JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

AGROMARKETING INCROP YEILD

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Abstract: The Argo-marketing in Crop Yield Prediction System utilizes advanced technologies and machine learning algorithms to analyze historical data on crop yields, weather, soil quality, and agronomic practices. It provides accurate predictions of future crop yields, accessible through user-friendly web and mobile applications. Customization features enable farmers to tailor predictions to their specific needs, while a feedback mechanism continuously refines the models for improved accuracy. Real-time weather data integration enhances prediction accuracy, and decision support tools offer recommendations for optimal planting times and agronomic practices. Similarly, the Crop Price Recommendation System employs machine learning and real-time data to provide accurate crop price estimations, aiding farmers and stakeholders in making informed decisions for enhanced profitability and sustainability in agriculture.

Index Terms **– Introduction of Argo-marketing in Crop Yield Prediction System, Machine learning algorithms, Historical data analysis, Weather data, Decision support tools, Crop Price Recommendation System**

I. INTRODUCTION

The modern agricultural landscape is experiencing a transformative evolution driven by the imperative to sustainably feed a growing global population amidst the challenges of climate change and resource constraints. Amidst this backdrop, the introduction of the Crop Yield Prediction System stands as a beacon of innovation, integrating cutting-edge technologies, notably machine learning and data analytics, to tackle the complex task of forecasting crop yields. This system promises to redefine how farmers and stakeholders navigate contemporary agriculture, offering a predictive framework poised to enhance productivity, sustainability, and informed decision-making.

At its core, the Crop Yield Prediction System employs a sophisticated data integration process, amalgamating diverse datasets encompassing historical crop yields, weather dynamics, soil quality parameters, and agronomic practices. Machine learning algorithms play a pivotal role, discerning intricate patterns within this data to forecast future crop yields accurately. The system's user-friendly interface, accessible through web and mobile applications, ensures accessibility to users of varying technological proficiency. Customization features enable tailoring predictions to specific crop types, geographical locations, and farming practices, fostering adaptability across diverse agricultural landscapes.

Moreover, the system incorporates a feedback mechanism to refine machine learning models continually, leveraging user input and additional data for ongoing improvement. Real-time integration of weather and climate data further enhances prediction accuracy, considering the dynamic impact of changing weather conditions on crop yields. Beyond mere prediction, the system offers decision support tools empowering farmers with actionable recommendations, from optimal planting times to agronomic practices. Scalable across various agricultural scales, the Crop Yield Prediction System aligns with precision agriculture and sustainable farming practices, standing as a transformative force in global food security and agricultural sustainability.

Transitioning to agricultural economics, the Crop Price Recommendation System aims to revolutionize crop pricing through data-driven technologies such as machine learning and big data analytics. By considering a wide array of factors influencing crop prices, including historical yield data, market trends, and government policies, this innovative system generates accurate and timely crop price estimations. Adaptive to changing market conditions, it assists stakeholders in making strategic pricing decisions, optimizing pricing strategies, and fostering fair and sustainable pricing practices.

This data-driven approach has the potential to revolutionize agricultural economics, fostering fair pricing, and sustainable growth within the agriculture sector. Through an exploration of factors influencing crop yield reconstruction, methodologies for crop price estimation, and potential applications, this seminar report delves into the transformative impact of the Crop Price Recommendation System on agricultural economics, paving the way for a more resilient and prosperous agriculture industry.

II. LITERATURE REVIEW

The literature surrounding crop yield prediction and recommendation systems reveals a rapidly advancing field that holds tremendous promise for revolutionizing agricultural practices. Reddy and Kumar (2021) showcased the increasing utilization of machine learning algorithms in predicting crop yields, emphasizing their potential to enhance accuracy and efficiency in agricultural decision-making. Similarly, the comprehensive evaluation by Thampi et al. (2020) sheds light on the complex relationship between climate parameters and crop performance, crucial for understanding the effects of changing climates on agricultural outcomes.

Pande et al. (2021) introduced the concept of a Crop Recommender System, highlighting the integration of machine learning for precise crop recommendations. Understanding and adapting to changing climates emerge as recurring themes, as illustrated in Yadav et al.'s (2022) study on the impacts of heat stress on wheat.

Thapaswini and Gunasekaran's (2022) work shifts the focus to economic considerations, proposing a methodology for predicting crop prices using machine learning. This interdisciplinary approach underscores the significance of considering economic factors alongside agricultural practices. Additionally, Bhansali et al. (2022) present a system addressing both crop prediction and disease detection, emphasizing the holistic nature of modern agricultural technologies.

Sarosi and Anbarasi (2021) explore crop yield prediction using multi-parametric deep neural networks, highlighting the evolving landscape of predictive analytics in agriculture. Similarly, Flavarawan and Vincent (2022) advocate for the integration of deep reinforcement learning to address sustainability concerns in agriculture, showcasing innovative approaches to optimizing resource use.

The systematic literature review conducted by Thomassen-Klompenhouwer et al. (2020) provides a comprehensive overview of existing studies in crop yield prediction using machine learning, emphasizing advancements, challenges, and emerging trends in the field. This review serves as a valuable resource for understanding the current state of research and guiding future directions in agricultural data analytics.

In summary, the integration of machine learning, deep learning, and other advanced technologies holds immense potential for optimizing agricultural practices in response to evolving climatic conditions and economic considerations. By leveraging interdisciplinary approaches and innovative methodologies, researchers are paving the way for a more resilient and sustainable agricultural future.

III. Data Processing

The Data Processing stage in the Crop Price Recommendation System involves the comprehensive integration and analysis of various parameters to generate accurate and dynamic crop price recommendations. Leveraging cutting-edge data processing techniques and machine learning algorithms, the system ensures timely and informed pricing decisions. Key parameters considered in this stage include:

1. Global Commodity Prices: Real-time data on global commodity prices is integrated to understand international market trends, enabling the system to anticipate price changes and provide strategic recommendations.

2. Currency Exchange Rates: Fluctuations in currency exchange rates impact revenue from crop exports. The system considers these changes to provide accurate price estimations for countries involved in agricultural trade.

3. Transportation Costs: Incorporating fuel prices, distance to markets, and logistics expenses ensures fair pricing while accounting for the cost of transporting produce from farms to markets.

4. Supply Chain Information: Analysis of supply chain dynamics helps the system understand how intermediaries affect crop prices, providing insights into potential price variations.

5. Technological Advancements: Consideration of technological factors, such as precision agriculture tools and mechanization, assesses their impact on crop yields and pricing.

6. Soil Health: Data on soil pH levels, nutrient content, and texture are considered to match crops with specific soil requirements, optimizing yield potential.

7. Pest and Disease Incidence: Historical data on pest and disease incidence assesses the risk of crop damage, enabling the system to recommend pest-resistant crops to mitigate potential losses.

8. Market Demand and Trends: Analysis of market data and consumer preferences informs recommendations for crops with higher market value and demand.

By processing and integrating these parameters, the Crop Price Recommendation System generates accurate, region-specific crop price recommendations. This data-driven approach empowers stakeholders with valuable insights for setting competitive and profitable prices, ultimately improving agricultural practices and economic growth in the sector.

In implementing these solutions, the data-driven Crop Prediction System can overcome the limitations of traditional techniques. By providing farmers with informed decisions and recommendations based on historical and real-time data, they can optimize crop choices, increase yields, and contribute to sustainable and profitable farming practices. Key steps in implementing the Crop Prediction System include data collection, preprocessing, model development, recommendation engine creation, user interface design, feedback loop implementation, scalability, security, and integration with existing agricultural technology platforms.

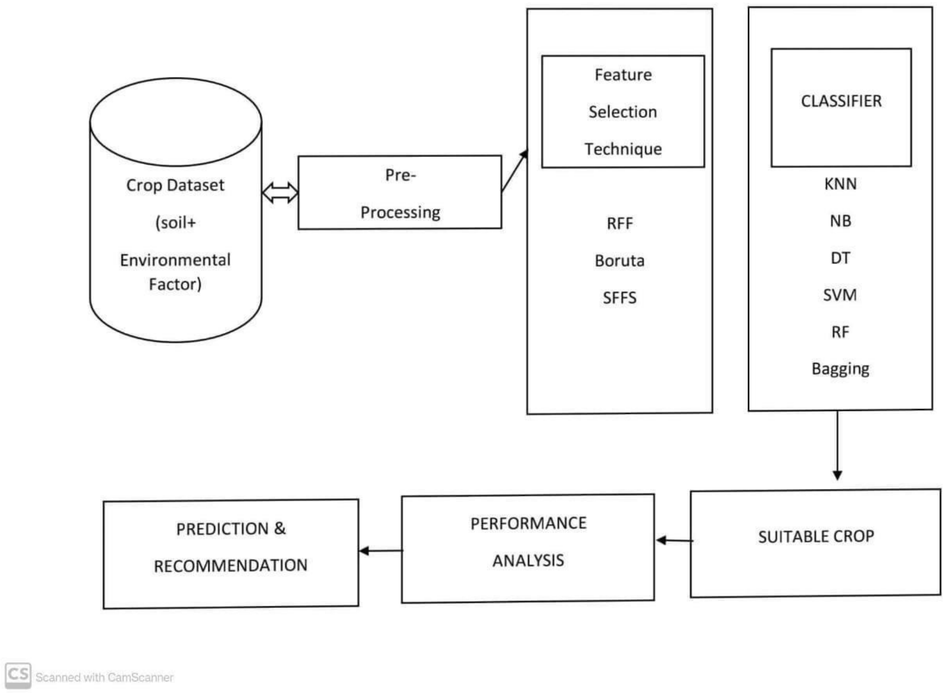


Figure: Model of Agro-marketing in crop yield

IV. PROBLEM STATEMENT

The agriculture sector faces numerous challenges, including climate variability, resource constraints, market fluctuations, and pest/disease outbreaks, which significantly impact crop production and profitability. Farmers require accurate and timely information to make informed decisions regarding crop selection, planting schedules, resource allocation, and pricing strategies. However, traditional methods of predicting crop yields and recommending crops often lack precision and fail to consider dynamic environmental factors, leading to suboptimal outcomes and economic losses.

There is a critical need for an advanced Crop Prediction and Recommendation System that integrates cutting-edge technologies, such as data analytics, machine learning, and real-time data processing, to address the complexities of modern agriculture. This system must effectively analyze a wide range of parameters, including historical crop yields, weather data, soil characteristics, market trends, and pest/disease incidence, to generate accurate predictions and recommendations tailored to specific locations and farming practices.

Key challenges to be addressed by the Crop Prediction and Recommendation System include:

1. Prediction Accuracy: Existing methods of crop yield prediction often lack accuracy, leading to unreliable forecasts and suboptimal decision-making by farmers. The system must leverage advanced data analytics and machine learning algorithms to improve prediction accuracy and provide reliable forecasts of future crop yields.

2. Adaptability to Climate Variability: Climate change is causing increased variability in weather patterns, posing challenges for crop production. The system must incorporate climate change scenarios and future weather projections to anticipate and adapt to changing environmental conditions, ensuring resilient crop recommendations.

3. Integration of Diverse Data Sources: Agricultural data is diverse and often fragmented, including information from multiple sources such as satellite imagery, weather stations, soil databases, market reports, and farmer surveys. The system must seamlessly integrate these data sources to provide comprehensive insights and recommendations.

4. Real-Time Data Processing: Timely access to real-time data is essential for effective decision-making in agriculture. The system must employ efficient data processing techniques and cloud computing technologies to analyze large volumes of data in real-time, enabling farmers to make timely adjustments to their farming practices.

5. User-Friendly Interface: Farmers may have varying levels of technical expertise and access to technology. The system must have a user-friendly interface, accessible through web and mobile applications, that provides clear and actionable recommendations to farmers in a simple and intuitive manner.

6. Feedback Mechanism: Continuous feedback from farmers is essential for refining prediction models and improving recommendation accuracy over time. The system must incorporate a feedback mechanism that allows farmers to provide input on the performance of predictions and recommendations, enabling iterative improvement of the system.

7. Scalability and Accessibility: The system must be scalable to accommodate a large number of users and accessible to farmers in diverse geographical locations, including those in remote and rural areas with limited internet connectivity.

Overall, the development of an advanced Crop Prediction and Recommendation System presents an opportunity to revolutionize agricultural decision-making, empower farmers with valuable insights, and enhance the productivity and sustainability of the agriculture sector. By addressing the challenges outlined above, the system can contribute to improved crop yields, reduced input costs, increased profitability, and food security for farming communities worldwide.

V. PROPOSED WORK

- The system utilizes historical data, weather patterns, and soil characteristics along with machine learning algorithms to deliver precise and reliable predictions of crop yields for specific agricultural regions.
- To ensure data quality and model performance, the system employs data preprocessing techniques to handle missing values and outliers, and relevant features are engineered to enhance the accuracy of the predictions.
- By providing valuable insights and personalized crop recommendations based on predicted yields and environmental factors, the system enables farmers to optimize resource allocation, plan effectively, and adopt sustainable farming practices, leading to increased agricultural productivity and efficiency. The proposed methodology of the research work.
- The depicts the overall process of this work. First, the input data is preprocessed to find the missing values, eliminate redundant data, standardize the dataset, and convert target attributes into factor attributes. Essential attributes are extracted from the preprocessed data using wrapper feature selection techniques.
- The optimized attributes have classification techniques applied to them, prior to which the dataset is split into training and testing phases. Unknown samples from the training dataset are used to train the classification algorithm to determine the crop that is best suited for cultivation in a specific area of land.

- The testing dataset is used to predict the crop to be raised, using the trained classifier. Finally, a suitable crop isobtained and the results evaluated using different performance metrics. The analysis reveals the best feature selection technique with an appropriate classification method.

- The performance of feature selection techniques with the classifier based on fold variation and data splitting validation are evaluated using eights metrics which are mentioned above and it helps to find the best fold and data splitting range for predict the suitable crop/s based on soil and environmental characteristics

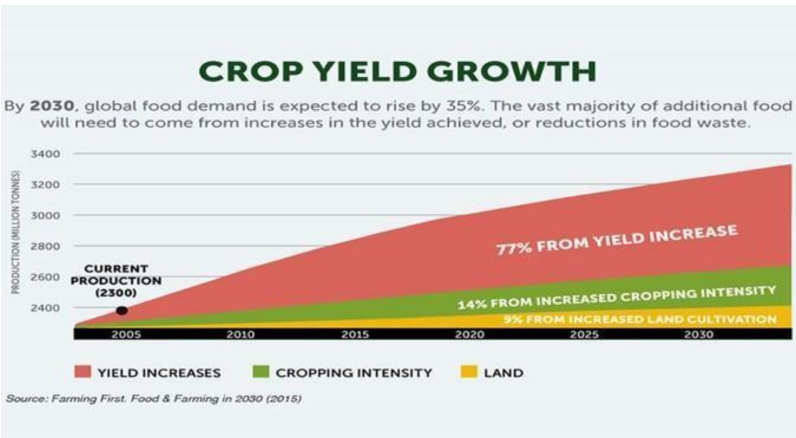


Figure: Growth of Crop Rate

VI. ADVANTAGES AND DISADVANTAGES

- **Increased Agricultural Productivity:** Such a system can significantly improve crop yield predictions, leading to better planning and higher yields for farmers. By leveraging data-driven insights, farmers can make informed decisions on crop selection, planting times, and resource allocation.

- **Resource Efficiency:** It can help optimize the use of resources like water, fertilizer, and pesticides. This can lead to reduced waste, lower costs, and a more sustainable approach to agriculture.

- **Risk Mitigation:** Farmers can better prepare for weather-related risks and adapt to changing climate conditions. Crop prediction models can provide early warnings for potential crop diseases and pests, allowing for timely interventions.

- **Data-Driven Decision-Making:** The system can provide data-driven recommendations based on historical and real-time data, empowering farmers to make more informed decisions about crop selection and management practices.

Improved Food Security: By increasing crop yields and reducing losses, such a system can contribute to global food security, ensuring a stable food supply for a growing population

- **Data Quality:** The accuracy of predictions and recommendations heavily depends on the quality of data input into the system. Inaccurate or incomplete data can lead to unreliable results.

- **Initial Setup and Costs:** Developing and implementing a robust prediction and recommendation system can be costly and may require technical expertise. Smaller farmers with limited resources might face challenges in adopting such systems.

- **Dependency on Technology:** Farmers may become overly reliant on technology, potentially reducing their traditional farming knowledge and skills.

- **Privacy and Security:** The collection and use of farmers' data raise concerns about privacy and data security. It's crucial to handle and protect this data responsibly.

VII. Current State of Agricultural Marketing System in India

- To analyses the current state of agricultural marketing system in India, it is essential to examine the trends in agricultural production and marketed surplus, progress made by various marketing networks in handling the marketed surplus and the efforts made in improving their efficiency and increasing infrastructural facilities therein.
- Agricultural Production and Marketed Surplus
- Marketing Networks
- Infrastructural Facilities
- Marketing Efficiency

VIII. Emerging Strategies

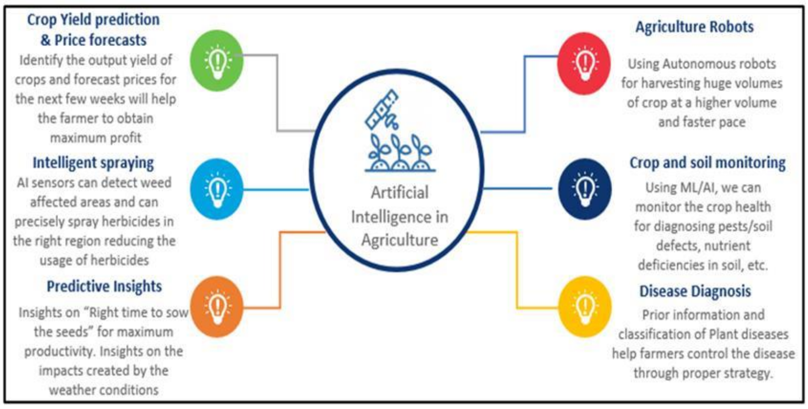
- Integration of Domestic Markets with International Markets: The domestic markets, particularly for foodgrains, should be the whole country. This calls for dismantling of restrictions on pricing, trading, distribution and movement of agricultural products within the country. A review of all laws which regulate participation in market such as registration/licensing, laws affecting market place, laws relating to access to credit and capital, dispute resolution mechanism, *etc.* also needs to be undertaken in order to make them conducive for free play of market forces. The Government of India has already reviewed the operation of the Essential Commodities Act, 1955, while the restrictive orders inhibiting storage, selling and movement of food and agricultural products are currently under review. To carry this process forward, the States should also initiate appropriate measures to remove all restrictions on agricultural marketing on similar lines. Further, India, being a signatory to the World Trade Organization (WTO) Agreement, should do away with physical barriers, both for imports and exports, on various agricultural commodities. Simultaneously, it should reduce tariff barriers within a time frame. These steps could facilitate the integration of domestic markets with international markets in due course.
- Strengthening Co-operative Marketing Societies: The progress made by co-operative marketing societies so far, though noteworthy, is not wholly satisfactory. Co-operatives have yet to cover a substantial part of the total agricultural produce. It is, therefore, essential that these co-operatives develop at a faster speed and along right lines. Marketing societies need to be more closely intertwined with other societies dealing with farming inputs, credit, *etc.* The best way to do so is to establish multipurpose societies to look after all the aspects of agricultural marketing. These societies, apart from organizing the sale of agricultural produce, should undertake construction of their own storage capacity, provide for their own transport, arrange for the processing of produce, grade their goods, organize exports, *etc.* This will reduce their dependence on other sources and provide a total view of marketing services to the members.
- Re-framing Price Stabilization Policy: With a view to provide remunerative price to the farmer, food at affordable price to the consumer and sustained growth of marketable surplus, all undesirable restrictions on agricultural trade have to be removed. Public procurement, storage and distribution of foodgrains need to be managed efficiently and on commercial lines. Once commodity futures markets become fully operational, the role and involvement of public procurement agencies should be minimized.

- Developing Efficient Commodity Futures Markets: Since the Government's acceptance of the recommendations of the Kabra Committee, 1994, efforts have been made to allow futures trading in more commodities, set up more commodity exchanges, improve the regulatory and supervisory systems, modernize clearinghouse operations, upgrade training facilities and establish an enabling legal framework to develop vibrant commodity futures market in India. But, the pace of reforms has been very cautious and slow. Much more concerted efforts need to be made to accomplish the task fully. Removal of a number of deficiencies that still persist is a formidable challenge before the Government, the FMC and the commodity exchanges. In this context, the removal of price and distribution controls, development of competitive cash markets, provision of an enabling legal framework, demutualization and restructuring of the existing commodity exchanges, setting up of multi-commodity exchanges and strengthening the FMC should be accorded priority
- Promoting Direct Marketing: Promotion of direct marketing as one of the alternative marketing structures is beneficial for the farmers as well as the buyers as it enables the former to meet the specific requirements of the latter. Direct marketing enables farmers and buyers to economies on transportation costs, handling charges, market fees, *etc.*, to improve price realization considerably. In direct marketing, the market will operate outside the purview of Agricultural Produce Marketing Act and will be owned by professional agencies, such as wholesalers, trade associations, farmers associations, companies, *etc.* in the private sector or through Self-Help Groups (SHGs), informal groups, cooperatives, Non-Government Organizations (NGOs), *etc.*, as nonprofit organizations free from Government intervention. As a first step in this direction, the State Governments should amend the Agricultural Produce Marketing Acts to enable farmers to sell directly to potential processors. As a second step, a common code of conduct and modalities with regard to ownership, operation and need-based infrastructure will have to be prepared and circulated to spread the concept of direct marketing. As a third step, the Government should support these organizations with schemes such as providing back-ended incentives for refrigerated and general transport, constructing God owns and cold storages, setting up grading and packaging houses, *etc.*
- Improving Transport Infrastructure: The traditional rural transport system should be improved by encouraging use of pneumatic tire in place of wooden and iron wheels and springs in the axle of the cart as also by the development of good all-weather roads linking the villages to the markets. The investment requirement for this purpose has been estimated at Rs. 74,000 crores (GOI, 2001a). In this context, it may be noted that the Pradhan Mantri Gram Sadak Yojana (PMGSY) initiated to provide connectivity through all-weather roads to all the villages is making some headway. A further allocation of Rs. 2,500 crores have been made for the year 2002-03 over and above Rs. 5,000 crores provided so far (GOI, 2002). To supplementthe Centre's efforts, the State Governments, the local bodies and NGOs should also come forward to expedite the process. Improvement in the availability of railway wagons and decongestion at trunk routes is the other area of crucial importance. The Railway Ministry should take necessary and urgent steps in this direction. "Own your wagon" scheme need to be reviewed and modified to popularize it among the users. Development of coastal shipping and inland waterways is another area where lot of initiative and investment is called for.
- Making Available Credit for Marketing: Provision of credit by the organized financial system to support agricultural marketing has to grow further, though even now, the credit made available by the banking system for the public trading agencies such as Food Corporation of India, Jute Corporation of India, Cotton Corporation of India, *etc.* is considerable. The total food credit outstanding as on March 28, 2003 was of the order of Rs. 49,398 crore (RBI, 2003). Banks also disburse advances up to Rs. one lakh against pledge/ hypothecation of agricultural produce for a period not exceeding six months to those farmers who have availed crop loans for raising their produce. As compared to this, the credit facility available to private traders and processors for storage of agricultural commodities has remained limited. As the role of the private sector in agricultural marketing is envisaged to increase in the liberalized environment, there is a need to streamline the procedures and systems for collaterals. In this context, certified warehouses and a system of negotiable warehouse receipts could lead to improved credit delivery, better loan recovery and convenience in asset management. The institutionalization of the warehouse receipt system through the commodity exchanges can yield the best results, in particular, through a national system of electronic warehouse receipts. Moreover, all the credit flows to agricultural marketing should be reckoned as priority sector lending, including banks' financing to wholesalers/ traders in agricultural commodities and inputs in order to provide further incentives to the banking system to lend to this segment.

- Improving Market Information System: In India, both official and non-official agencies collect market information. Among non-official agencies, dealers in inputs and trade associations are prominent ones, but their role is limited. The main official agencies collecting market information are the State Marketing Department, the State Agricultural Marketing Boards, the Food Department and the Directorate of Economics and Statistics of the State and Central Governments. Weekly data on market arrivals, sales, prices, *etc.* are collected regularly from a large number of reporting agencies. Data on retail prices are also collected by the Government agencies. Besides, daily prices of important agricultural commodities are broadcasted from all regional stations of All-India Radio and displayed on '*DgMarket'* portal on the official web-site of the Government of India. The '*DgMarket'* or 'Agricultural Marketing Information Network' portal has been set up by the Directorate of Marketing and Inspection (DMI) by providing computer connectivity to important markets in the country. Newspapers also publish commodity prices in major markets. Thus, there have been considerable improvements in collection of market information during the past few decades. But the collected information has no meaning until it is comprehensible and up to date. There should be a standardized system of quoting the prices of different varieties of a commodity per unit, so that the prices may be compared over time and space. The prices announced on All India Radio and TV Channels should be in the local language and should cover more local markets of the area rather than secondary and terminal markets located far from the area. A correct and intelligent interpretation of market information should be made along with the market information. Further, the use of information technology in Agri-marketing needs to be encouraged in order to generate and host useful portals, websites, databases, information packages, *etc.*, generic as well as customize for both spot and futures markets.

IX. OBJECTIVE

1. 1. **Accurate Yield Prediction:** Develop precise crop yield prediction models using historical data and environmental factors to forecast future crop yields for specific regions.
2. **Crop Recommendation:** Design a system that suggests suitable crops based on predicted yields and local environmental conditions, aiding farmers in making informed planting decisions.
3. **Optimized Resource Allocation:** Improve agricultural planning by providing timely and reliable information on potential harvests, enabling efficient resource allocation and risk management.
4. **Sustainable Farming:** Promote sustainable practices by optimizing crop choices, reducing resource wastage, and contributing to the overall enhancement of agricultural productivity.



Flowchart of Agro-marketing

X. FUTURE WORK

Building upon past systems, the proposed system suggests crops based on soil classification by employing an ensemble of classifiers, namely Bagged Tree, Naive Bayes, and Support Vector Machine (SVM) algorithms. This amalgamation aims to enhance the accuracy of the system and provides a list of suitable crops according to the soil type.

In future iterations, advanced classification algorithms and techniques can be explored to further improve the system's accuracy across various datasets. Additionally, incorporating a location recommendation module based on crop suggestions could enhance the practicality of the system by recommending suitable locations for cultivating suggested crops.

The proposed model is designed to be computationally efficient, making it suitable for deployment on lightweight capability devices. However, it requires a larger number of parameters for better accuracy. Future improvements could focus on enhancing data collection methods, integrating emerging technologies like blockchain for transparent pricing data, and incorporating climate change scenarios to prepare for future challenges in agriculture. Additionally, efforts can be directed towards reducing the training time of the model and incorporating self-learning capabilities for continual improvement.

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