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ARTIFICIAL NEURAL NETWORK FOR PREDICTING RICE YIELD IN CHHATTISGARH

Mohammed Arif Khan, Research Scholar, ISBM University, Nawapara (Kosmi), Block & Tehsil- Chhura, Gariyaband, Chhattisgarh- 493996, India.
Sunil K Sahu, Research Scholar, ISBM University, Nawapara (Kosmi), Block & Tehsil- Chhura, Gariyaband, Chhattisgarh- 493996, India.
Dr Abha Mahalwar, Assistant Professor, ISBM University, Nawapara (Kosmi), Block & Tehsil- Chhura, Gariyaband, Chhattisgarh- 493996, India.
N. K. Swamy, Associate Professor**,** ISBM University, Nawapara (Kosmi), Block & Tehsil- Chhura, Gariyaband, Chhattisgarh- 493996, India.

Abstract
Crop yield prediction is very important for precision agriculture. It depends on many factors such as the weather and soil properties. In this study, Artificial neural network for predicting rice yield in Bemetara district of Chhattisgarh, India has been analyzed using tools Feed forward back propagation and layer recurrent network. Input parameter like temperature, humidity, wind speed, and rainfall. The Output parameter was paddy crop production data from 2012-2017. The Mean absolute percentage error was found in Feed forward back propagation algorithm was 5.86 and Layer recurrent network was 3.03 for Kharif Season. MAPE for Ravi Season for model feedforward back propagation was 5.43 and layer recurrent was 5.38.

Keywords: Temperature, rainfall, artificial neural network, prediction and crop yield.

I. Introduction

Every farmer in India is very interested in knowing the exact yield of their crop. Weather conditions and farm productivity are some of the factors that influence the production of crop. Climate change prediction will help the farmers in cultivating crops. It will also help them avoid experiencing food shortages due to unfavorable weather conditions. The objective of crop yield prediction is to provide a more accurate and challenging analysis of the various factors that affect the productivity of a crop. It is a vital factor that can help predict the profitability of a crop. The evolution of many prediction models helps improve their effectiveness. This paper presents the various techniques used for achieving the yield prediction. With an employment potential of 50%, agriculture is one of the largest sectors in the Indian economy. Its continuous growth is being influenced by various factors such as climate, biological factors, and seasonal factors [1]. Crop yield prediction is very important for food production and maintenance globally. It can help governments and farmers make informed decisions regarding farm inputs and outputs (Tiwari & Shukla, 2018). Machine learning techniques are being used to predict crop yield. These models consider the inputs and the output to identify the mapping function between them. An artificial neural network is a good function approximation algorithm that can perform better in approximation of the unknown mapping function between a crop yield and various input factors or inputs [2]. The main objective of this paper is to provide a reliable and appropriate neural network model that can provide valuable insights to the farmer about the production of crops. Through this study, we aim to develop a strategy that will allow various stakeholder groups to predict the production of crops in advance. This method will take into account many different factors that will affect the crops' profitability. The goal of this project is to implement a neural network model that is more prone to errors than other machine learning algorithms [3].

The purpose of the study was to developed artificial neural network for predicting the rice crop yield in Bemetara district of Chhattisgarh, India. In this study there were two methods are analyzed that is feed forward back propagation and Layer Recurrent network for both the Seasons Kharif and Ravi.

II. Literature

The crop yield prediction helps the farmers to know about the expected yield of their chosen crop. It also helps them in avoiding unfavorable weather conditions. The objective of this study is to predict the crop yield using the suitable crop parameters such as temperature, humidity, and wind speed. The outputs of the experiments were analyzed using a feed forward neural network and Layer recurrent neural network[4]. Rice crop production is a vital aspect of India's food security. The production of rice depends on the ideal seasonal climate conditions. Developing effective techniques to predict the productivity of crop can help farmers make informed decisions. This study analyzed the rice crop yield prediction using Bayesian Networks in 27 districts of India. The data were selected based on the selected crop and climate parameters. The data was collected using the WEKA tool. The two main classifiers were used for the study. The results indicated that Bayes Net performed better than NaiveBayesn [5].

Crop yield prediction is a vital aspect of precision agriculture. It involves estimating the expected production of a crop based on various factors such as the weather and soil properties. The RNN model was formulated to forecast the rice crop yield in the Karnataka State for the years 2015 to 2017. It performed well with a mean absolute-error of 0.02187 tons per hectare Various studies have been performed in an attempt to study the link between crop yield and weather conditions in different parts of the world. The findings have revealed the importance of climate data for crop production. Crop prediction is done by monitoring various parameter of soil and atmosphere. Some of these include soil pH, nitrogen, phosphorus, potassium, manganese, and iron [6].

This paper talks about the use of a neural network model to improve crop yield prediction. It can help predict the productivity under different climatic conditions. The neural network can be used to predict the production of rice crops in different areas of Maharashtra State India. It can also investigate factors that affect the production of rice crops in these regions. The data was processed using WEKA tool. The author used Artificial Neural Networks to forecast the rice crop yields in India (PES Institute of Technology (Bangalore et al., n.d.).This paper discussed the various aspects of artificial intelligence models for crop yield prediction. While machine learning methods are commonly used for farm produce prediction, the availability of tools that allow farmers to generate and interpret outputs from remote sensing is still not widely available. The researchers were able to extract the field variability steps to improve the level of crop yield. This method is commonly used for smart farming techniques. The main issue with UAVs is that they need to be operated locally. Doing so usually requires special skills and equipment to extract useful data. There are various tasks that can be done depending on the characteristics of a given crop. For instance, identifying the ideal size of a field can be done by analyzing data collected from different sources [3].

III. Materials and Method

3.1 Artificial neural network

Artificial neural networks are often referred to as systems that are inspired by the brain's central nervous system. Like other machine learning techniques, neural networks can be used to solve a wide range of tasks that require special programming. The term artificial neural network refers to the inter-connected connections between the outputs and input neurons of a system. For an example, a system has three layers. The first layer is the input neurons, the second layer is the output neurons, and the third layer is the output neurons. Complex systems have more layers of neurons with outputs and input neurons. The outputs and input neurons have increased levels of complexity. An artificial neural network is a type of network that sees the nodes as artificial neurons. It uses a back propagation algorithm to send and receive signals. The network receives inputs from the input layer and outputs from the output layer. There may be a hidden layer that controls the output.

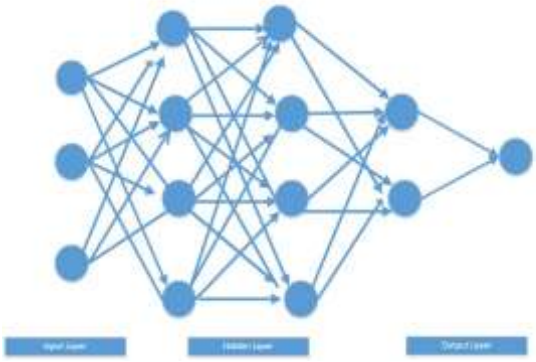

Figure 1 General architecture of artificial neural network

3.2 Feed forward back propagation algorithm

The concept of feed forward neural network is that it processes and recalls patterns. It has multiple connections to each other. Back propagation is a type of supervised training. This procedure involves providing both sample inputs and anticipated outputs to a network. The back propagation training algorithm calculates an error and adjusts the weights of various layers backward from the output to the input layer. Although the feed forward and back propagation algorithms are often used together, it is not necessary to create a neural network that uses both of them. Instead, it can be created that uses one or both of them to determine its output. The goal of the back propagation algorithm is to minimize the error when the network is computed. This method works by providing the algorithm with examples of the inputs and outputs that the network needs to perform its operation. The feed forward and back propagation algorithms are often used together to create a neural network. However, it is not necessary to use these two algorithms to create a network that uses both feeds forward and back propagation techniques. The goal of the back propagation algorithm is not to provide an error-free result, but to minimize it. This is because supervised learning is used to learn the inputs and outputs of the network.

3.3 Layer recurrent network

A layer recurrent neural network is a type of neural network where the outputs from the previous step are fed as inputs to the current step. In this method, the outputs are independent from each other. The concept of Layer Recurrent Neural Network was solved with the help of a hidden layer. This feature helps keep track of the sequence of events in the network. Recurrent Neural Network have a memory that retains all the details about the calculation. It performs the same task with all the inputs and hidden layers. Recurrent Neural Network is capable of remembering all the details of a given time period. It does so by remembering all the previous inputs. It is also useful for predicting future events. This topic is about training an RNN. It is very challenging to train a machine that has many functions. In this study two method was used that is feed forward back propagation and layer recurrent network with the training algorithm and are used and two ANN model was developed for rice crop yield prediction using ANN in MATLAB. The ANN model1 was used for Kharif season and ANN model 2 used for Ravi Seasons. In ANN model 1 the artificial neural network method was training with the Bayesian Regularization and ANN model 2 was training with the scale conjugate gradient.

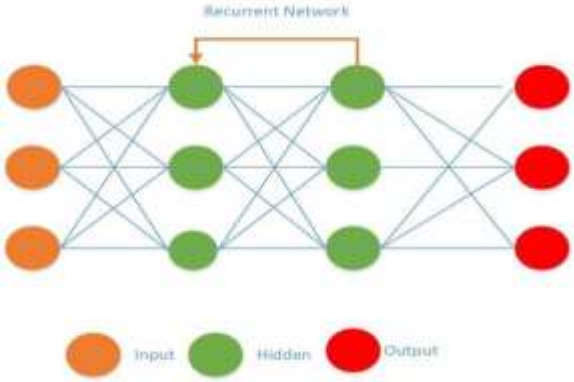

Figure 2 Layer recurrent network

IV. Result and discussion

In ANN model the performance of the rice crop yield prediction model was mean absolute percentage error (MAPE). In figure-01 show the feed forward back propagation algorithm best training performances is just 5.8382e-09 at epoch 1000, the mean square error of the training state this show the accuracy of the model. In figure-02 show the regression model for feed forward back propagation algorithm. The deviation of the plot of the R value is equal to 1 which is the best regression plot. In figure-03 shows the best training of performance of the Layer recurrent network who's the mean square error of the model is close to 0.000896. Which is close to zero the mean square error whose value is zero is close to actual value. The figure-04 shows the actual data and predicted data for the feed forward back propagation algorithm in the graph clearly shows the predicted value same trend as the actual value. In the figure-05 shows the Layer recurrent network for the plot between actual and predicted data. In this method the actual and the predicted value almost same in every cases. The mean absolute percentage error of the feed forward back propagation was 5.34%. Which is shown in figure-06 in maximum cases the MAPE is close to Zero which show the performances of the model. In figure- 07 show the Layer recurrent network mean absolute percentage error was 3.03 % only. Hence in the ANN model-1 the result show that the Layer recurrent network trained with the Bayesian Regularization was acceptable.

In ANN model 2 developed for the Ravi season rice crop yield prediction using feed forward back propagation and Layer Recurrent network. In the feed forward back propagation algorithm the regression deviation is little curved in the training state the value of R was 0.55989.

The mean absolute percentage error of feed forward back propagation algorithm was 5.43 and Layer Recurrent network was 5.38. in ANN model 2 the MAPE was not good as compare to ANN model 1.

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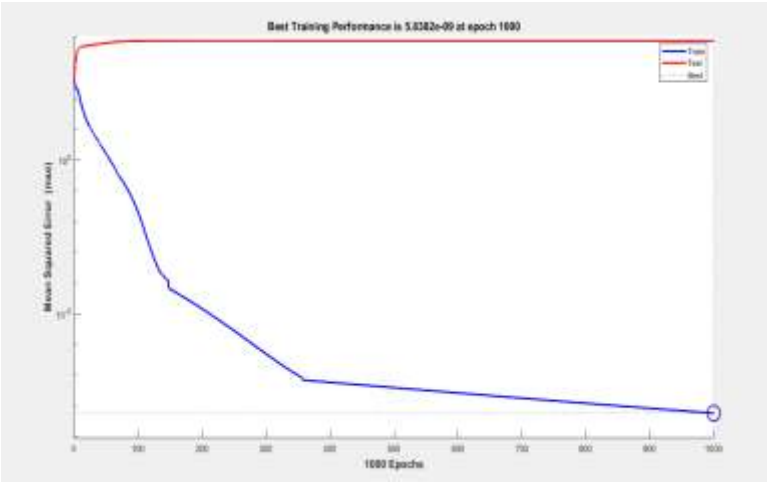

Figure 3 Feed forward back propagation best training performances

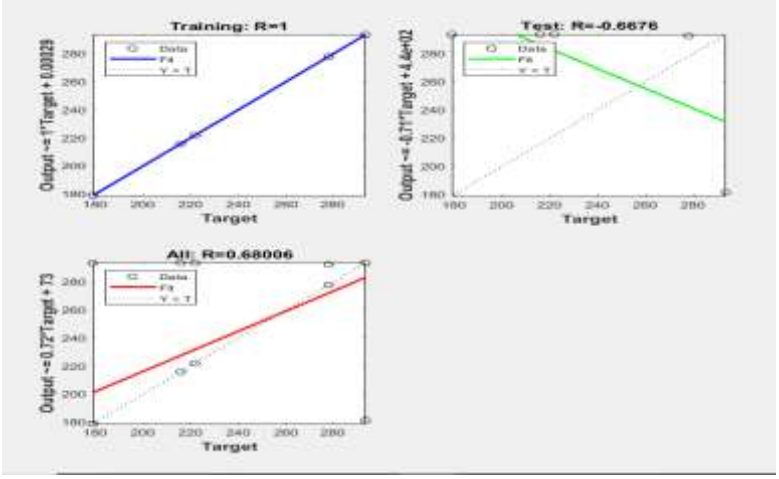

Figure 4 Regression model for Feed forward back propagation algorithm

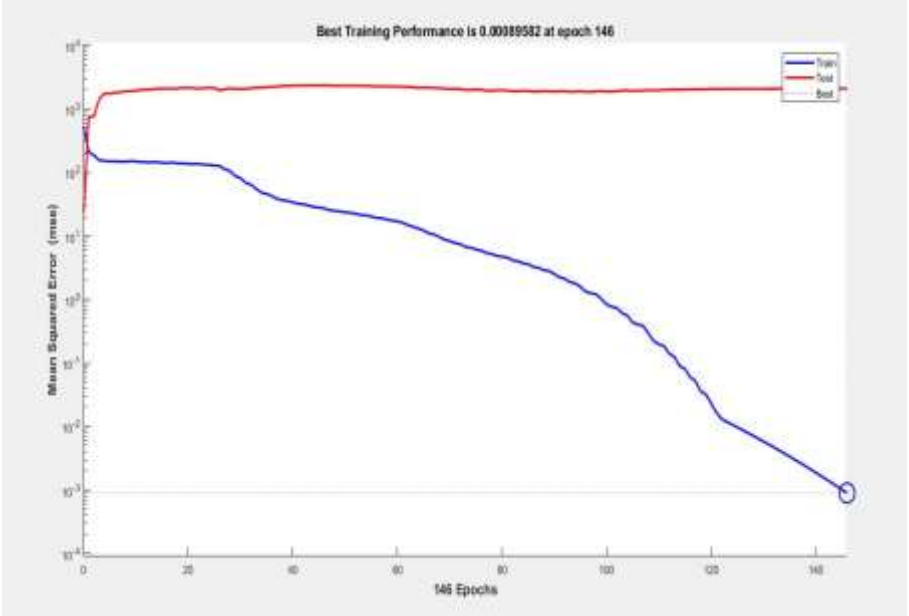

Figure 5 Layer recurrent network best training performances

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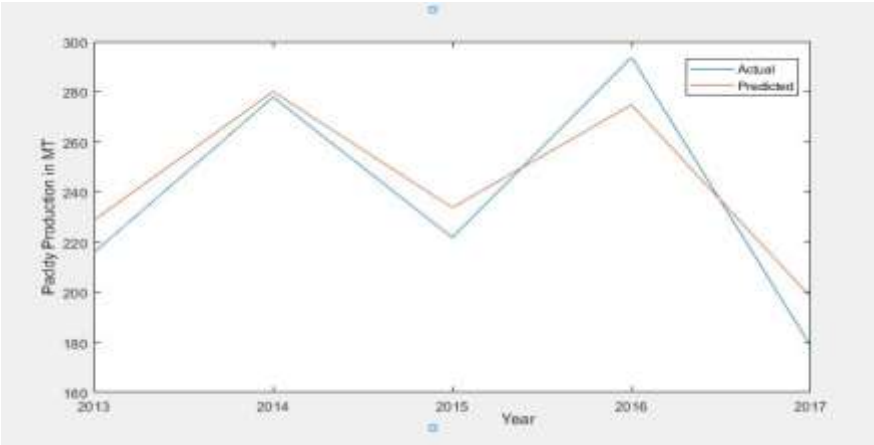

Figure 6 Comparison between actual and predicted production for feed forward back propagation algorithm

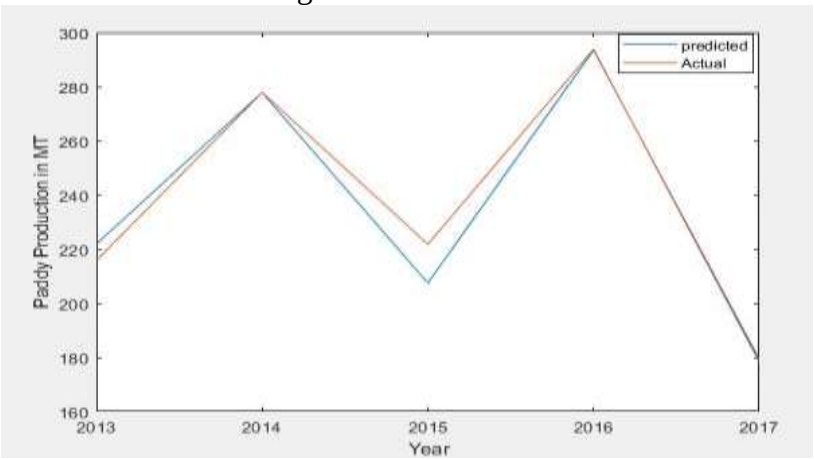

Figure 7 Comparison between actual and predicted in Layer recurrent network

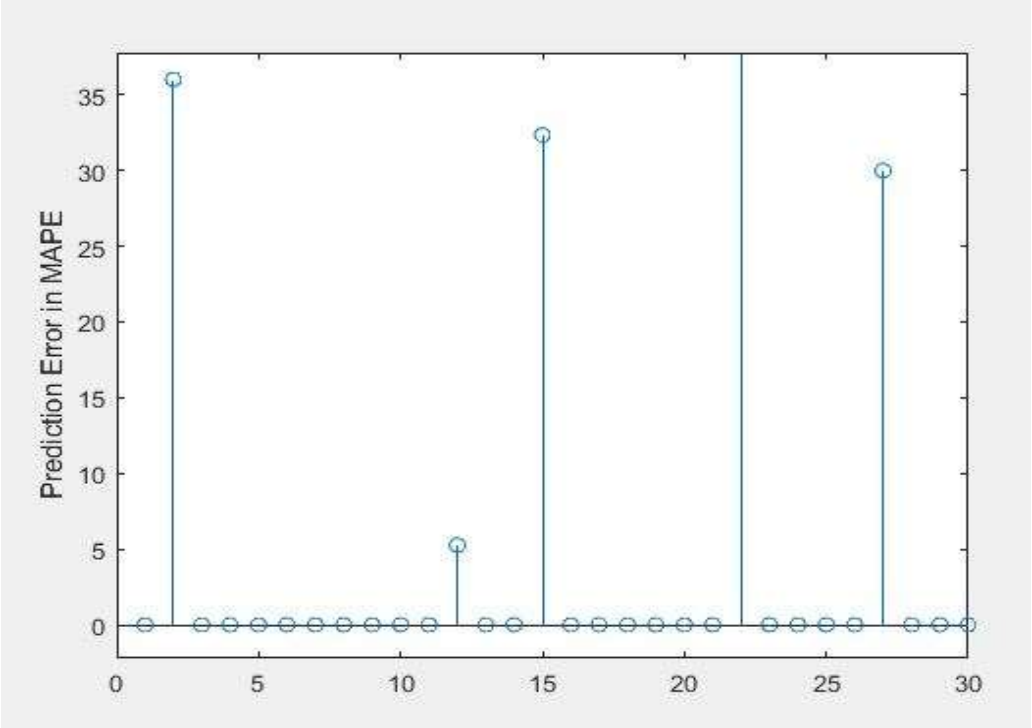

Figure 8 Prediction error in MAPE for feed forward back propagation algorithm

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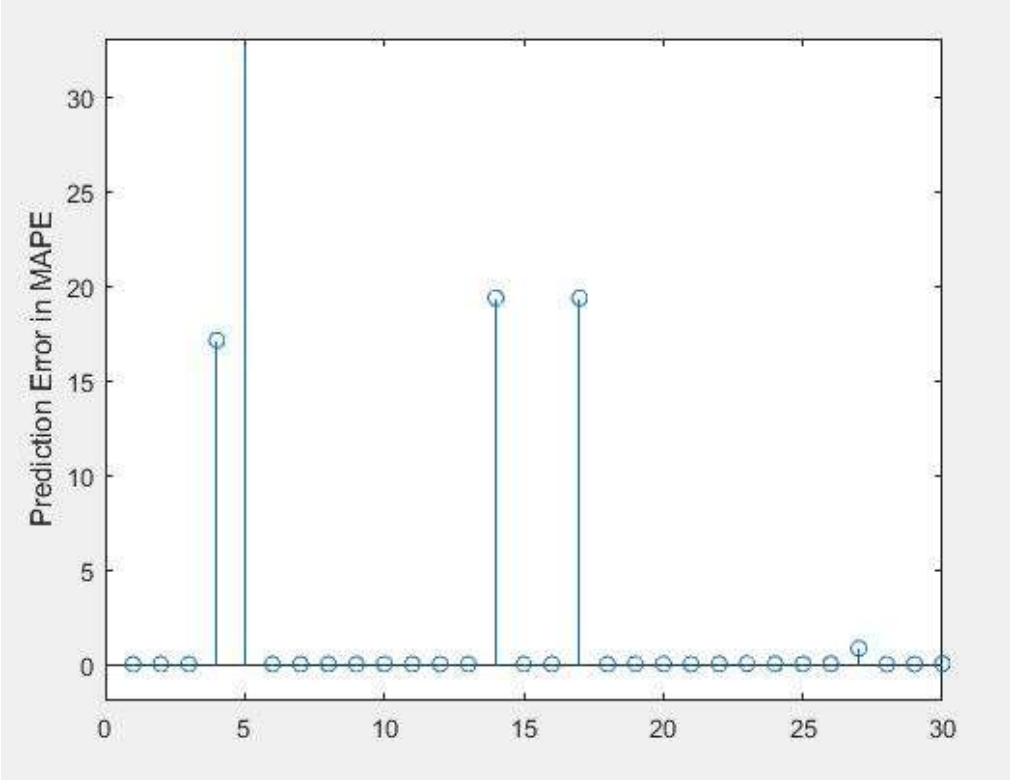

Figure 9 Prediction error in MAPE for layer recurrent network

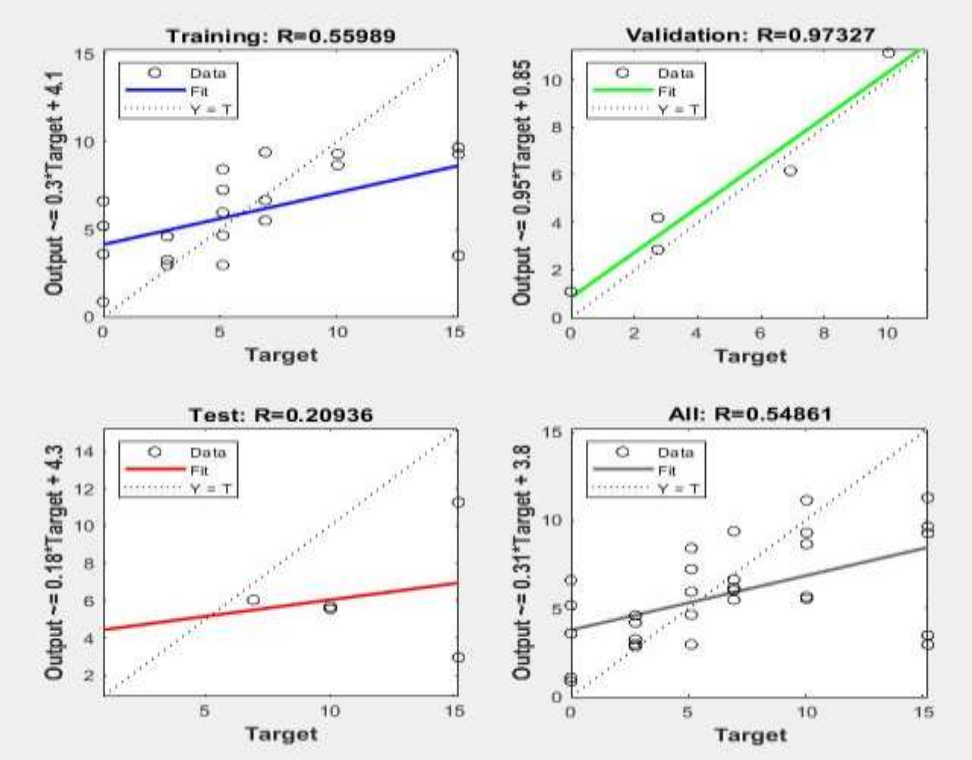

Figure 10 Regression model on FFBA for ravi season

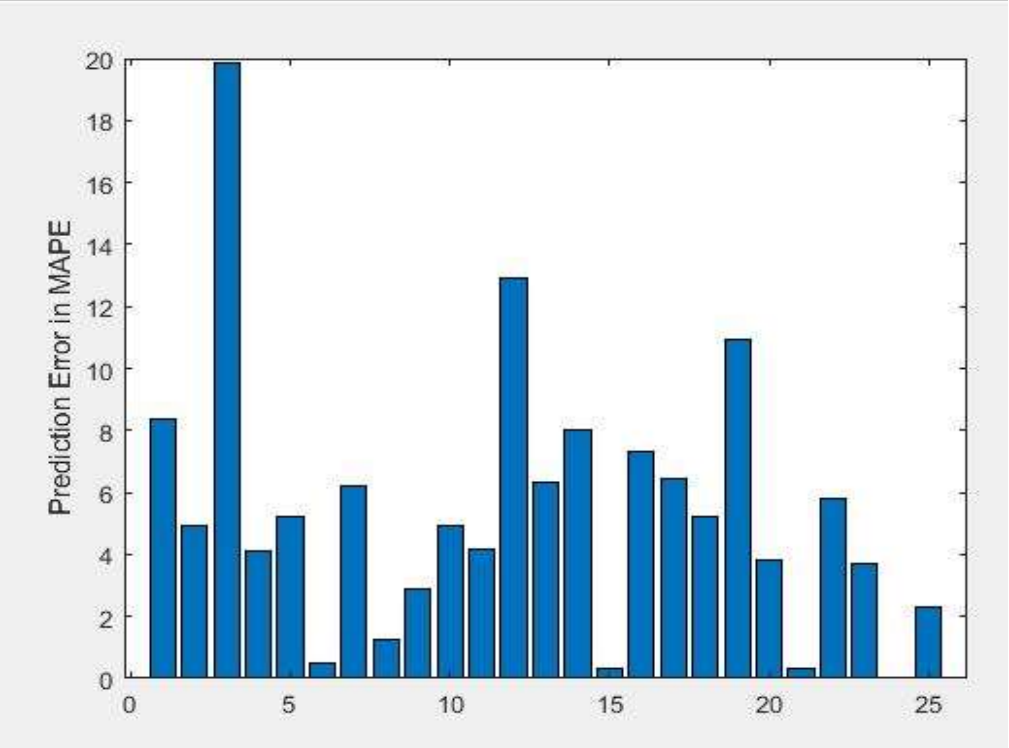

Figure 11 Prediction error in MAPE for FFBA for ravi season

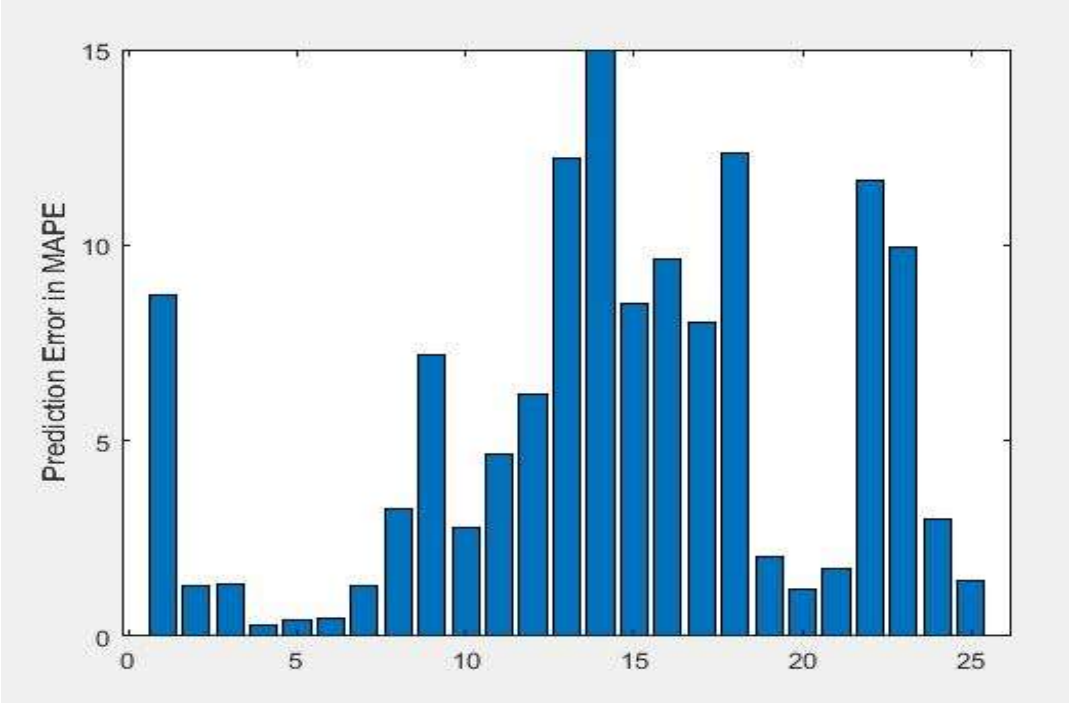

Figure 12 Prediction error in MAPE in LRN for ravi season

V. Conclusion

In this study the artificial neural network model were used for rice crop yield prediction in Bemetara district in the state of Chhattisgarh, India. There are two model was developed that is ANN model 1 for Kharif Seasons and ANN model 2 for Ravi Seasons. The method were used are Feed forward back propagation and Layer recurrent network in MATLAB under the NNTOOL. The result for ANN model 1and ANN model 2 was Feed forward back propagation with Bayesian Regularization algorithm was

an shown good accuracy. In terms of Mean absolute percentage error the 3.03 percentage in Layer Recurrent Network in Model 1.

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