

## ANN Based Agricultural Crop Predictor

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Received September 2018; accepted December 2018

*ABSTRACT. Agriculture is one of the most important stream based on which a country's economy is decided. But fortunately today we see that the sector of agriculture is gradually coming down due to various factors. One of the drastic factor is that the "Crop Loss". In many cases the crop loss is due to the illiteracy of the farmers. Hence to resolve this problem, a system has been proposed which guides the farmers to understand the status of the land and to make them aware of the crops that could benefit them. This proposed system uses the Artificial Neural Network, which is one of the most effective tool in modelling and prediction. There are various parameters that decide the crop productivity. Hence these parameters should be taken as the input for the proposed system and based on the manipulation with theses inputs, the desired output must be produced. The parameters include pH, phosphate, potassium, nitrogen, depth, temperature, rainfall. Also the proposed system suggests some fertilizers that could improve the productivity. Since the system developed should be portable and easy to be used by a common man, the system is developed as an Android Application, which could be installed in a Smart Phone and could be easily checked out.*

**Keywords:** Artificial Neural Network, Feed Forward Back Propagation, Android Application, Eclipse IDE.

**1. Introduction.** India is an Agricultural Nation. Almost majority of the Indians traditional occupation is agriculture. Many of them worship their land as the god. It is one of the prominent factor that decides the economy of our country. Government is also facilitating farmers with many features such as subsidy in fertilizers, cancellation of their interest for loans etc. But today the farmers are adversely affected by the crop loss.

Now a days there are variety of reason for the crop loss. One of the most important factor is that there is no proper literacy for farmers about the crops, fertilizers and productivity. Also due these factors, the crop loss has increased and hence the famer's suicide has increased and the employment status in Agriculture field has gradually

decreased. The following diagram shows the drop in employment sector in the agricultural field.

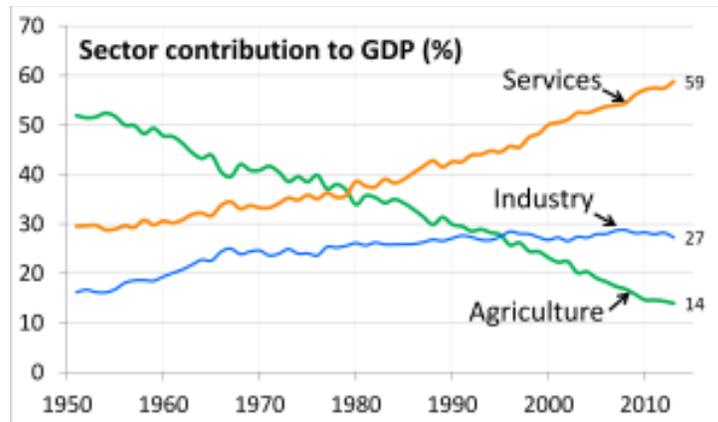


Figure 1. Graph showing the drop in agricultural sector

Hence to aid them help in the technological point of view, a system is proposed that could intake the various parameters that decide the productivity. Since linear systems aren't capable to resolve many problems, the Artificial Neural Network is utilized. The prerequisite of intelligent system using ANN has lead to a next mile stone in agricultural researches.

They ANN has played a crucial role in developing various models. This thesis uses the most prominently used ANN, Feedforward and back propagation network. The basic principle behind the operation of the proposed system is to take the inputs as various parameters that decide the productivity, process them based on the algorithm provided by ANN, and predict the suitable crop for the land. Also the system suggests some fertilizers that could be used to improve the fertility. It also provides the Status of productivity of a crop in a soil. In order to make this system accessible to common people, the proposed system is made as an Android Application, where the user could feed the inputs, and obtain the desirable application.

## 2. Proposed Model.

2.1. **Artificial Neural Network.** Human brain is something different that is capable to analyze the situation based on the data, and is capable to make decisions based on training. Similar to the human brain a prototype is developed which is capable of taking decisions with the inculcated artificial intelligence. It is made possible by series of training given to that particular system. Since ANN is formed from simulated neurons, the function of ANN is similar to that of Human Brain.

The functionality of ANN is similar to the functionality of the Human Brain. Human brain one the most complicated part of a human body uses the intelligent approach in decision making. One such methodology is used here to implement the decision making in

practical cases. In the human brain, the electrical signal is transmitted through the neurons with the help of the strand called axons. The end of the each branch contains a synapse. The processing of information in neural network is done by different methodologies. Here the Non-linear algorithm called as Feed forward propagation is one of the most commonly used algorithm is implemented.

**2.2. Feedforward and Backpropagation.** One of the most commonly used algorithms or networks in Artificial Neural Network is,

1. Feedforward Network
2. Back Propagation Network

In this particular context, the above two networks are used together to implement the Artificial Neural Network.

The term Feedforward says the process and recall pattern. The training to the proposed neural network is given using the back-propagation network, which is a supervised training methodology.

Basically, an ANN model has three different layers. They include

- a. Input Layer
- b. Hidden Layer
- c. Output Layer

The nodes are present in input layer as well as the output layer that corresponds to the variables at the input and output. Here across the nodes the weighted connections and the data traverses between these nodes.

In this particular model of propagation mechanism, each node is excited by the previous node, and a weighted sum of all its inputs,  $t$  is calculated as follows:

$$t_i = \sum_{j=1}^n w_{ij}x_j$$

Here

$n$  - number of inputs,

$w$  - weight of the connection between  $i^{\text{th}}$  and  $j^{\text{th}}$  node, and

$x$  - input from node  $j$ .

Here to calculate the output of the node, a transfer function is applied to the weighted value  $t$  and it is given as  $O_i$ :

$$o_i = f(t_i)$$

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The following diagram shows the representation of a three layer ANN.

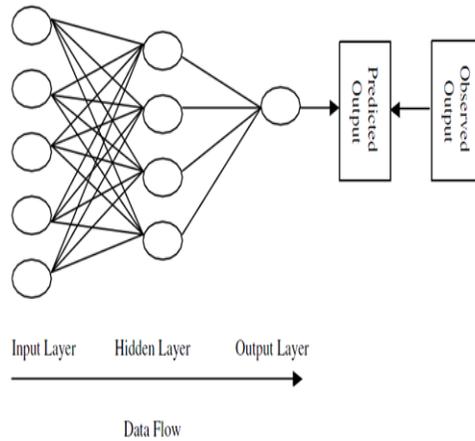


Figure 3. Layer connection of feedforward back propagation network

3. **Design Flow.** The process of developing the proposed system involves the following process:

1. Data collection/ Preparation
2. Build the Prediction Model
3. Classification
4. Fertilizer suggestion for appropriate crop.

All the details regarding the crops are collected from the Department of Agriculture and Science, Annamalai University.

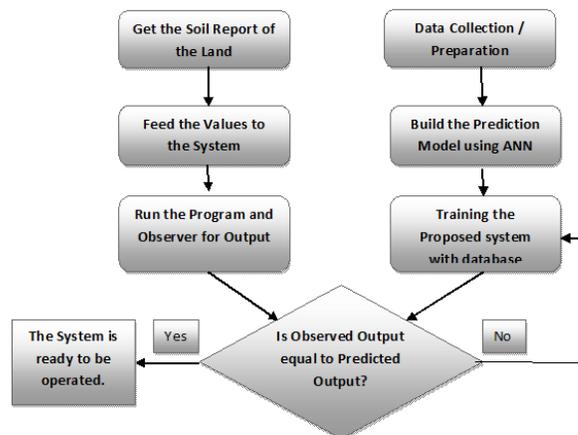


Figure 4. Flow chart of working

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4. **Building the Model.** The building of the Prediction and analyzing model using ANN is divided into the following steps.

Step 1, It is necessary to combine many different ANN Prototypes, to find out the optimal configuration. Hence 9 algorithms were used for training this particular model.

Step 2, Trial and error method is used to decide the number of hidden layers. Also certain value of training parameters are obtain through the same method. A very careful observation is needed for selecting the number of hidden layers. Hence different networks with different number of neurons at middle layer is used and comparison is made between the results. Here the comparison is made and best result is selected using Root Mean Square Error (RMSE) and hence the number of hidden layers is selected.

Step 3, By adjusting the momentum to the appropriate value, we can initialize the network weights and parameters.

Step 4, The Prediction system is developed using the MATLAB platform, using the ANN Toolbox.

Step 5, Since the system is to be developed as the Android application, the Matlab code of the system is extracted.

Step 6, The front panel of the Application is developed using Eclipse IDE, and the Java program written at the backend.

Step 7. Finally extract the application in the APK format, so that it can be installed in a smart phone and utilized.

Table 1. Database considered for the Proposed System

<b>Crop</b>	<b>pH</b>	<b>N</b>	<b>P</b>	<b>K</b>	<b>Depth</b>	<b>Temp</b>	<b>Rainfall</b>
<b>Cotton</b>	7-8.5	100	50	50	30	27-33	700-1200
<b>Sugarcane</b>	6.5-7.5	175	100	100	60	20-50	750-1200
<b>Jowar</b>	6.0-8.5	80	40	40	50-20	25-30	800-1000
<b>Bajra</b>	7-8.5	40	20	25	15	28-32	400-750
<b>Soybeans</b>	6.5-7.5	30	75	15	15-20	25-33	700-1000
<b>Corn</b>	7.5-8.5	100	25	0	20-50	13-30	500-600
<b>Rice</b>	6-8.5	100	50	50	15-20	16-22	25-180
<b>Wheat</b>	5.5-8.5	100	50	50	50-20	22-25	1000-1500
<b>Groundnut</b>	6-7.5	25	50	30	20	24-27	500-1250

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Feed forward back propagation mechanism and its parameters are shown below:

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1. <b>Input layers</b>	7
2. <b>Output layer</b>	1
3. <b>Hidden layers</b>	50
4. <b>No. of Iterations</b>	1200

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TRANSFER FUNTION:

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TRAINING ALGORITHM:

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**trainlm(Back Propagation Algorithm)**

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LEARNING:

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**learngdm**

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Based on the above functions the ANN manipulates the input data and processes the information by linear network at the input level. Then the information is propagated through the hidden layers, where the sigmoidal function is applied to the data processed and the desired result is produced.

Here following functions are used:

- a. **Sigmoidal function - Hidden and Output layers.**
- b. **Linear function - Input layer.**

**5. Suggestion of Fertilizers.** The main objective of the proposed system is to suggest crops to the farmer for his land. But there is an alternate case in which a farmer want to use his own desired crop into his field. In such controversial situation the proposed system has an added advantage of suggesting the fertilizer for his land for his desired crop. Also it says, whether the desired crop of the farmer, can yield productivity of or not. Here Nitrogen, Phosphor and Potassium are the three basic important things for a crop and hence the fertilizer suggestion is based on these three values. If there is the optimum availability of these basic nutrition in the soil, then no fertilizers are required and fertilizers are suggested in case of their lower values.

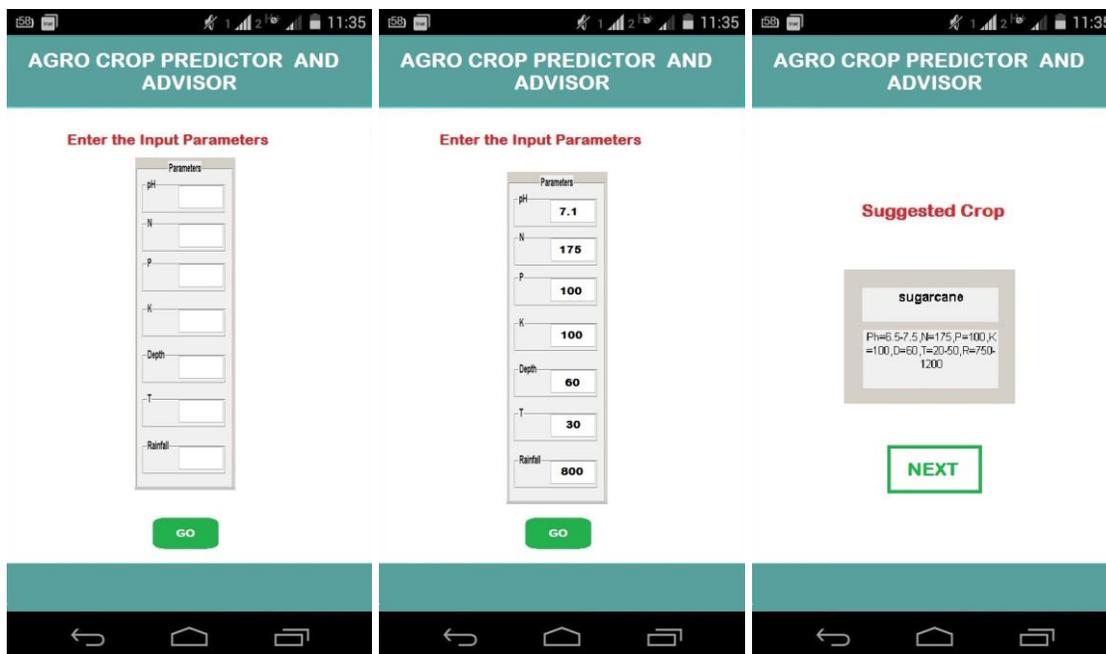
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S.No	Deficiency	Suggested Fertilizers
1.	Nitrogen	Urea
		Ammonium sulphate
		Sodium nitrate
2.	Phosphorous	A. Calcium hydrogen phosphate or superphosphate
		Ammonium hydrogen phosphate or ammophos
		Ammonium phosphate
3.	Potassium	A. Potassium nitrate
		C. Potassium sulphate
		Potassium chloride
		Potassium sulphate

**6. Features of Proposed System and Results.** The developed application has four basic features. They include:

1. Provides suitable crop for the particular soil.
2. Reveals the productivity detail of the desired crop in that particular soil.
3. Fertilizers that are necessary to improve the productivity furthermore.

Hence the system or application can be used in either way to check the suitable crop for the soil or to obtain the productivity status of the desired crop in the particular land. The only input to obtain these results is the latest soil test report along with the rainfall details. The following diagrams shows the screen shots of the developed android application to predict the agricultural crop for a particular land.



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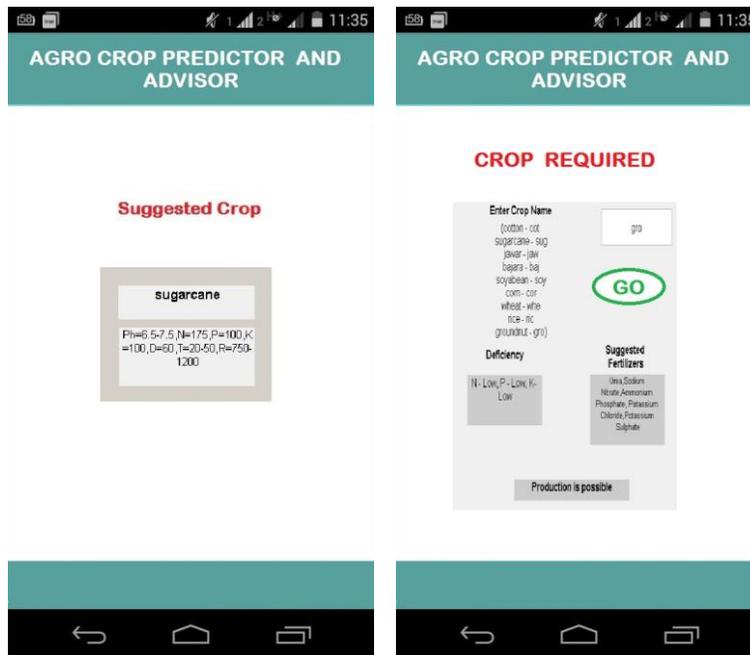


Figure 5. Screenshots of the developed android applications.

**7. Conclusion.** From the above results it is clearly identified that the proposed system functions properly on the input data, manipulates it and provides the desirable output. Also the system is tested with some standard inputs and verified for its results. The accuracy of the system is very high. One of the most advantageous factors is that this particular system is there is no cost for this particular system, and it can be installed in any smart phones, which makes this system more comfortable for usage. Also, the farmers are accessible to these systems, and hence they would be properly educated regarding which crop to grow, and which not to grow. The future work of this involves building this particular application in the regional languages, so that the it would be more comfortable for farmers as many of them are illiterates. Further it can be improved by adding certain add-ons such as details about crop diseases, information about micronutrients etc. This helps to reduce the crop loss by properly educating the farmers with the crops details and their requirements.

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