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Artificial Neural Network Based Solution for Crop Prediction

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Abstract:

This proposed work is to develop a solution to guide the farmers using Artificial Neural Network for crop production. With considerations of various situations of climatology, the local weather conditions affect the various parts of the crop yield. This is based on Artificial Neural Network which is demonstrated to be powerful tools for modeling and prediction. The most common method of feed forward back propagation is used. This method is used to predict the suitable crop by sensing various parameters of soil and various parameters of atmosphere. The parameters are pH, temperature, rainfall, nitrogen, phosphate, potassium. The Artificial Neural Network paradigm is also used to suggest suitable fertilizer for crop production.

Keywords **—Artificial Neural Network (ANN), Feed Forward Back Propagation Method, Crop prediction.**

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I. INTRODUCTION

Most of the business in India is based the farming which is the prominent occupation in the country; it is the backbone of the country's economy.

Farming is a main occupation in India, about 70% of primary and secondary business is based on farming and it is also the backbone of our Indian economy. For the furtherance of farming, Indian government provides subsidies for fertilizers to the farmers. But, due to unawareness of the farmers they are not exposed to the use the proper amount of fertilizers for their land that would result as the infertile land. Regarding this the government provides basic education to farmers on how to keep our land and crops healthy.

A requirement of intelligent system has brought artificial neural network (ANN) to become a novel technology which provide innovative solutions for the complex problems in agriculture researches. Since it can solve many problems that linear system is incapable to resolve, ANN becomes vital especially in innovating and developing better yields for society. Though there are many types of ANN, this paper presents the most commonly used type of ANN, which is the feed forward back propagation network. This proposed work presents the elementary principle of ANN architecture, application of ANN in predicting crop yield by using various types of crop performance factors as the input parameters, guidelines for selecting ANN method and future development and current trends in the application of ANN to predict yield. Using ANN, predicting the proper crop for particular soil and also suggesting proper fertilizer for that crop is shown.

Many agriculturalists trust on their long-terms experiences in the field on particular crops to expect a higher yield in the next harvesting epoch. Two important stages to predict crop performance; first was by using traditional approach of mathematical models and the second was on the

application of artificial intelligent for the prediction of crop response.

a.

II. METHODOLOGY

Artificial neural networks are designed after the learning functions of the human brain so it can recognize patterns and predict. ANNs are formed from simulated neurons that are analogous to functions of the human brain for numerous reasons. In the brain, a neuron sends out an electrical signal through a strand known as an axon, which splits into many branches [1]. At the end of each branch, there is an area called a synapse. An ANN is similar to the functioning of the brain because there are weighted connections (correspond to synapses) between simulated neurons where signals it receives (numbers) are summed and then (with most neuron models) a signal is sent (fired) if a certain threshold is reached. There are different neural network designs whereby information is processed in different manners. The most used type of ANN today is nonlinear feed forward and by far the most popular feed forward type is back propagation [1].

A. Feed Forward Back Propagation Method

In this proposed work, we shall examine one of the most common neural network architectures, the feed forward back propagation neural network. This neural network architecture is very prevalent, because it can be applied to many different tasks. The first term, 'feed forward' designates how this neural network processes and recalls Patterns [2]. The term 'back propagation' pronounces how this type of neural network is trained. Back propagation is a form of supervised training.

B. Steps Involved In Training

1) Data Collection

The all data related to crop production based on plant nutrients and other parameter is collected from agricultural colleges.

2) Build The Prediction Model

a. Find out the optimal configuration of neural network by combining many different ANN prototypes.

b. The number of hidden layers and training parameters were obtained by trial and error method.

c. Initialization of network weights and parameters by adjusting the momentum.

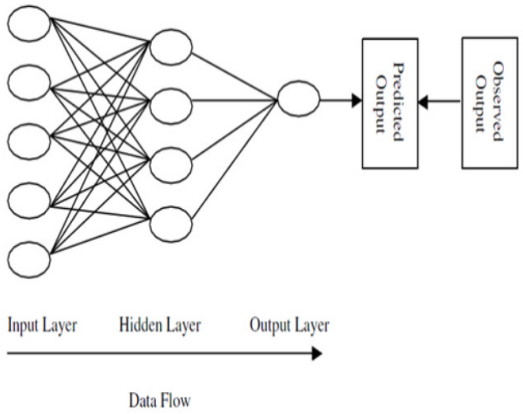

Fig. 1Feed forward back propagating ANN

3) Prediction of Crop

On the basis of training parameter, we train the ANN the parameters like pH, N, P, K, rainfall, temperature are given to predict the crop using Artificial Neural Network [3].

CROP	pH (gram mole/ liter)	N (milligram, kilogram)	P (parts per million)	K (mole per liter)	DEPTH (centimeter, millimeter)	TEMP (degree Celsius)	RAINFALL (millimeter per hour)
Cotton	7.0-8.5	100	50	50	30	27-33	700-1200
Jowar	6.0-8.5	80	40	40	20-50	25-30	800-1000
Bajra	7.0-8.5	40	20	25	15	28-32	400-750
Soya beans	6.5-7.5	30	75	15	15-20	25-33	700-1000
Parley	7.5-8.5	100	25	0	20-50	13-30	500-600
Rice	6.0-8.5	100	50	50	15-20	16-22	25-180
Wheat	5.5-8.5	100	50	50	20-50	22-25	1000-1500
Groundnut	6.0-7.5	25	50	30	20	24-27	500-1250
Sugarcane	6.5-7.5	175	100	100	60	20-50	750-1200

Fig. 2 Essential parameters of crops

Following parameters we used for creating feed-forward back propagation network.
No. of input layers = 7
No. of output layers = 1
No. of hidden layers = 50 Transfer function used = {tansig,tansig}
Training Algorithm = trainlm (Back Propogation Algorithm)
learning = 'learngdm'; Iterations = 1200

4) Suggestion Of Fertilizer

In some cases, when an user doesn't want to grow predicted crop in his field and wants some other crop to cultivate from his field, then there are some suggestions for the fertilizer to fulfill his constrains. Fertilizer is suggested according to the values of N, P and K and its values are comparing with predicted crop. If values of N, P and K are high then no fertilizers [4] suggested and values are low then suggested fertilizer as follows,

If "N" is less then Urea [CO(NH2)], Ammonium sulphate [(NH4)2SO4], Ammonium nitrate (NH4NO3), and Sodium nitrate (NaNO3) [5].

If "P" is less then Calcium hydrogen phosphate or superphosphate [Ca (H2PO4)2], Ammonium hydrogen phosphate or amorphous [(NH4)H2PO4], and Ammonium phosphate [(NH4)3PO4].

III. DESCRIPTION

In this paper, MATLAB is used to build the ANN prediction model.

Crop is predicted by ANN by entering various parameters. If we enter the parameters pH, N, P, K, Temp, depth, rainfall, then predicted crop by ANN will be displayed and also shows its standard value.

Window That Shows The Suggested Fertilizers

When an user doesn't want to grow predicted crop in his field and wants some other crop to cultivate from his field, fertilizer is suggested according to the values of N, P and K and its values are comparing with predicted crop [4].

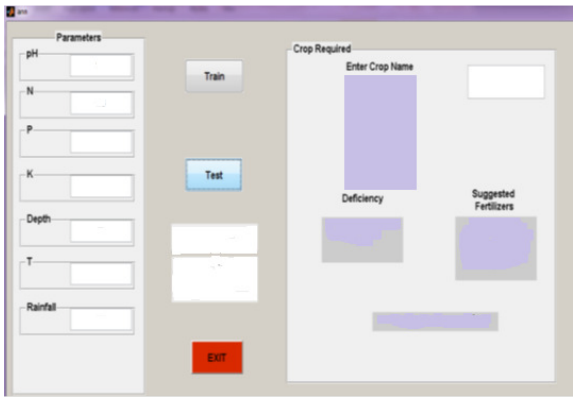

Fig. 3 Window that shows the suggested fertilizers

5) Training Window

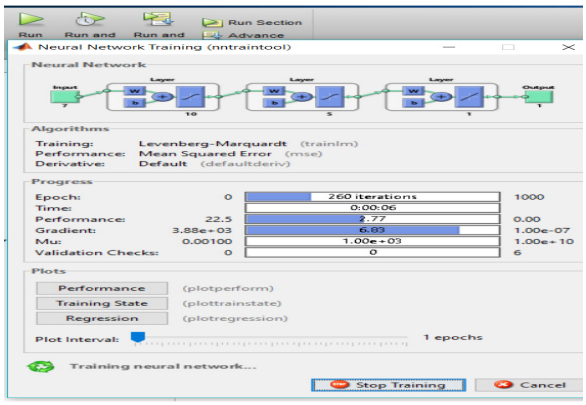

Fig. 4 Training window

An optimization problem activates with a set of independent variables and often includes conditions or restrictions that define satisfactory values of the variables. Such type of restrictions are called restraints. The necessary component is the objective function, which depends in some way on the variables. The solution of an optimization problem is a set of permissible values of the variables for which the objective function adopts an optimal value. In mathematical terms, optimization usually encompasses maximizing or minimizing.

IV. RESULT

For the parameters entered as pH=6.8, N=100, P=50, K=50, Temp=20, depth=18, rainfall=150, the output received is 'Recommended Crop is Corn'.

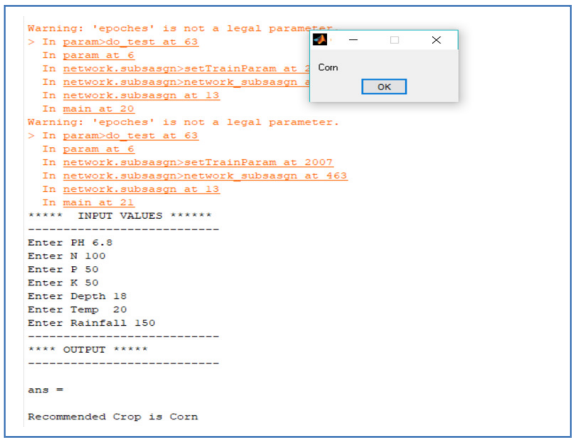

Fig. 5. Output window

V. CONCLUSION

The system gives the result as given by ANN test and the result is satisfactory. Based on MATLAB software, it is concluded that by using Artificial Neural Network, a crop is predicted based on various parameters. By calculating deficiency of N, P and K suggest the fertilizer. This system is useful for farmers who are economically weak and can't afford the lab soil test. Furthermore, the model will be operationalized and made available to appropriate stakeholders and decision makers such as commercial and small-scale farmers and the Department of Agriculture.

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