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AGROSOIL INTELLIGENCE SYSTEM

[1]Chaitra Bhosgi, [2]G.Sahana, [3]Deepthi Reddy ,[4]Sara Tahniyath

[1]Student, [2]Student,[3]Student ,[4]Assistant Professor

[1]Dept of Computer Science,

[1]Navodaya Institute Of Technology, Raichur, India

Abstract: As a coastal state, Tamil Nadu faces uncertainty in agriculture which decreases its production. With more population and area, more productivity should be achieved but it cannot be reached. Farmers have words-of-mouth in past decades but now it cannot be used due to climatic factors. Agricultural factors and parameters make the data to get insights about the Agri-facts. Growth of IT world drives some highlights in Agriculture Sciences to help farmers with good agricultural information. Intelligence of applying modern technological methods in the field of agriculture is desirable in this current scenario. Machine Learning Techniques develops a well-defined model with the data and helps us to attain predictions. Agricultural issues like crop prediction, rotation, water requirement, fertilizer requirement and protection can be solved. Due to the variable climatic factors o f the environment, there is a necessity to have a efficient technique to facilitate the crop cultivation and to lend a hand to the farmers in their production and management. This may help upcoming agriculturalists to have a better agriculture. A system o f recommendations can be provided to a farmer to help them in crop cultivation with the help o f data mining. To implement such an approach, crops are recommended based on its climatic factors and quantity. Data Analytics paves a way to evolve useful extraction from agricultural database. Crop Dataset has been analyzed and recommendation o f crops is done based on productivity and season.

Index Terms – Soil Analysis, Crop Recommendation, Machine Learning, Agricultural Informatics, Data Preprocessing, Supervised Learning, Python Programming, Predictive Analytics, Smart Agriculture, Decision Support System, Precision Farming Algorithms MobilenetV2 Network,Decsion tree,Random forest.

I. INTRODUCTION

Tamil Nadu being 7th largest area in India has 6th largest population. It is the leading producer of agriculture products. Agriculture is the main occupation of Tamil Nadu people. Agriculture has a sound tone in this competitive world. Cauvery is the main source of water. Cauvery delta regions are called as rice bow l of Tamil Nadu. Rice is the major crop grown in Tamil Nadu. Other crops like Paddy, Sugarcane, Cotton, Coconut and groundnut are grown. Bio-fertilizers are produced efficiently. Many areas Farming acts as major source of occupation. Agriculture makes a dramatic impact in the economy o f a country. Due to the change of natural factors, Agriculture farming is degrading now-a-days. Agriculture directly depends on the environmental factors such as sunlight humidity, soil type, rainfall, Maxim um and Minimum Temperature, climate, fertilizers, pesticides etc. Knowledge of proper harvesting o f crops is in need to bloom in Agriculture. India has seasons of

1. Winter which occurs from December to M arch
2. Summer season from April to June
3. Monsoon or rainy season lasting from July to September
4. Post-monsoon or autumn season occurring from

October to November .Due to the diversity of season and rainfall, assessment of suitable crops to cultivate is necessary. Farmers face major problem s such as crop management, expected crop yield and productive yield from the crops. Farmers or cultivators need proper assistant regarding crop cultivation as now-a-days many fresh youngsters are interested in agriculture .Impact of IT sector in assessing real world problem is moving at a faster rate. Data is increasing day by day in field o f agriculture. With the advancement in Internet of

Things, there are ways to grasp huge data in field o f Agriculture. There is a need o f a system to have obvious analyzes o f data o f agriculture and extract or use useful information from the spreading data. To get insights from data, it has to be learnt. In 2025, the agricultural sector remains the backbone of the global economy, yet it faces unprecedented challenges from erratic climate change, soil degradation, and the need to feed a rapidly growing population. Traditional farming often relies on inherited heuristics and local experience, which are increasingly insufficient to guarantee optimal yields under modern environmental uncertainties. A Crop Recommendation System (CRS) represents a transformative shift toward precision agriculture by leveraging Machine Learning (ML) and Internet of Things (IOT) to replace guesswork with data-driven intelligence. These systems analyze critical site-specific parameters—including soil nutrients (Nitrogen, Phosphorus, Potassium), pH levels, temperature, humidity, and annual rainfall—to scientifically predict the most suitable crops for a particular plot of land.

II. related work

Machine Learning techniques have been widely applied in agriculture to improve soil analysis and crop recommendation. Earlier studies used algorithms such as Decision Tree, Naïve Bayes, and K-Nearest Neighbors to predict suitable crops based on soil parameters like pH and nutrient content. Although these methods provided reasonable results, they often suffered from limited accuracy and poor handling of complex datasets.

Recent research has shown that ensemble learning methods, particularly Random Forest, offer better performance for agricultural prediction tasks due to their ability to manage non-linear relationships and noisy data. Some studies also incorporated environmental factors such as temperature and humidity to enhance prediction accuracy, but this increased system complexity.

The proposed AgroSoil Intelligence System builds on these works by using an optimized Random Forest algorithm with proper data preprocessing and a user-friendly web interface, enabling accurate and practical crop recommendations .Machine Learning Classifiers: Most research utilizes supervised learning to categorize suitable crops based on environmental features.

Random Forest (RF): Frequently cited as the highest-performing individual model, often achieving accuracies between 95% and 99.2%.

Support Vector Machines (SVM): Favored for its stability and high precision in localized datasets (e.g., Ramtek region, India).

Ensemble Methods: Recent 2025 research has moved toward stacked ensembles and voting classifiers (combining RF, XGBoost, and Naive Bayes) to enhance reliability and handle noisy data.

Uncertainty Quantification: Existing models often provide "deterministic" outputs (yes/no) without accounting for sensor noise or climate variability.

Dynamic Data: Most models rely on static datasets; newer research suggests incorporating real-time weather APIs and satellite imagery to improve temporal accuracy.

Sensor Technology: Research utilizes 8-in-1 sensors for measuring NPK, electrical conductivity (EC), moisture, and pH levels, often deployed via Arduino or ESP8266 Wi-Fi modules.

Communication Protocols: LoRaWAN is frequently used for long-range, low-power data transmission in agricultural fields.

Case Studies: Prototyping has been done for home gardening (spinach) to compare sensor data with laboratory results, showing minimal variation (0.1% to 0.7% for pH and EC).

III. KNOWLEDGE DISCOVERY IN DATABASES

It aims to give accurate results to farmers. It finds hidden patterns. It discovers useful knowledge from the Extreme data set. It is one of the processes in Knowledge Discovery in Databases (KDD) Apart from the KDD process, in recent days with the development in IT world, Machine Learning has emerged to handle big volume of data and involves high performance com putting too. Application of Machine Learning in Agriculture peaks up day by day. Machine Learning techniques are used in crop management, livestock management, water management and soil management One kind of machine leaning technique is using a recommendation algorithm. They provide personalized products in E-Commerce. These recommendation concepts are used in agriculture in this paper to provide crops to sow. Simple Data Analytics is used on crop dataset and personalization of agricultural crops are suggested to famers.

IV. EXISTING SYSTEM

1. Tripathy et al., provided a system to have management of pesticides for crop cultivation using data mining process.
2. Pritam Bose developed a SNN model to have a spatiotemporal analysis with crop estimation.
3. Crop and Yield Prediction Model suggested by Shreya S. Bhamose used Modified k-means clustering algorithm predicts the amount of harvest of crops and also water requirement for crops.
4. The existing system for providing agricultural crop recommendations primarily relies on traditional knowledge and manual advisory services. Farmers typically make crop selection decisions based on their personal experience, historical crop performance, and general recommendations provided by agricultural extension services. These recommendations are often derived from regional agricultural research centers and are based on long-term observations and studies of crop performance under various climatic and soil conditions.
5. Agricultural extension officers play a crucial role in this system, disseminating information to farmers about suitable crops, farming techniques, and seasonal variations. These officers often use printed guides, community meetings, and field visits to share their expertise. Additionally, farmers may access weather forecasts and basic agronomic information from local agricultural departments and meteorological services.
6. In some regions, there are established guidelines and calendars that suggest optimal planting times and crop types based on the local agro-climatic zones. These guidelines are developed through comprehensive research and data collection over many years, providing a foundational framework for farmers to follow.

V. DISADVANTAGES OF EXISTING SYSTEM

1. Hard to interpret.
2. Computationally expensive.
3. Reliance on Personal Experience: The existing system largely depends on the personal experience and intuition of farmers, which can be inconsistent and subjective. This may lead to suboptimal crop choices, particularly for inexperienced farmers.
4. Limited Access to Information: Farmers in remote or underdeveloped areas may have limited access to timely and accurate information. Agricultural extension services may not reach all farmers effectively, leading to knowledge gaps.
5. Static Recommendations: Traditional agricultural recommendations often rely on historical data and may not be updated frequently to reflect current environmental conditions or advancements in agricultural practices.
6. Generalized Advice: The advice provided by extension services and regional guidelines is often generalized and may not account for the specific conditions of individual farms, such as unique soil properties or microclimates.
7. Slow Dissemination of Knowledge: The dissemination of new agricultural research and techniques through traditional means can be slow.
8. Farmers may not receive the latest recommendations promptly, potentially missing out on improved practices and technologies.
9. Resource Constraints: Agricultural extension services are often under-resourced, leading to inadequate support and coverage. This limits the ability to provide personalized and frequent assistance to farmers.
10. Limited Data Utilization: The existing system does not fully leverage the potential of data analytics and machine learning to provide precise recommendations. As a result, valuable insights from large datasets remain untapped.
11. Inconsistent Quality of Advice: The quality and accuracy of advice can vary significantly depending on the expertise of individual extension officers. This inconsistency can lead to variable outcomes for different farmers.
12. Adaptation to Climate Change: Traditional systems may struggle to adapt quickly to the changing climatic conditions and new agricultural challenges posed by climate change, leading to recommendations that are less effective in current contexts.
13. Economic Considerations: The existing system may not fully integrate economic factors such as market trends, cost-benefit analyses, and financial risks, which are crucial for making informed agricultural decisions.

14. Dependency on Physical Presence: Farmers often need to attend community meetings, workshops, or field visits to receive information, which can be time-consuming and inconvenient, particularly during busy farming periods.

VI. PROPOSED SYSTEM

1. The proposed system for "Agrosoil Intelligence System" is developed using Python and employs a Decision Tree Classifier as the primary algorithm for making predictions. The system is designed to provide tailored crop recommendations by analyzing a comprehensive dataset that includes various agricultural parameters.
2. The dataset utilized in the system contains the following attributes:
    - States: The total number of states in India.
    - Rainfall: The amount of rainfall measured in millimeters (mm).
    - Ground Water: The total ground water level.
    - Temperature: The temperature measured in degrees Celsius.
    - Soil Type: The number of soil types.
    - Season: The suitable seasons for different crops.
    - Crops: The types of crops that can be cultivated.
    - Fertilizers Required: The types of fertilizers required for each crop.
    - Cost of Cultivation: The total cost involved in cultivating each crop.
    - Expected Revenues: The total expected revenues from the crop yield.
    - Quantity of Seeds per Hectare: The quantity of seeds needed per hectare.
    - Duration of Cultivation: The number of days required for the cultivation process.
    - Demand of Crop: The demand for each crop (categorized as high or low).
    - Crops for Mixed Cropping: Information on which crops can be mixed for cropping.
3. The Decision Tree Classifier analyzes these attributes to learn patterns and relationships within the data, enabling it to make informed crop recommendations based on the input parameters.The model has
4. Demonstrated a high level of accuracy, with a training accuracy of 91% and a test accuracy of 90%, reflecting its ability to generalize well to new data.

VII. ADVANTAGES OF PROPOSED SYSTEM

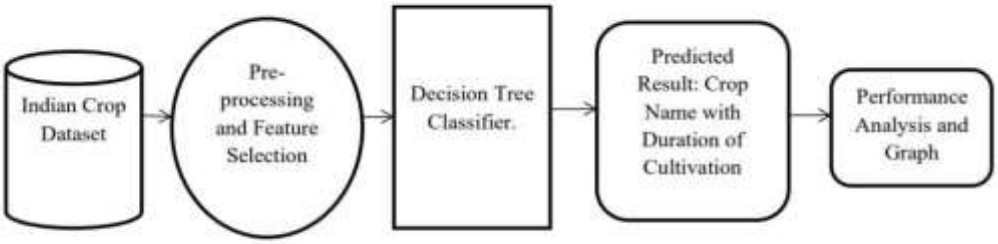
1.User-Friendly Interface: Python’s flexibility allows for the development of intuitive interfaces that can present complex data and recommendations in an easily understandable format, making it accessible even to those with limited technical expertise.

2. Adaptability to Climate Change: The system’s ability to analyze historical and current climatic data enables it to provide recommendations that are adaptive to changing environmental conditions, helping farmers mitigate the impacts of climate variability.

3. Enhanced Productivity: By integrating data on ground water levels, soil types, and climatic conditions, the system helps in selecting crops that are most likely to thrive, thus enhancing overall agricultural productivity.

4.Time Efficiency: Automated recommendations save time for farmers by reducing the need for extensive manual research and consultation with agricultural experts, allowing them to focus more on implementation and farming activities

VIII. SYSTEM ARCHITECTURE



IX. SYSTEM REQUIREMENTS

HARDWARE REQUIREMENTS:

- ➢ System : Pentium i3 Processor.
- ➢ Hard Disk : 500 GB.
- ➢ Monitor : 15'' LED
- ➢ Input Devices : Keyboard, Mouse
- ➢ Ram : 4 GB

SOFTWARE REQUIREMENTS:

- ➢ Operating system : Windows 10 / 11.
- ➢ Coding Language : Python 3.8.
- ➢ Web Framework : Flask.
- ➢ Frontend : HTML, CSS, JavaScript

X.RESULTS

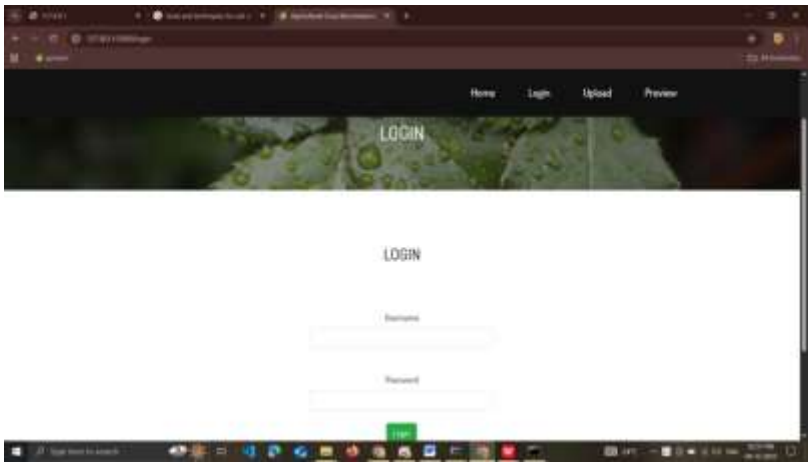


Fig1: login page

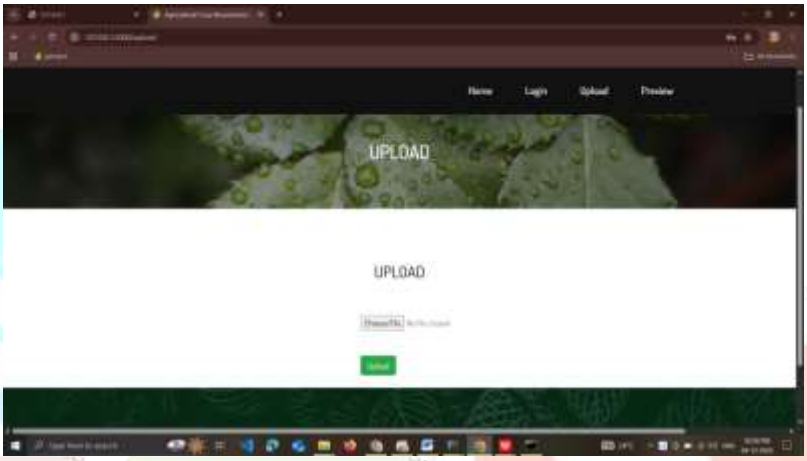


Fig2:Upload File

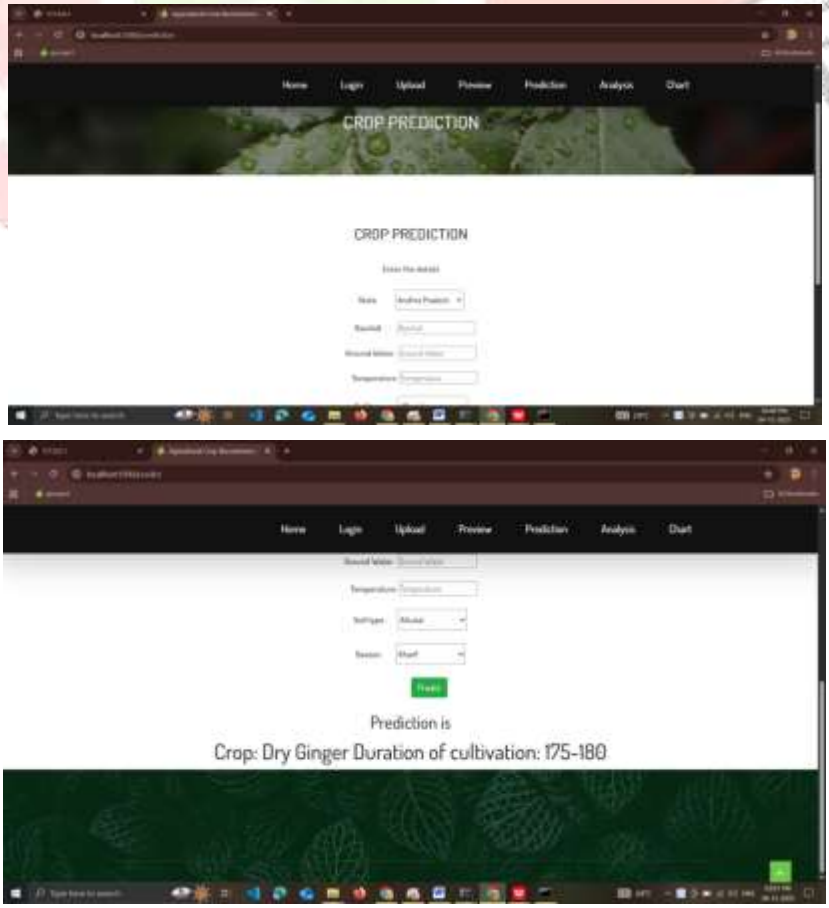


Fig3:Crop Prediction

XI. CONCLUSION

In this paper, significance of management of crops was studied vastly. Farmers need assistance with recent technology to grow their crops. Proper prediction o f crops can be informed to agriculturists in time basis. Many Machine Learning techniques have been used to analyze the agriculture parameters. Some o f the techniques in different aspects o f agriculture are studied by a literature study. Blooming Neural networks, Soft computing techniques plays significant part in providing recommendations. Considering the parameter like production and season, more personalized and relevant recommendations can be given to farmers which make them to yield good volume of productions. By offering accurate recommendations on crop selection, irrigation scheduling, and fertilizer usage, the system improves crop yield while reducing resource wastage and environmental impact. It also supports sustainable farming practices by preventing overuse of water and chemicals, thus maintaining long-term soil fertility. Overall, the AgroSoil Intelligence System bridges the gap between traditional farming and smart agriculture. It empowers farmers with timely insights, increases productivity, reduces costs, and contributes to food security. With future enhancements like AI-based predictions and cloud integration, the system has strong potential to transform agriculture into a more efficient and sustainable sector. The AgroSoil Intelligence System provides a smart and data-driven approach to modern agriculture by combining soil analysis, sensor data, and intelligent algorithms. This system helps farmers understand soil health parameters such as moisture, pH, nutrient content, and temperature in real time, enabling informed decision-making.

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