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A Review on Agriculture Crop Prediction Techniques Using Machine Learning

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Abstract: Machine learning is a useful decision-making tool for predicting crop yields, as well as for deciding what crops to plant and what to do during the crop's growth season. To aid agricultural yield prediction studies, a number of machine learning techniques have been used. We employed a Systematic Literature Review (SLR) to extract and synthesize the algorithms and features used in crop production prediction research in this investigation This paper provides a comprehensive overview of the most recent machine learning applications in agriculture, with a focus on pre-harvesting, harvesting, and post-harvesting issues The papers have been studied in depth, analysed the methodology and features employed, and made recommendations for future study. Temperature, rainfall, and soil type are the most commonly utilised features, according to our data, while Artificial Neural Networks are the most commonly employed method in these models.

I. INTRODUCTION

Food is believed to be a basic human requirement that may be met through farming. Agriculture not only meets humans' basic requirements, but it is also a source of employment around the world. Agriculture is regarded as the economic backbone and a source of employment in emerging countries such as India. Agriculture accounts for 15.4 percent of India's GDP. A lack of information at each level of agriculture creates new problems or exacerbates existing ones, increasing the expense of farming. The demand on the agriculture industry is increasing as the population grows. Overall losses in agriculture systems, from crop selection through product sale, are extremely substantial. Keeping track of information on crops, the environment, and the market, as the old phrase goes, can help farmers make better decisions and solve challenges related to agriculture. To collect and process data, technologies such as blockchain, IoT, machine learning, deep learning, cloud computing, and edge computing can be used. Computer vision, machine learning, and IoT applications will assist farmers and related domains enhance production, improve quality, and ultimately increase profitability. Pre-harvesting, harvesting, and post-harvesting are the three major categories of agricultural activity. Machine learning advancements have aided in boosting agricultural gains. Machine learning is a recent technology that is assisting farmers in reducing farming losses by offering detailed crop recommendations and insights.. Machine learning has by far been the most helpful and an innovative method that is recommended to be used in agriculture based applications. A farmer can receive an accurate estimate of harvestable versus non-harvestable acres on a particular day by logging into a customised dashboard on a computer or tablet using machine learning technology. Harvestable crop weight and maturity can also be assessed and projected. Additionally, crops can be examined both before and after harvest for the presence of attractive traits, level of damage (if applicable), nutritional makeup, and other factors that may effect the ultimate viable yield and product pricing using a range of technologies, including image analysis. Machine learning (ML) methodologies are applied in a variety of industries, from evaluating customer behaviour in supermarkets (Ayodele, 2010) to predicting customer phone usage (Witten et al., 2016). Agriculture has been using machine learning for several years (McQueen et al., 1995). Crop yield prediction is one of precision agriculture's most difficult problems, and numerous models have been suggested and confirmed so far. Because crop production is affected by a range of factors such as climate, weather, soil, fertiliser use, and seed variety, this challenge necessitates the use of many datasets (Xu et al., 2019). This suggests that predicting agricultural yields is not a simple operation; rather, it entails a series of complex stages. Crop yield prediction programmes can now reasonably forecast actual yields, but greater yield prediction performance is still desired Researchers have contributed in various ways to solving the problem of climate change's impact on crop productivity. In this section, we give a brief literature review of colleague research scholars' work and attempt to critically evaluate it so that we can determine the scope for future research. as part of our research, we will continue to work.

Its applications can be divided into four major categories:

1) Crop management
2) Livestock management
3) Water management
4) Soil management

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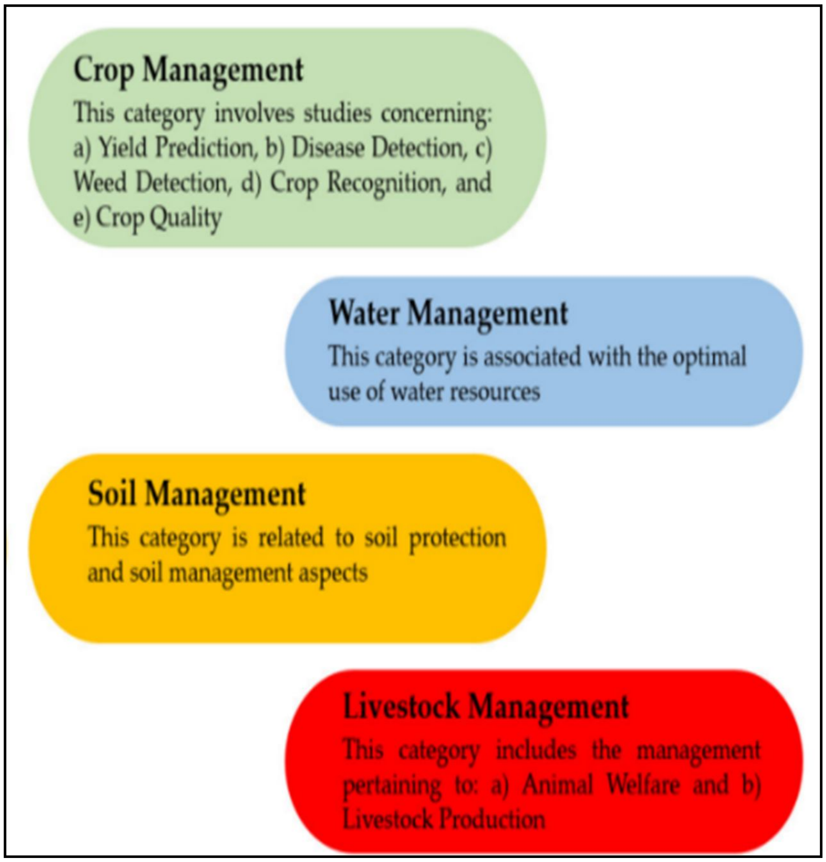

Fig i: Management categories

II. RELATED WORKS

L. Ismail et al. (2018) [1] developed a methodology for predicting a country's preparedness to face a crisis Machine learning is being used to study climate change.

The research is focused on Southeast Asia. Data acquisition, data training, data testing, and index calculation are the steps involved in calculating the predictive index. Prediction, index validation, and index visualisation are all things that can be done with an index. The research is being conducted as a preventative step. The regions will be alerted, and deep learning will be used to check the vulnerable index.

Crop yield forecast is a critical challenge for decision-makers at all levels, including national and regional (e.g., EU) decision-making. Farmers can use an accurate crop production prediction model to assist them determine what to grow and when to grow it. Crop production prediction can be done in a variety of ways. This review article looked into what has been done in the literature about the use of machine learning in crop yield prediction.

One of the exclusion criteria in our analysis of the recovered publications is that the publication is a survey or traditional review paper. Those papers that were left out are, in reality, related work that is described in this section. Chlingaryan and Sukkarieh (Chlingaryan et al., 2018) conducted a review study on nitrogen status estimate using machine learning. The study recommends broadening your search to identify more crop yield-related characteristics (Elavarasan et al., 2018). A review study on the application of machine learning in the agriculture sector was released by Liakos et al. (2018). Crop management, animal management, water management, and soil management literature were used in the analysis.

A review study was conducted by Li, Lecourt, and Bishop to determine the maturity of fruits in order to determine the best harvest timing and production forecast (Li et al., 2018). Mayuri and Priya discussed the issues and techniques that are experienced in the agricultural sector when it comes to image processing and machine learning, particularly in the detection of illnesses (Mayuri and Priya, xxxx). Somvanshi and Mishra (2015) discussed a number of machine learning approaches and their applications in plant biology. A review paper on the application of data mining in the agriculture industry was released by Gandhi and Armstrong.

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III. MACHINE LEARNING IMPLEMENTATION TECHNIQUE

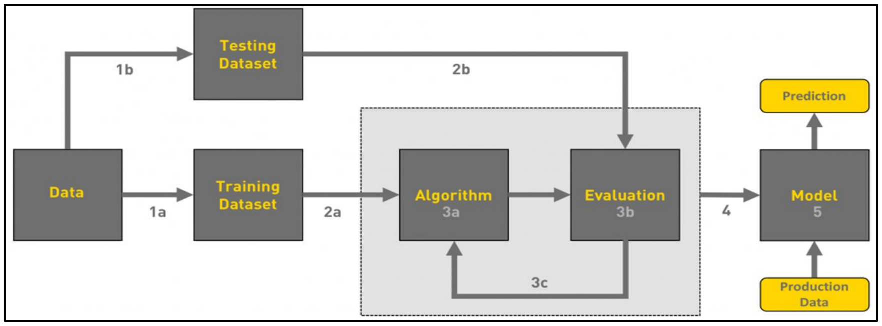

Fig ii: Machine Learning block diagram

Python Libraries required for implemention

1) Numpy
2) Pandas
3) Sci-kit Learn
4) Matplotlib

A. Pre-processing of Data

The method for acquiring data depends on the sort of project we want to create. For example, if we want to create an ML project that uses real-time data, we can create an IoT system that uses data from various sensors. The data set can come from a variety of places, including a file, a database, a sensor, and many other places, but it cannot be utilised immediately for analysis since there may be a lot of missing data, extremely big values, disorganised text data, or noisy data. As a result, Data Preparation is completed to address this issue.

One of the most crucial processes in machine learning is data pre-processing. It is the most crucial step in improving the accuracy of machine learning models. There is an 80/20 rule in machine learning. Every data scientist should devote 80% of their effort to data pre-processing and 20% of their time to real analysis.

B. Data Classification

When the goal variable is categorical (i.e., the output may be classified into classes – it belongs to Class A, B, or something else), a classification problem arises.

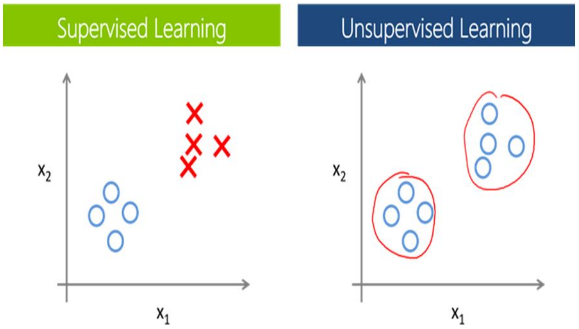

Fig iii: Classification techniques

C. Algorithms for Classification

1) K-Nearest Neighbor
2) Naive Bayes
3) Decision Trees/Random Forest
4) Support Vector Machine
5) Logistic Regression

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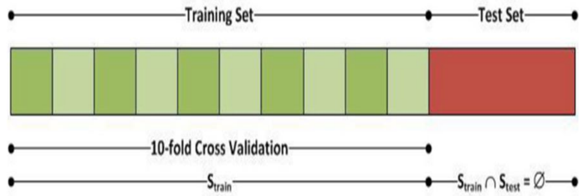
To begin training a model, we divide it into three sections: 'Training data,' 'Validation data,' and 'Testing data.'You use a 'training dat a set' to train the classifier, a 'validation set' to modify the parameters, and a 'unseen test data set' to test the classifier's performance. It'worth noting that only the training and/or validation sets are available to the classifier during training. The test data set must not b e used when the classifier is being trained. The test set will only be available while the classifier is being tested.



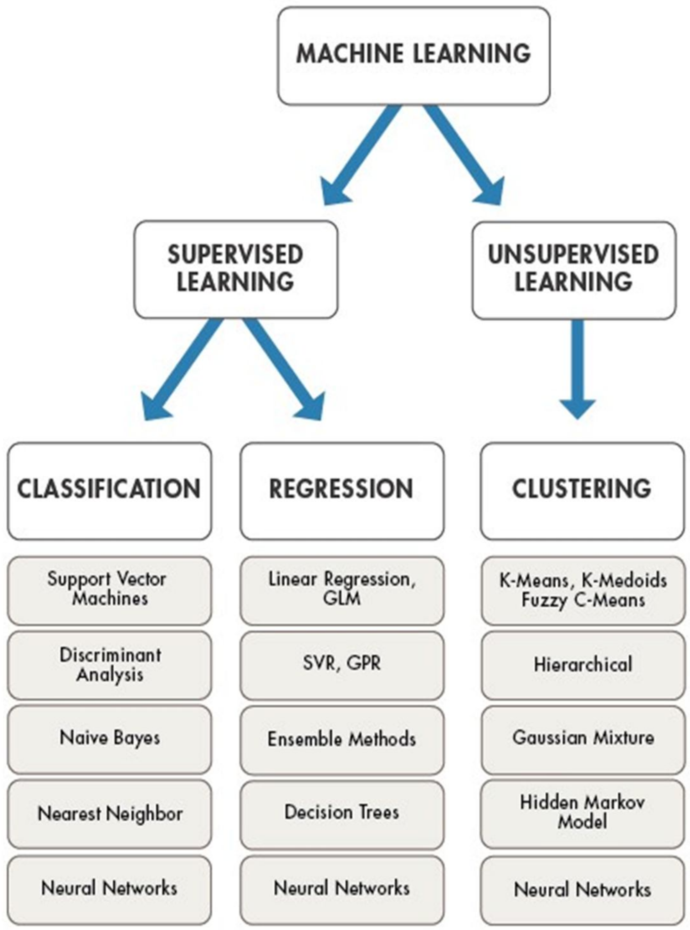


Fig iv: Algorithms for classification

IV. CONCLUSION

According to the findings, depending on the scope of the research and the availability of data, the selected publications employ a variety of elements. Each paper looks into yield prediction using machine learning, however the features vary. The scale, geological location, and crop of the research all varies. The features chosen are determined by the dataset's availability and the research's goal. According to studies, models with more characteristics may not always deliver the highest yield prediction performance. Models with more and fewer features should be evaluated to discover the best performing model. Several algorithms have been employed in various research. The findings reveal that while no definitive conclusion can be taken about which model is the best, they do show that some machine learning models are utilised more frequently than others. The random forest, neural networks, and linear models are the most commonly utilised models.

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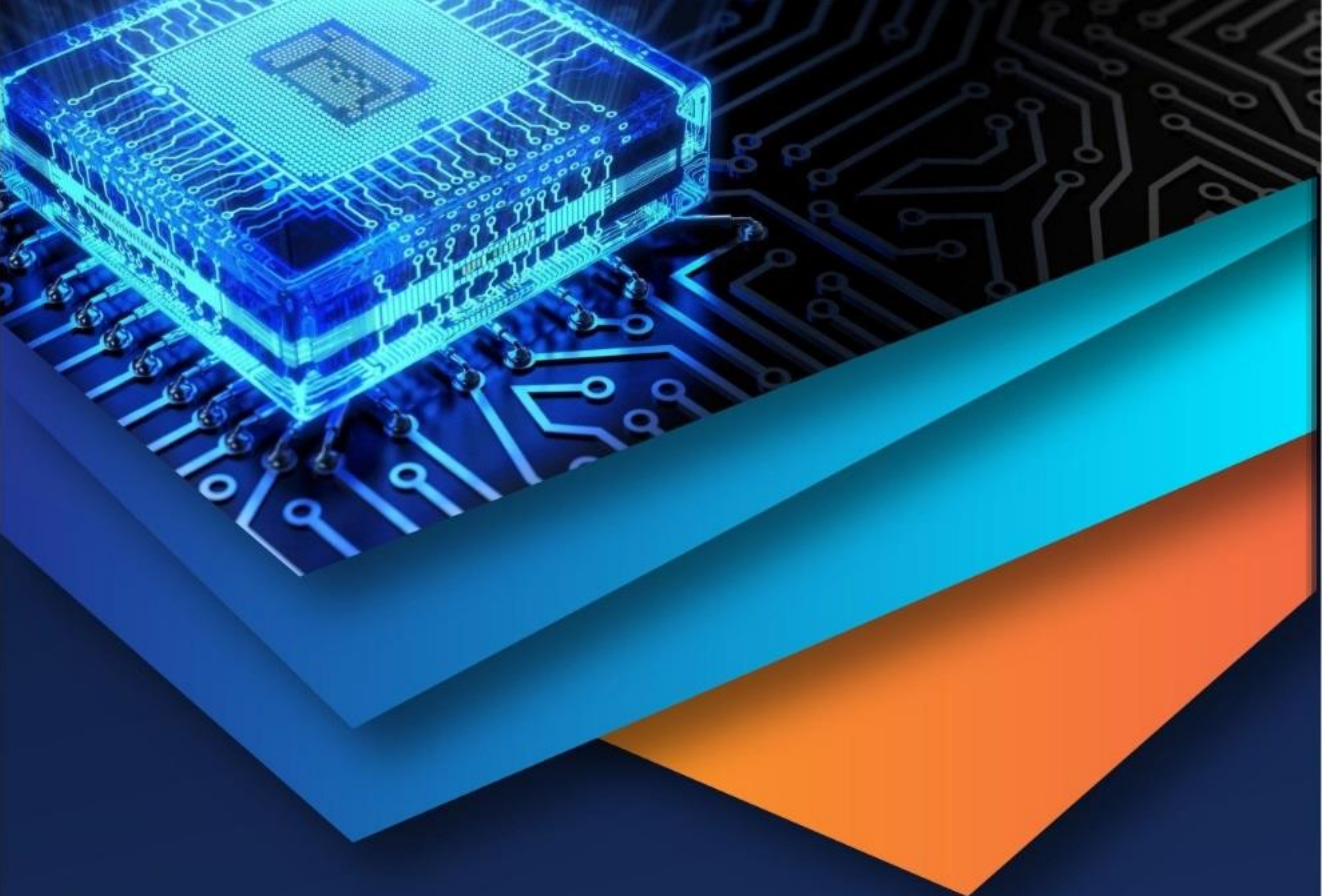

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