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# Crop Yield Prediction Using Machine Learning Models: Case of Irish Potato and Maize

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## Abstract

***In this project we are using machine learning and deep learning algorithms to predict future crop yield based on weather data such as temperature and rainfall. If farmers know the crop yield before sowing based on historical weather data, then he may take better decision. So, by employing machine/deep learning algorithms we can inform farmers about future crop yield. In proposed method we are using Irish Maize and Potato yield dataset to train all machine learning models and then these models can be used to predict future crop yield. In proposed method we are using random forest, SVR, DNN, CNN, ANN and LSTM. So, we have implemented all 6 algorithms on both datasets. To evaluate performance of each algorithm we are calculating MSE and R2 Score where MSE refers to mean square error (difference between TEST crop yield and predicted yield). R2 refers to correct prediction rate. So, for any algorithm MSE must be lower and R2 must be higher for better crop yield prediction.***

***Keywords: crop yield prediction, Mean square error, R2 value , RF, ANN, DNN LSTM.***

## INTRODUCTION

Agriculture, since its invention and inception, be the prime and pre-eminent activity of every culture and civilization throughout the history of mankind. It is not only an enormous aspect of the growing economy, but it's essential for us to survive. It's also a crucial sector for Indian economy and also human future.

It also contributes an outsized portion of employment. Because the time passes the requirement for production has been increased exponentially. So as to produce in mass quantity people are using technology in an exceedingly wrong way. New sorts of hybrid varieties are produced day by day.

However, these varieties don't provide the essential contents as naturally produced crop. These unnatural techniques spoil the soil. It all ends up in further environmental harm. Most of these unnatural techniques are wont to avoid losses. But when the producers of the crops know the accurate information on the crop yield it minimizes the loss. Machine learning, a fast-growing approach that's spreading out and helping every sector in making viable decisions to create the foremost of its applications.

Most devices nowadays are facilitated by models being analysed before deployment. The main concept is to increase the throughput of the agriculture sector with the Machine Learning models. Another factor that also affects the prediction is the amount of knowledge that's being given within the training period, as the number of parameters was higher comparatively. The core emphasis would be on precision agriculture, where quality is ensured over undesirable environmental factors.

## LITERATURE REVIEW

**[1] S. S. Sannakki and V. S. Rajpurohit, proposed**

A "Classification of Pomegranate Diseases Based on Back Propagation Neural Network" which mainly works on the method of Segment the defected area and Color and texture are used as the features. Here they used neural network classifier for the classification. The main advantage is it Converts to L*a*b to extract chromaticity layers of the image and Categorisation is found to be 97.30% accurate. The main disadvantage is that it is used only for the limited crops.

**[2] P. R. Rothe and R. V. Kshirsagar introduced**

A" Cotton Leaf Disease Identification was using Pattern Recognition Techniques" which Uses snake segmentation; here Hu's moments are used as distinctive attribute. Active contour model used to limit the vitality inside the infection spot, BPNN classifier tackles the numerous class problems. The average classification is found to be 85.52%.

**[3] Aakanksha Rastogi, Ritika Arora and Shanu Sharma,"**

Leaf Disease Detection and Grading using Computer Vision Technology &Fuzzy Logic". K-means clustering used to segment the defected area; GLCM is used for the extraction of texture features, Fuzzy logic is used for disease grading. They used artificial neural network (ANN) as a classifier which mainly helps to check the severity of the diseased leaf.

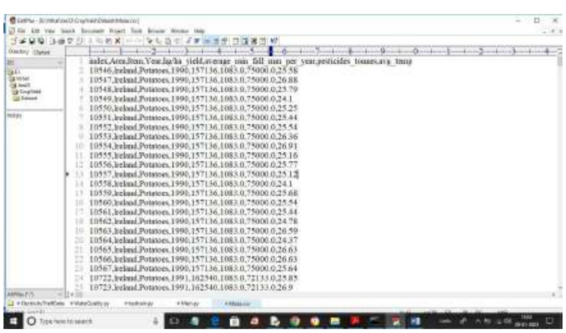
**[4] Godliver Owomugisha, John A.**

Quinn, Ernest Mwebaze and James Lwasa, proposed" Automated Vision-Based Diagnosis of Banana Bacterial Wilt Disease and Black Sigatoka Disease "Color histograms are extracted and transformed from RGB to HSV, RGB to L*a*b. Peak components are used to create max tree, five shape attributes are used and area under the curve analysis is used for classification.

They used nearest neighbours, Decision tree, random forest, extremely randomized tree, Naïve Bayes and SV classifier. In seven classifiers extremely, randomized trees yield a very high score, provide real time information provide flexibility to the application.

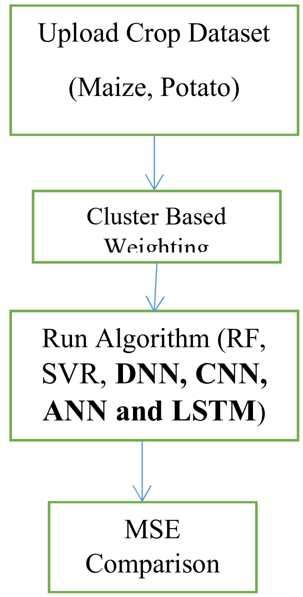
## PROPOSED METHOD

In propose paper author using Random Forest and SVR algorithm but you asked us to implement RF, SVR, DNN, CNN, ANN and LSTM so we have implemented all 5 algorithms on both datasets. To evaluate performance of each algorithm we are calculating MSE and R2 Score where MSE refers to mean square error (difference between TEST crop yield and predicted yield). R2 refers to correct prediction rate. So for any algorithm MSE must be lower and R2 must be higher,



### 3.1 Dataset

In above dataset screen first row contains dataset column names and remaining rows contains dataset values. We have coded this project using JUPYTER notebook and below are the output screens with code and below colour comments




## RESULT

In this paper author employing Random Forest and SVR algorithm to predict future crop yield based on weather data such as temperature and rainfall. If farmers know the crop yield before sowing based on historical weather data then he may take better decision. So by employing machine learning algorithms we can inform farmers about future crop yield. In propose paper author using Irish Maize and Potato yield dataset to train all machine learning models and then this models can be used to predict future crop yield.

In propose paper author using Random Forest and SVR algorithm but you asked us to implement SVR, DNN, CNN, ANN and LSTM so we have implemented all 5 algorithms on both datasets. To evaluate performance of each algorithm we are calculating MSE and R2 Score where MSE refers to mean square error (difference between TEST crop yield and predicted yield). R2 refers to correct prediction rate. So for any algorithm MSE must be lower and R2 must be higher.

In below screen we are showing dataset details used in this project

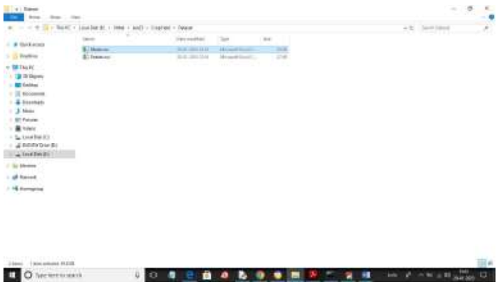


**Fig.5.1 Dataset folder**

In above dataset folder we have 2 folders called as Maize and Potato and just open those files to view below data

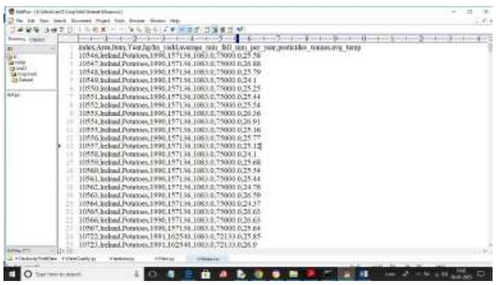


**Fig.5.2 dataset**

In above dataset screen first row contains dataset column names and remaining rows contains dataset values. We have coded this project using JUPYTER notebook and below are the output screens with code and below colour comments

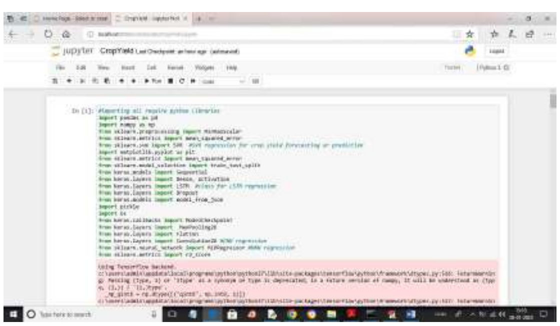


**Fig.5.3 Importing all require python packages**

In above screen we are importing all require python packages

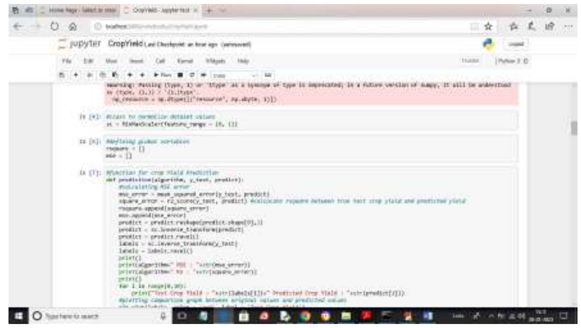


**Fig.5.4 defining MINMAX and defining MSE**

In above screen in first block defining MINMAX class to normalize dataset values and then defining MSE and square variables and then defining function predict and plot Crop Yield graph

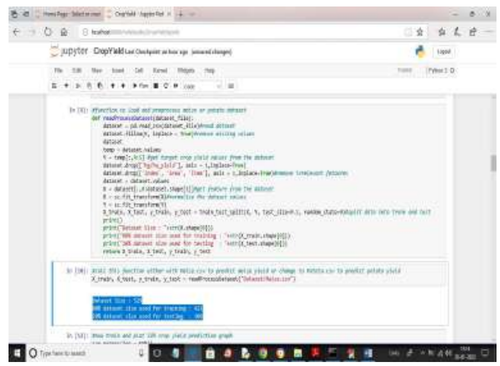


**Fig.5.5 Read dataset function**

In above screen we are calling Read dataset function to read and process dataset and then get train and test data and now using train and test data we will train and test performance of all algorithms and in blue colour we can see total dataset size and training and testing size

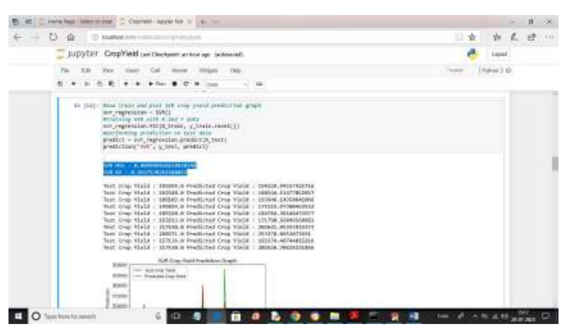


**Fig.5.6 training with SVR algorithm**

In above screen we are training with SVR algorithm and then in blue colour text  we can see SVR MSE and R2 values and then in next lines we can see TEST crop yield values and SVR predicted crop yield values and in below screen we can see Test yield and predicted yield graph

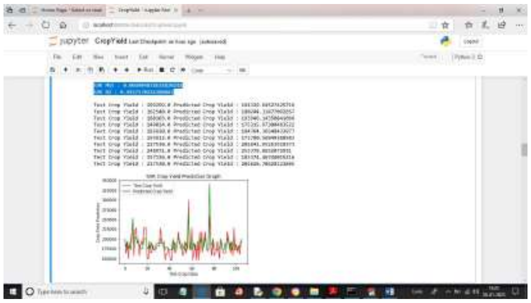


**Fig.5.7 Graphical representation**

In above screen x-axis represents number of test records and y-axis represents Yield values where red line represents TEST yield and green line represents predicted yield and in above graph we can see there lots of gap between red and green line so SVR prediction is not accurate

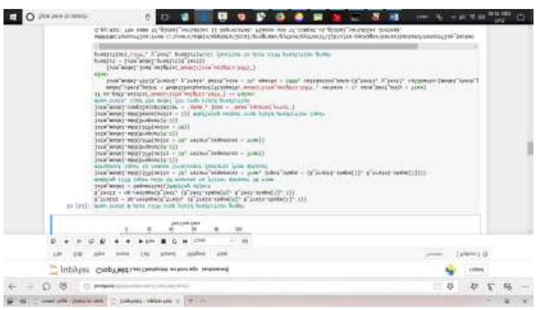


**Fig.5.8 defining and training with LSTM**

In above screen we are defining and training with LSTM and after executing above block will get below output

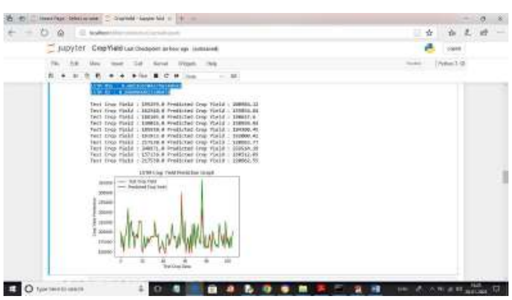


**Fig.5.9 LSTM MSE and R2 values**

In above screen in blue colour we can see LSTM MSE and R2 values and then in next lines we can see TEST crop yield and LSTM predicted crop yield and in LSTM graph we can see both green line and red is fully overlapping so LSTM prediction is accurate

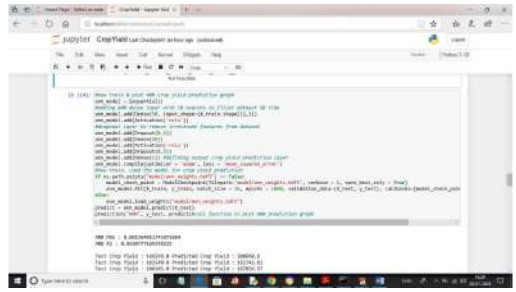


**Fig 5.10 training with ANN model**

In above screen we are training with ANN model and after executing above block will get below output

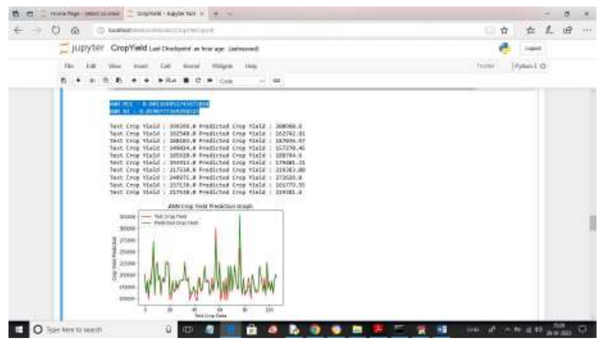


**Fig.5.11 ANN MSE and R2 values**

In above screen in blue colour text we can see ANN MSE and R2 values and then in next lines we can see TEST and predicted crop yield for ANN and then in ANN graph we can see both lines are fully overlapping so ANN prediction also accurate

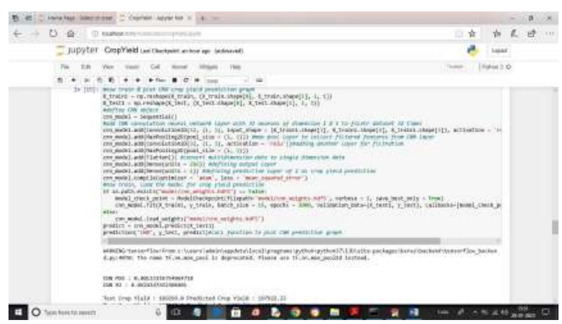


**Fig.5.12 training with CNN**

In above screen we are training with CNN and after executing above block will get below output

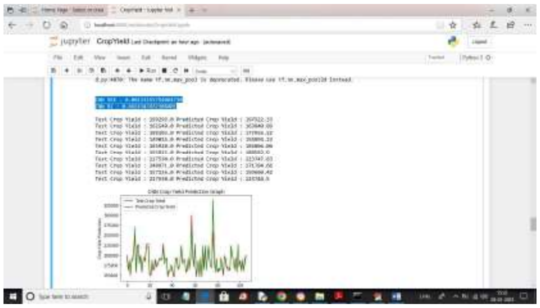


**Fig.5.13 CNN MSE and R2 values**

In above screen we can see CNN MSE and R2 values and then we can see TEST and predicted yield for CNN and then in graph we can see both lines are fully overlapping so CNN prediction is also accurate

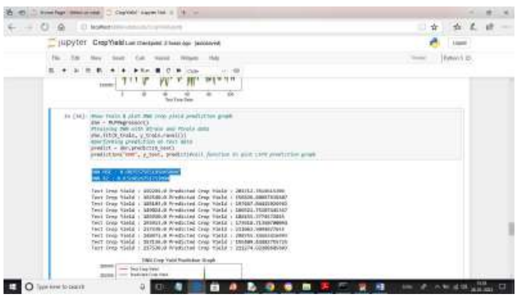


**Fig.5.14 training with DNN**

In above screen we are training with DNN and then we can see DNN MSE and R2 values and then we can see test and predicted crop yield for DNN

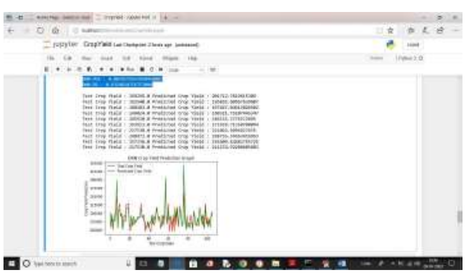


**Fig.5.15 DNN graph**

In above DNN graph there is little difference in red and green line as its contains some gap so DNN prediction is good but not accurate

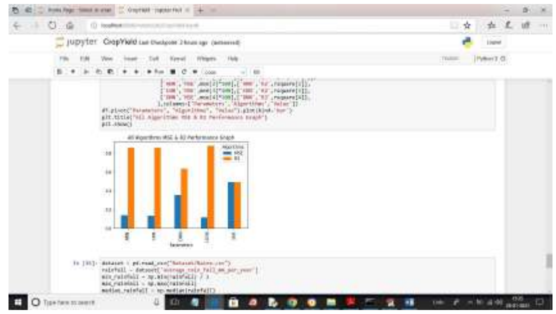


**Fig.5.16 graph representation**

In above graph blue bar represents MSE and orange bar represents R2 and x-axis represents algorithm names and y-axis represents values and in all algorithms we can see LSTM got high R2 and less MSE compare to all algorithms so we can say LSTM is good at crop yield prediction.

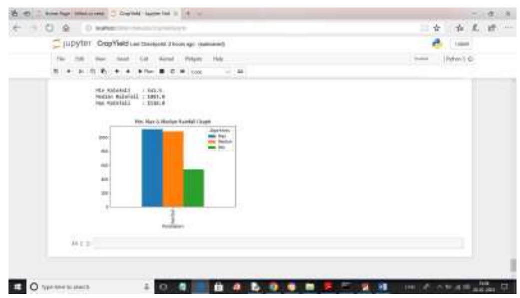


**Fig.5.17 plotting MIN, MAX and median**

In above graph we are plotting MIN, MAX and median rainfall graph found in the dataset

## CONCLUSION

The research on crop yield prediction using machine learning models holds promise for transforming agriculture. In this project we are using machine learning and deep learning algorithms to predict future crop yield based on weather data such as temperature and rainfall. In proposed method we are using Irish Maize and Potato yield dataset to train all machine learning models and then these models can be used to predict future crop yield. In proposed method we are using random forest, SVR, DNN, CNN, ANN and LSTM. So, we have implemented all 6 algorithms on both datasets. To evaluate performance of each algorithm we are calculating MSE and R2 Score where MSE refers to mean square error.

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