International Journal of Combined Research & Development (IJCRD)
eISSN:2321-225X; pISSN:2321-2241 Volume: 13; Issue: 7; July- 2024

A MACHINE LEARNING-BASED APPROACHES FOR CROP YIELD PREDICTION AND FERTILIZER RECOMMENDATIONS

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ABSTRACT

The foundation of a developing nation like India is agriculture. The majority of the population rely on agriculture for income. Agriculture practises are being modernised today for the advantage of the producers. An emerging area of informatics called machine learnings can be used to great effect in the agriculture sector. For agricultural stakeholders, fertilizer recommendations and crop output forecasting are crucial. The weather, environmental changes, rainfall water management, and fertilizer use all have a significant impact on crop yield or production. These changeable factors have a negative impact on productivity, which makes it even more essential to be precise when properly analyzing crop yield under changing climatic conditions. As a consequence, producers are unable to produce the crop's predicted yield. Today, a various of researchers employ data mining, machine learning, and deep learning techniques to enhance and improve crop productivity and quality.

This approach supports decisions on fertilization that are advantageous to producers. The accuracy of this system is around 99% for Harvest prediction and 100% for fertilizer recommendation.

Keywords: *Crop-Yield Prediction, Fertilizer Recommendation, Deep neural network Data-Driven Recommendations, GBM*

1. INTRODUCTION

Agriculture forms the backbone of civilizations worldwide, providing sustenance, income, and basic materials for various industries. With the global population constantly expanding, there is a growing demand for efficient and sustainable agricultural practices to ensure food security and satisfy the requirements of a burgeoning population. Crop yield predictions and fertilizer recommendation are crucial components of modern agriculture, seeking to optimize productivity while minimizing resource usage and environmental impact. Traditionally, these duties relied heavily on manual observation, historical data, and expert knowledge, which often led to suboptimal outcomes and inefficiencies. However, with recent advancements in machine learning (ML) and data analytics, there has been a paradigm shift in how these tasks are approached. ML techniques offer the potential to analyze immense quantities of agricultural data, including soil properties, weather patterns, crop characteristics, and farming practices, to generate accurate predictions and recommendations. This paper presents a comprehensive overview of a machine learning based approach for agricultural yield prediction and fertilizer recommendation. By leveraging historical data and real-time information, ML models can learn complex patterns and relationships within agricultural systems, enabling more precise predictions of crop yields and optimal fertilizer prescriptions. The integration of ML algorithms with sensor technologies, satellite imagery, and IoT devices further enhances the accuracy and scalability of these predictive models. Moreover, by learning from new data, these systems can adapt to changing environmental conditions and evolving agricultural practices, guaranteeing their relevance and efficacy over time. With respect to increasing agricultural productivity, ML-based forecasting agricultural production and suggesting fertilizer use systems have the potential to promote sustainability by optimizing resource utilization, reducing chemical inputs, and minimizing environmental degradation. By empowering farmers with data-driven insights, these technologies facilitate informed decision-making and enable precision agriculture practices tailored to specific crop varieties, soil conditions, and local climates. Overall, the incorporation of machine learnings agriculture holds great promise for revolutionizing crop management strategies, augmenting food production efficiency, and contributing to the global endeavor towards sustainable development. This paper seeks to examine the methodologies, challenges, and future prospects of ML-based approaches for crop yield prediction and fertilizer recommendation, emphasizing their role in influencing the future of agriculture.

2.LITERATURE REVIEW

1) Crop Yield Estimate Applications of Deep Reinforcement Learning exemplary sustainable model Agriculture D. Elavarasan, P. M. D. Vincent are the authors. One area of potential study has been agricultural production prediction based on agricultural product, water, soil, and environmental characteristics. Models developed using deep learning are often utilized to identify critical crop characteristics for forecasting. Although these methods may be able to help with the yield prediction problem, they have the following drawbacks: incapable of producing a straight or curved transfer of the yield values and the starting data; also, the effectiveness of such models is largely dependent on the caliber of the features that were extracted. For the aforementioned drawbacks, deep learning offers guidance and inspiration. By fusing the best aspects of neural networks with reinforcement learning, deep reinforcement learning generates a full structure for predicting crop production that can convert unprocessed data into crop prediction values. In order to anticipate agricultural productivity and the suggested study builds a Deep Recurrent Q Network method, which is an iterative neural network learning algorithm atop the Q-learning, also reinforcement education method. The information and its variables provide the successively constructed layers of the repetitive neural network. Based on input criteria, the learned Q-learning networks builds a crop production projection framework. A linear layer transforms the repeated neural network's output values into Q-values. The reinforcement learning agent combines the threshold with a collection of parametric features to assist predict crop productivity. In the end, the agent receives a score that is determined by how well it executes its efforts to reduce error and increase prediction accuracy. With a 93.7% accuracy rate, the suggested model accurately forecasts crop production, outperforming previous models while maintaining the previous original data distribution.

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2) Crop harvest Forecasting and Effective Fertilizer Use S. Bhanumathi and N. Rohit are the authors. India is an agricultural nation; hence the increase of its agricultural produce and the products of the agroindustry are the main drivers of its economy. In agricultural yield analysis, data mining is a new field of study. In agriculture, yield prediction is a crucial problem. Any farmer wants to know what kind of harvest he might anticipate in the near future. Examine the different relevant characteristics, such as location and pH level, which are used to calculate the soil's alkalinity. Location is used in conjunction via the assistance of third-party tools like APIs for the type of soil, the temperature, and the soil's nutritional value in that region, amount of rainfall in the region, and soil composition to determine the percentage of nutrients like nitrogen, phosphorus, and potassium (K). Each of these data attributes will be examined, and the data will be trained using a various machine learning methods in order to build a model. The system includes a model that is designed to be exact and accurate in forecasting crop production. It also provides the user with advice about the necessary ratio of fertilizer based on atmospheric and soil factors of the field, which improve crop yield and raise farmer income.

3.PROPOSED SYSTEM

There are two machine learning algorithms in the suggested system. The two tasks that the system aims to do are forecasting crop yield and suggesting suitable fertilizer. The Extra Trees Regressor algorithm was used to forecast crop yield, and GaussianNB was used to suggest fertilizer. Through the well-known dataset repository known as Kaggle, all the required datasets are gathered. The original datasets are modified, preprocessed, and null values are eliminated based on the row values in accordance with the model's requirements. The user can choose to receive recommendations for fertilizer or a crop yield estimate by simply picking options from the menu in the web interface that we have created using the Flask framework in Python. The user is prompted to enter the details of essential factors, such as State Name, Season, area and Type of Crop. The data is fed into an Extra Trees Regressor machine learning model. The projected crop yield, expressed in kilograms, is derived from the input numbers above. The user is prompted to provide information about temperature, humidity, moisture, crop type, soil type, potassium, nitrogen, and phosphorus before accessing the fertilizer suggestion model.

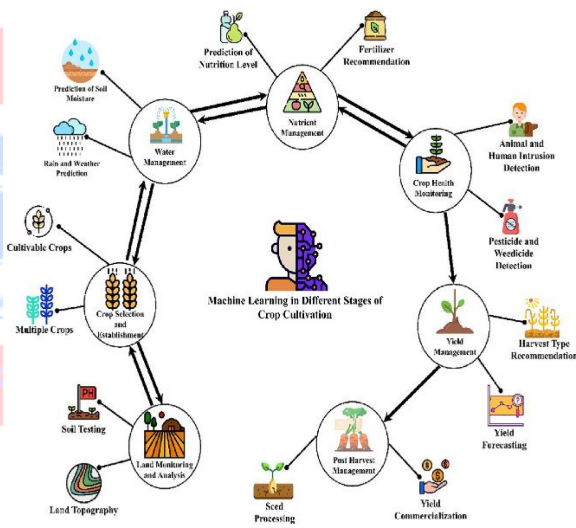

Fig 1. Stages of crop cultivation

The values inputted are fed into a GaussianNB model and the resulted fertilizer name is displayed. Advantages: The precision of the suggested crop production forecast model was 99%, while the suggested chemical suggestion model was 100% accuracy. The decrease of skew is the primary benefit of the suggested crop harvest prediction model with Added Trees. When building the trees, a piece of the full dataset was taken into consideration. Additional Trees samples the whole collection in order to avoid errors in the findings that may arise from different data regions. The proposed Extra Trees agricultural yield prediction models also decrease variation, which is an additional benefit. The approach is not greatly impacted by specific features or patterns in the dataset because of the randomized division of nodes inside the decision trees. The suggested fertilizer recommendation model method appears to be a straightforward classification algorithm, yet it plays a significant role in predictive modeling. The family of probabilistic classifiers, which is entirely based on Bayer's theorem, includes it.

Given how quickly it can be trained, the suggested system model GaussianNB is suitable for big datasets. Given that GaussianNB assumes feature independence, it is a good fit for datasets with low to no feature correlation.

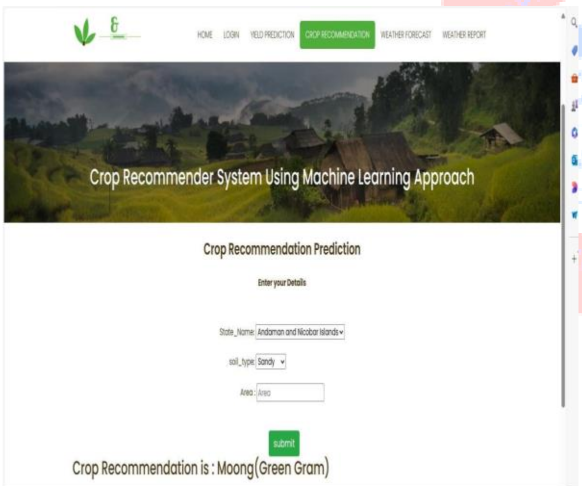

Fig 2. Crop recommendation prediction

4. MODULE DESCRIPTION

Data Collection:

4.1 Transparent Rankings Dashboard: Develop a user-friendly interface to display university rankings based on blockchain data. The dashboard should: - Provide access to ranking criteria and methodology. - Display rankings in a plain and comprehensible format. - Allow users to filter and compare universities based on different criteria.

4.2.Traceable Data Audits:
Implement mechanisms for auditing and tracing the origin of ranking data. This may involve: - Timestamping each data entry to monitor when it was posted to the blockchain. - Providing access to the transaction history for each university's classification data. - Enabling users to verify the authenticity and integrity of ranking data through blockchain records.

4.3.Trusted Accreditation Verification: Integrate features to verify the accreditation status of universities. This could include: - Displaying accreditation information immediately from blockchain records - Allowing users to verify accreditation certificates issued by pertinent authorities. - Providing alerts for universities with expired or revoked accreditation status.

Aspect	Description	Key Elements
1. Data Collection	Collect relevant datasets including historical crop yields, weather conditions, soil properties	Crop yield records, weather data, soil samples, fertilizer records
2. Model Development	Develop and train machine learning models to predict crop yield and recommend fertilizers.	Model types, Training algorithms
3. Model Evaluation	Evaluate the performance of the trained models using metrics and validation techniques.	Metrics Validation methods (e.g., Cross-Validation)
4. Deployment & Use	Deploy the models in a practical system for end-users to predict yields and get fertilizer recommendations.	Deployment platforms (e.g., Cloud services, Web apps), User interface design

Table 1. Process

4.4.Configurable Reporting:

Offer configurable reporting tools for stakeholders to analyze ranking data. This could include: - Generating reports based on specific criteria or regions. - Exporting data in various formats for further analysis. - Integrating with external analytics platforms for advanced reporting capabilities.

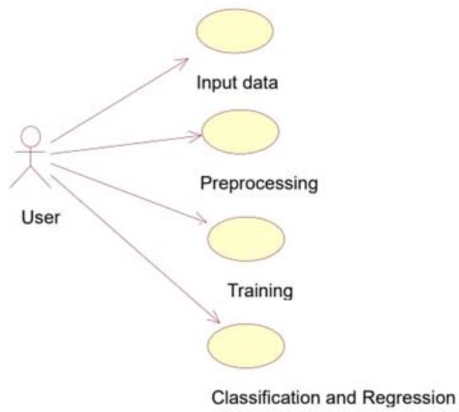

Fig 3. Use case diagram

5.RESULT

The incorporation of engine education techniques into agriculture holds immense promise for revolutionizing harvest prediction and fertilizer recommendation systems, particularly in nations like India where agriculture forms the support of the economy.

By leveraging algorithms like Extra Trees Regressor for yield prediction and GaussianNB for fertilizer recommendation, this proposed approach demonstrates extraordinary accuracy rates of 99% for harvest prediction and 100% for fertilizer recommendation. Such precision empowers farmers with invaluable insights, enabling them to make informed decisions on crop management practices, ultimately leading to enhanced productivity and economic stability within the agricultural sector. This innovative solution not only addresses the challenges posed by fluctuating environmental conditions but also underscores the transformative potential of data-driven approaches in optimizing agricultural outcomes.

6.CONCLUSION

A machine learning algorithm was suggested by the suggested system to estimate crop production, predict ion, and recommend fertilizer. The result is efficiently generated by the suggested machine learning model, and the algorithms Extra TreesRegressor and GaussianNB both work well. Because our farmers are now not utilizing technology and analysis properly, it is possible that they will choose the wrong crop to cultivate, which will lower their income. In order to lessen those kinds of losses, we have created a user-friendly system with a graphical user interface (GUI) that will identify the finest produce for a certain plot of land and provide information on the necessary fertilizers to boost output.

Consequently, this enables farmers to make informed crop choices, advancing the agricultural sector through creative and scientific thought.

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