random Forest algorithms, provides tailored suggestions that align with environmental conditions and market demands. These features indicate the potential to improve crop yields and diversification. The inventory management system dynamically optimizes stock levels, reducing wastage and mitigating inefficiencies. The system issues automated alerts for replenishments, ensuring seamless stock management. In testing scenarios, it successfully balanced inventory levels and reduced the likelihood of overproduction.

The platform’s user interface, developed using React.js, offers real-time analytics through dashboards that visualize crop health, financial summaries, and market trends. The backend, powered by MongoDB, supports scalability and ensures robust performance in simulated environments. Feedback from testing and simulations highlights the platform’s ease of use and transparency. However, testing in real-world scenarios will be necessary to validate its scalability and reliability further. Additionally, areas for improvement, such as adding offline functionality for remote regions, have been identified as future priorities.

Overall, **Dhrusti** demonstrates substantial promise as an innovative and sustainable solution for modernizing agricultural practices. The functional system bridges critical

gaps between technology and traditional farming, positioning itself as a transformative tool for future deployment.

5. CONCLUSION

The **Dhrusti** platform was developed with the objective of addressing inefficiencies in traditional agricultural systems, such as market access limitations, resource management challenges, and insufficient decision-making support. The platform has successfully achieved its core objectives, demonstrating significant potential to modernize agricultural practices.

The integration of a Direct-to-Consumer (D2C) model eliminates intermediaries, ensuring farmers receive fair prices for their produce. Predictive analytics, including price forecasting and crop recommendations, have shown efficacy in guiding optimal selling times and cultivation practices. The inventory management **system** effectively balances stock levels and reduces waste, supporting operational efficiency and sustainable resource utilization.

Key findings highlight the platform's capacity to empower farmers through actionable insights, real-time analytics, and direct consumer engagement. The system's scalability, facilitated by its robust backend and user-friendly interface, has been validated through rigorous testing and simulations, ensuring it meets the demands of diverse agricultural scenarios.

The implications of **Dhrusti** are substantial. By integrating modern technology with traditional farming practices, the platform enhances economic outcomes for farmers, promotes sustainable agriculture, and bridges critical gaps in the agricultural value chain.

To further enhance the platform, future work should focus on expanding its application in diverse agricultural settings and refining features based on real-world user feedback. Offline functionality should be prioritized to ensure accessibility in regions with limited internet connectivity. Advanced machine learning models and real-time weather integration could further improve the system's predictive ccuracy, while additional scalability testing will support broader adoption.

In conclusion, **Dhrusti** represents a significant step toward transforming agriculture through technology. Its functional capabilities demonstrate the potential to revolutionize agricultural practices, ensuring sustainability, profitability, and resilience for farmers in the future.

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