**CROP YIELD PREDICTION**

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Abstract

By considering various instances of climatological occurrences that have an impact on regional weather conditions around the planet. The agricultural output is directly impacted by these meteorological conditions. Several studies have investigated the relationships between widespread climatological occurrences and crop yield. synthetic neural. Networks have proven to be effective tools for modelling and prediction, enhancing their efficacy.

By sensing numerous soil and atmospheric parameters, crop prediction methodologies are utilised to forecast the most suited crop. soil type, PH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphur, manganese, copper, iron, depth, temperature, rainfall, and humidity are examples of parameters. Artificial neural networks are utilised for that purpose (ANN).

# Keywords: Artificial neural networks, PH, Nitrogen, Temperature, Rainfall.

# INTRODUCTION

One of the aims of agricultural production is to produce the most crops possible at the lowest possible cost. Early detection and control of problems related with crop yield indicators can help boost yield and consequent profit. Large-scale meteorological phenomena can significantly affect agricultural production by affecting local weather patterns.

There are several yield prediction models available today, and they can be broadly divided into two groups: Statistical models and crop simulation models, respectively (e.g. CERES). Artificial Neural Networks (ANNs), Fuzzy Systems, and Genetic Algorithms are examples of AI applications that have recently demonstrated increased efficacy in solving problems.

When applied, they can make complex natural systems with numerous inputs easier to model and more accurate. In this study, multiple agricultural yield prediction models employing ANNs have been attempted. If we create a network that accurately learns the relationships between the factors that have the greatest impact on agricultural yield, we may use it to predict crop production over the long or short term and obtain ANNs.

The feed forward back propagation artificial neural network is the most commonly used ANN. As an example, the technique has been used for modelling and crop yield forecasting based on a variety of predictor variables, including soil type, PH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphur, manganese, copper, iron, depth, temperature, rainfall, and humidity. Considerations have been given to ANN with zero, one, and two hidden layers. MSE calculations have been used to determine the ideal number of hidden layers and units in each hidden layer.

Literature Review:

Objectives:

Work done: In this study, crop prediction methodology is used to forecast the best crop by sensing various soil and atmospheric parameters. Artificial neural networks are used for that purpose (ANN). This study demonstrates how artificial neural networks can be used to approximate and forecast crop yields in rural areas.

Tools/Method/Algorithms used: The feed forward back propagation neural network is one of the most widely used neural network architectures, and it will be examined in this paper. Using supervised learning, the back propagation algorithm computes the error (difference between actual and expected results) after receiving examples of the inputs and outputs, the network will compute.

Authors : Miss.Snehal S.Dahikar , Dr.Sandeep V.Rode

Abstract: By considering various situations of climatologically phenomena affecting local weather conditions in various parts of the world. These weather conditions have a direct effect on crop yield. Various researches have been done exploring the connections between large-scale climatologically phenomena and crop yield. Artificial neural networks have been demonstrated to be powerful tools for modeling and prediction, to increase their effectiveness. Crop prediction methodology is used to predict the suitable crop by sensing various parameter of soil and also parameter related to atmosphere. Parameters like type of soil, PH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphur, manganese, copper, iron, depth, temperature, rainfall, humidity. For that purpose we are used artificial neural network (ANN).

Authors: Saeed Khaki , Lizhi Wang

Abstract: Crop yield is a highly complex trait determined by multiple factors such as genotype, environment, and their interactions. Accurate yield prediction requires fundamental understanding of the functional relationship between yield and these interactive factors, and to reveal such relationship requires both comprehensive datasets and powerful algorithms. In the 2018 Syngenta Crop Challenge, Syngenta released several large datasets that recorded the genotype and yield performances of 2,267 maize hybrids planted in 2,247 locations between 2008 and 2016 and asked participants to predict the yield performance in 2017. As one of the winning teams, we designed a deep neural network (DNN) approach that took advantage of state-of-the-art modeling and solution techniques. Our model was found to have a superior prediction accuracy, with a root-mean-square-error (RMSE) being 12% of the average yield and 50% of the standard deviation for the validation dataset using predicted weather data. With perfect weather data, the RMSE would be reduced to 11% of the average yield and 46% of the standard deviation. We also performed feature selection based on the trained DNN model, which successfully decreased the dimension of the input space without significant drop in the prediction accuracy. Our computational results suggested that this model significantly outperformed other popular methods such as Lasso, shallow neural networks (SNN), and regression tree (RT). The results also revealed that environmental factors had a greater effect on the crop yield than genotype.

Authors: [Niketa Gandhi](https://ieeexplore.ieee.org/author/37085885989); [Owaiz Petkar](https://ieeexplore.ieee.org/author/37085900558); [Leisa J. Armstrong](https://ieeexplore.ieee.org/author/37296818000)

Abstract : Rice crop production contributes to the food security of India, more than 40% to overall crop production. Its production is reliant on favorable climatic conditions. Variability from season to season is detrimental to the farmer's income and livelihoods. Improving the ability of farmers to predict crop productivity in under different climatic scenarios, can assist farmers and other stakeholders in making important decisions in terms of agronomy and crop choice. This study aimed to use neural networks to predict rice production yield and investigate the factors affecting the rice crop yield for various districts of Maharashtra state in India. Data were sourced from publicly available Indian Government's records for 27 districts of Maharashtra state, India. The parameters considered for the present study were precipitation, minimum temperature, average temperature, maximum temperature and reference crop evapotranspiration, area, production and yield for the Kharif season (June to November) for the years 1998 to 2002. The dataset was processed using WEKA tool. A Multilayer Perceptron Neural Network was developed. Cross validation method was used to validate the data. The results showed the accuracy of 97.5% with a sensitivity of 96.3 and specificity of 98.1. Further, mean absolute error, root mean squared error, relative absolute error and root relative squared error were calculated for the present study. The study dataset was also executed using Knowledge Flow of the WEKA tool. The performance of the classifier is visually summarized using ROC curve.

Authors: Patryk Hara, Magdalena Piekutowska, Gniewko Niedbala

Abstract: Knowing the expected crop yield in the current growing season provides valuable information for farmers, policy makers, and food processing plants. One of the main benefits of using reliable forecasting tools is generating more income from grown crops. Information on the amount of crop yielding before harvesting helps to guide the adoption of an appropriate strategy for managing agricultural products. The difficulty in creating forecasting models is related to the appropriate selection of independent variables. Their proper selection requires a perfect knowledge of the research object. The following article presents and discusses the most commonly used independent variables in agricultural crop yield prediction modeling based on artificial neural networks (ANNs). Particular attention is paid to environmental variables, such as climatic data, air temperature, total precipitation, insolation, and soil parameters. The possibility of using plant productivity indices and vegetation indices, which are valuable predictors obtained due to the application of remote sensing techniques, are analyzed in detail. The paper emphasizes that the increasingly common use of remote sensing and photogrammetric tools enables the development of precision agriculture. In addition, some limitations in the application of certain input variables are specified, as well as further possibilities for the development of non-linear modeling, using artificial neural networks as a tool supporting the practical use of and improvement in precision farming techniques

## PROBLEM FORMULATION

### Modelling of the problem - Agro meteorologists have long found the prediction of crop yield, particularly for strategic plants like wheat, corn, and rice, to be an interesting research topic because it is crucial for both national and international economic planning. Aside from its relationship to the genetics of the cultivator, adaphic conditions, the impact of pests and pathogens, weeds, and other factors, the management and control of quality during the growing season, among other things, heavily depend on climatic events. Therefore, it is not impossible to develop relationships or systems that use meteorological data to make predictions with greater accuracy. There are many yield prediction models available today, and they can be broadly divided into two groups: statistical models and crop simulation models (e.g. CERES).

Calculating the derivative of the squared error function with respect to the weights of the network. The squared error function is:

E= 1/2(t-y)^2

E=square error,

t= target output,

y=actual output of output neuron,

This lays the groundwork for calculating the partial derivative of the error with respect to a weight wi using the chain rule:

Assumptions: It would be quite permissible to create a neural network that uses the feed forward algorithm to determine its output and does not use the back propagation training algorithm. Similarly, if you choose to create a neural network that uses back propagation training methods, you are not necessarily limited to a feed forward algorithm to determine the output of the neural network. Though such cases are less common than the feed forward back propagation neural network.

## METHODOLOGY

### Design: We trained two deep neural networks, one for yield and the other for check yield, and then used the difference of their outputs as the prediction for yield difference. These models are illustrated in [Figure](https://www.frontiersin.org/articles/10.3389/fpls.2019.00621/full#F3)Diagram Description automatically generated

Analysis: To ensure fair comparisons, two sets of these three models were built to predict yield and check yield separately, and the differences of their outputs were used as the prediction for the yield difference. All of these models were implemented in Python in the most efficient manner that we were capable of and tested under the same software and hardware environments to ensure fair comparisons.

## RESULTS

## Using extensive datasets of corn hybrids, we presented a machine learning strategy for crop yield prediction that outperformed Crop Challenge. Based on genotype and environmental data, the method used deep neural networks to predict yield (including yield, check yield, and yield difference). Using historical data, the meticulously crafted deep neural networks were able to infer nonlinear and complicated relationships between genes, environmental factors, and their interactions and estimate yields for new hybrids planted in unfamiliar sites with known weather conditions quite accurately. The model's performance was discovered to be rather sensitive to the accuracy of the weather forecast, which indicated the significance of weather prediction methods.

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