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# Crop Yield Prediction and Recommendation System Using Machine Learning

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***Abstract* - About half of the population of India depends on agriculture for its livelihood, but its contribution towards the GDP of India is only 14 per cent. One possible reason for this is the lack of adequate crop planning by farmers. There is no system in place to advice farmers what crops to grow. In this paper we present an attempt to predict crop yield and price that a farmer can obtain from his land, by analysing patterns in past data. We make use of a sliding window non-linear regression technique to predict based on different factors affecting agricultural production such as rainfall, temperature, market prices, area of land and past yield of a crop. The analysis is done for several districts of the state of Tamilnadu, India. Our system intends to suggest the best crop choices for a farmer to adapt to the demand of the prevailing social crisis facing many farmers today.**

***Keywords:*** KNN, ANN, CNN, Machine Learning.

## I. Introduction

Gone are the times when the world used to depend a lot on agriculture and now, agriculture is dependent on the world. Agriculture is something that people have started to become lethargic on, forgetting that it is what is keeping us alive. But there are still some hardworking, passionate farmers whose life runs on just farming. But there's also the corruption that's increasing a lot nowadays. The Main motive of the Department of Agricultural Marketing & Agricultural Business is to have a fair price to the farming community who are pushed behind the current competitive marketing scenario and the mission of achieving the fair price is by making the existing act and rules strong and more effective by implementing new technologies and techniques aimed at reducing pre and post-harvest losses through proper and organised methods and encourage adding value to the market. The main purpose of creating a regulated market is to eliminate the unhealthy trade practice, to reduce the expenses in the market and to provide fair prices to the farmers. Several initiatives have been taken to promote agricultural marketing in order to foster and sustain the pace of rural economic development. To benefit the farming from the new global market access opportunities, the internal agricultural marketing system in the country also needs to be integrated and strengthened. In particular, the market system has to be revitalized to: a) Provide incentives to farmer to produce more; b) Convey the changing needs of the buyers to the producers to enable production planning; c) Foster true competition among the market players and d) To enhance the share of farmers in the ultimate price of his agricultural produce.

Today the farmers cultivate crops based on the experience gained from the previous generation .Since the traditional method of farming is practiced there exists an excess or scarcity of crops without meeting the actual requirement. The farmers are not aware about the demand that takes place in the current agricultural economy. This results in the loss to the farmers. The expressed reasons in order of importance behind farmer suicides were – environment, low produce prices, stress and family responsibilities, poor irrigation, and increase in the cost of cultivation. The main reason is the low prices of the products and the increased cost of cultivation. The cost of crops are determined by economic demand and the limits of the production.

## II. Related Surveys

| Reference Year | Contribution | Dataset | Models &techniques | Strengths | Weaknesses | Performance |
|---|---|---|---|---|---|---|
| [1] 2020 | This article suggests a FL-based CR system to assist farmers in selecting | Jute, Potato, Tobacco, Wheat, Sesamum, Mustard and Green gram. | FL | the validation was based on a Cultivation Index (CI). | No explanation of how the member- ship functions of the inputs and outputs | Accuracy: 92.14 |

 

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| | suitable crops. | -Features: 11 soil parameters, elevation and rainfall. | | | were derived from the dataset. | |
| [2] 2020 | This article proposes a system for predicting the crop which has maximum yield per unit area in a district. | -A dataset published by the Government of Maharashtra, India, containing approximately 246 100 data points. | RF | The algorithm works even when the variables are mostly categorical. | The performance could be much better when considering more variables. | Normalized Ro Squared Error 49% (median va |
| [3] 2020 | This paper treats the integration of AHP and POPSIS with GIS to determine most suitable crops for parcels for land consolidation areas | Crops: Corn, Clover, Sugar beet and Wheat. -Features: 63 Land Map Units and their chemical, physical, topographical, and socio-economic features | Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) | The integration of AHP, TOPSIS and GIS functions provide an effective platform to determine the suitability. | Several criteria can be added such as meteorological and irrigation | No performance used. |
| [4] 2020 | This study Proposes a clustering center optimized algorithm by SMOTE, then use an ensemble of RF and weighed SVM to predict the recommended crop. | The data includes 1530 soil samples and 13 types of cultivated land crops. | RF and SVM. | Classification of crops based on soil analysis | The study reference range is limited. | Accuracy: 98.7 Precision: 97.4 Score: 97.8%. |
| [5] 2020 | This paper proposes a CS method to maximize crop yield based on weather and soil parameters. | Crops: 10 Crops. Features: Soil type, soil nutrients, soil pH value, Drainage capacity, weather conditions. | RF | The soil and predicted weather parameters are used collectively to choose suitable crops for land. | Only Four soil parameters were considered. | No performance was used. |
| [6] 2020 | This work proposes a CR system according to multiple properties of the crop and land. | Crops: 24 crops. Features: Soil types, pH, Electric Conductivity, Organic Carbon, Nitrogen, Phosphorus, Sulfur, Zinc, Boron, Iron, Manganese and Copper | Property matching. | Fast and simple algorithm. | Only soil properties were considered as in-put to the model. | PCS: 4.80% COS: 6.45% |
| [7] 2020 | This paper proposed an implementation of a fuzzy-based rough set approach to help farmers in deciding on CS in their agriculture land. | Crops: 23 Crops.Features: 16 Features. | . | The performance is measured using different evaluation metrics | The suggested method can be tested with a wide set of new crops. | 92%. -F-Me 91% |

 

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| [8] 2020 | This work developed an application that helps selecting the most convenient type of crops in a certain zone considering the climate conditions of that zone, the production, and the needed resources for each crop | Crops: Peach, Pear, Apricot, and Almond. -Features: Relative humidity, Radiation, Wind speed, Temperature, Wind direction, Cooling units, Sunlight, Rainfall, Accumulated radiation, and Wind run. | Fuzzy system. | The farmer's recommendation request is made using internet of things (IoT) devices. | The recommendation module can be scaled to consider other types of additional information like soil parameters. | No performance used. |
| [9] 2020 | The article proposes using hierarchical fuzzy model to reduce the classical system complexity with the huge number of generated rules. | Crops: Not mentioned. -Features: Sand, silt, clay, nitrogen, phosphorus, potassium, soil color, soil pH, soil electrical conductivity, rainfall, climate zone, and water resources. | Hierarchical fuzzy model. | The number of generated rules were reduced from 439 to only 152 | No evaluation metrics are provided. | No performance was used. |
| [10] 2019 | This paper proposed a hybrid RS based on two classification algorithms by considering various attributes | Crops: 24 Crops. -Features: 15 Features | Naive Bayes, J48. | The model was evaluated using Multiple Performance metrics. | Farmers cannot lo- cate their exact coordinates. | Accuracy(J48) : -Recall( F-Measure(J48 |
| [11] 2019 | This work proposes an ontology-based recommendation system for crop suitability recommendation based on region and soil type | Crops: Not mentioned. -Features: Soil characteristics, weather conditions and crop production. | RF | The accuracy of the developed system is reasonably high. | Only 4 parameters were considered from CR | Precision: 65% |
| [12] 2019 | The article addressed the problem of selection of best suitable crop for a farm, by applying different classification algorithms. | Crops: 15 Crops. -Features: Soil color, pH, average rainfall, and temperature | SVM, DT and Logistic regression. | The authors compared different models. | Only four parameters were considered as in- put to the model. | The best performance 89.66% using the SVM |
| [13] 2019 | This work proposes a model that can predict soil series with land type, according to which it can suggest suitable crops. | Crops: Not mentioned. -Features: Soil dataset and crop datase | Weighted KNN, Gaussian Kernel based SVM, and Bagged Tree | Suggesting crops based only on Class of soil series is very interesting. | More focus on soil classification. | Accuracy (SVM) |

 

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| [14] 2019 | This paper presents a hybrid crop RS based on a combination of a CF technique and a case-based reasoning. | Crops: Not mentioned. -Features: Temperature data, rainfall, solar radiation, wind speed, evaporation, relative humidity, and evapotranspiration | ANN and Case Based Reasoning (CBR) | The presented model has a remarkable performance and rational accuracy of prediction. | Only weather parameters were considered. | Precision: 90% Recall: 93% |

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