ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 1, January 2014

Agricultural Crop Yield Prediction Using Artificial Neural Network Approach

Miss.Snehal S.Dahikar[1], Dr.Sandeep V.Rode[2]

PG Student (EXTC), Dept. Of EXTC, Sipna College of Engineering, Amravati, Maharashtra, India[1]

Dr. Dept. Of EXTC, Sipna College of Engineering, Amravati, Maharashtra, India[2]

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).

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

I. INTRODUCTION

Achieving maximum crop yield at minimum cost is one of the goals of agricultural production. Early detection and management of problems associated with crop yield indicators can help increase yield and subsequent profit. By influencing regional weather patterns, large-scale meteorological phenomena can have a significant impact on agricultural production. Predictions could be used by crop managers to minimize losses when unfavourable conditions may occur. Additionally, these predictions could be used to maximize crop prediction when potential exists for favourable growing conditions.

Prediction of crop yield mainly strategic plants such as wheat, corn, rice has always been an interesting research area to agro meteorologists, as it is important in national and international economic programming. Dry farming crop production, apart from relationship to the genetic of cultivator, adaphic terms, effect of pests and pathology and weeds, the management and control quality during the growing season and etc. is severely depend to climatic events. Therefore it is systems which can predict the more accuracy using meteorological data. Nowadays, there are a lot of yield prediction models, that more of them have been generally classified in two group: a) Statistical Models, b) Crop Simulation Models (e.g. CERES). Recently, application of Artificial Intelligence (AI), such as Artificial Neural Networks (ANNs),, Fuzzy Systems and Genetic Algorithm has shown more efficiency in dissolving the problem. Application of them can make models easier and more accuracy from complex natural systems with many inputs. In this research it has been tried to develop a various crop yield prediction model using ANNs. If we design a network which correctly learn relations of effective climatic factors on crop yield, it can be used to estimate crop production in long or short term and also with enough and useful data can get a ANNs model for each area. Furthermore using ANNs can find the most effective factors on crop yield. Therefore some factors that their measurements are difficult and cost effective can be ignored. To handle such a situation, an extremely versatile approach of "Artificial neural networks" (ANNs) is developing rapidly.

Most widely used ANN is feed forward back propagation artificial neural network. As an illustration, the methodology has been applied for modelling and forecasting of various crop yield on the basis of various predictor variables, viz. type of soil, PH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphur, manganese, copper, iron, depth, temperature, rainfall, humidity. ANN with zero, one, and two hidden layers have been considered. Optimum numbers of hidden layers as well as optimum numbers of units in each hidden layer have been found by computing MSEs.

II. BACKGROUND

After a thorough background work, some of the most valuable recent documents and papers are,

B. J I ET AL [2] developed agricultural management need simple and accurate estimation techniques to predict rice yields in the planning process. The necessity of the present study were to: (1) identify whether artificial neural network (ANN) models could effectively predict rice yield for typical climatic conditions of the mountainous region, (2) evaluate ANN model performance relative to variations of developmental parameters and (3) compare the effectiveness of multiple linear regression models with ANN models. In this paper describes the development of artificial neural network

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 1, January 2014

models as an alternate and more accurate technique for yield prediction.

B.A. Smith et al [3] discuss year-round air temperature prediction models were developed for prediction horizons of 1 to 12 h using Ward-style ANNs. These models were intended for use in general decision support. The ANN design modifications described herein provided increased accuracy over previously developed, winter specific models during the winter period. It was shown that models that included rainfall terms in the input vector were more accurate than those that did not.

D.L. Ehret et al [5] introduce all crop attributes responded in much the same way to individual climatic factors. Radiation and temperature generally induced strong positive responses while RH produced a negative response. In the NN models, radiation and temperature were still prominent, but the importance of CO2 in predicting a crop response increased. One advantage of these automated systems is that they offer continuous information across a range of timescales. Furthermore, these systems can readily be used in commercial greenhouses so the derived NN models are relatively easy to deploy to a commercial setting where they can subsequently be improved over time.

In this paper 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). This project shows the ability of artificial neural network technology to be used for the approximation and prediction of crop yields at rural district.

A. *Need of Crop Prediction*

Prediction of crop yield mainly strategic plants such as wheat, corn, rice has always been an interesting research area to agro meteorologists, as it is important in national and international economic programming. Dry farming crop production, apart from relationship to the genetic of cultivator, adaphic terms, effect of pests and pathology and weeds, the management and control quality during the growing season and etc. is severely depend to climatic events. Therefore it is not beyond the possibility to acquire relations or systems which can predict the more accuracy using meteorological data. Nowadays, there are a lot of yield prediction models, that more of them have been generally classified in two group a) Statistical Models, b) Crop Simulation Models (e.g. CERES). Recently, application of Artificial Intelligence (AI), such as Artificial Neural Networks (ANNs), Fuzzy Systems and Genetic Algorithm has shown more efficiency in dissolving the problem. Application of them can make models easier and more accuracy from complex natural systems with many inputs. In this research it has been tried to develop a wheat yield prediction model using ANNs. If we design a network which correctly learn relations of effective climatic factors on crop yield, it can be used to estimate crop production in long or short term and also with enough and useful data can get a ANNs model for each area. Furthermore using ANNs can find the most effective factors on crop yield. Therefore some factors that their measurements are difficult and cost effective can be ignored. In this the effect of climatic factors on wheat yield has only been applied.

III. PROPOSED WORK

A. .*Artificial Neural Network*

In computer science and related fields, artificial neural networks are computational models inspired by animal central nervous systems (in particular the brain) that are capable of machine learning and pattern recognition. They are usually presented as systems of interconnected "neurons" that can compute values from inputs by feeding information through the network. Like other machine learning methods, neural networks have been used to solve a wide variety of tasks that are hard to solve using ordinary rule-based programming, including computer vision and speech recognition.

The word network in the term 'artificial neural network' refers to the inter–connections between the neurons in the different layers of each system. An example system has three layers. The first layer has input neurons, which send data via synapses to the second layer of neurons, and then via more synapses to the third layer of output neurons. More complex systems will have more layers of neurons with some having increased layers of input neurons and output neurons. The synapses store parameters called "weights" that manipulate the data in the calculations.

An ANN is typically defined by three types of parameters:

1. The interconnection pattern between different layers of neurons
2. The learning process for updating the weights of the interconnections
3. The activation function that converts a neuron's weighted input to its output activation.

One type of network sees the nodes as ‘artificial neurons’. These are called artificial neural networks (ANNs). The back propagation algorithm (Rumelhart and McClelland, 1986) is used in layered feed-forward ANNs. This means that the artificial neurons are organized in layers, and send their signals “forward”, and then the errors are propagated backwards. The network receives inputs by neurons in the input layer, and the output of the network is given by the neurons on an output layer. There may be one or more intermediate hidden layers.

In this paper we shall examine one of the most common neural network architectures, the feed forward back propagation neural network shows in fig 1. This neural

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 1, January 2014

network architecture is very popular, because it can be applid to many different tasks.

The first term, "feed forward" describes how this neural network processes and recalls patterns. In a feed forward neural network, neurons are only connected foreword. Each layer of the neural network contains connections to the next layer (for example, from the input to the hidden layer), but there are no connections back.

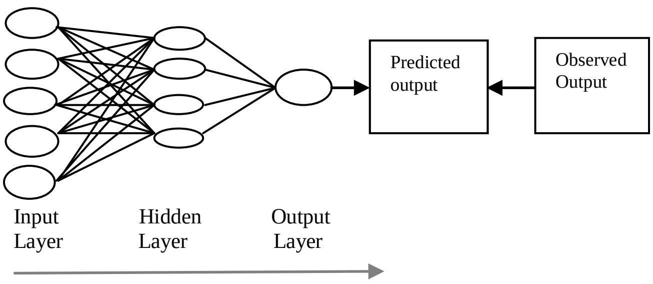

Fig 1.Layer and connection of a feed-forward back-propagating ANN.

The term "back propagation" describes how this type of neural network is trained. Back propagation is a form of supervised training. When using a supervised training method, the network must be provided with both sample inputs and anticipated outputs. The anticipated outputs are compared against the actual outputs for given input. Using the anticipated outputs, the back propagation training algorithm then takes a calculated error and adjusts the weights of the various layers backwards from the output layer to the input layer.

The back propagation and feed forward algorithms are often used together; however, this is by no means a requirement. 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.

The back propagation algorithm uses supervised learning, which means that we provide the algorithm with examples of the inputs and outputs we want the network to compute, and then the error (difference between actual and expected results) is calculated. The idea of the back propagation algorithm is to reduce this error, until the ANN *learns* the training data. The training begins with random weights, and the goal is to adjust them so that the error will be minimal.

Since back propagation uses the gradient descent method, one needs to calculate the derivative of the squared error function with respect to the weights of the network. The squared error function is:

$$E=\frac{1}{2}(t-y)^2,$$

E=square error,

t= target output,

y=actual output of output neuron.

$$y=\sum_{i=1}^{n} w_i x_i,$$

n=the number of input units to the neuron,

w_i=the ith weight ,

x_i=the ith input value to the neuron.

The above formula only holds true for a neuron with a linear activation function (that is the output is solely the weighted sum of the input). In general, a non-linear, differentiable activation function,is used. Thus, more correctly:

$$y=\varphi(\text{net}),$$

$$\text{net}=\sum_{i=1}^{n} w_i x_i,$$

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

$$\frac{\partial E}{\partial wi}=\frac{dE}{dy}\frac{dy}{dnet}\frac{dnet}{\partial wi},$$

$\frac{\partial E}{\partial wi}$ = How the error changes when the weights are changed

$\frac{dE}{dy}$ =How the error changes when the output is changed

$\frac{dy}{dnet}$ =How the output changes when the weighted sum change.

$\frac{dnet}{\partial wi}$ = How the weighted sum changes as the weights change.

In this paper crop prediction methodology is used to predict the suitable crop by sensing various parameter of soil and also parameter related to atmosphere. For that purpose we are used artificial neural network (ANN). This paper shows the ability of artificial neural network technology to be used for the approximation and prediction of crop yields at rural district. It is verified by using ANN is shown below,

Crop	PH	Nitrogen (ppm)	Depth (ppm)	Temp **(°C)**	Rainfall (cm)
Cotton	7-8.5	40	30	27-33	700-1200
Sugarcane	6.5-7.5	40	60	20-50	750-1200
Jawar	6.0-8.5	132-180	50-20	25-30	800-1000

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 2, Issue 1, January 2014

Bajara	7-8.5	120	15	28-32	400-750
Soyabean	6.5-7.5	37	15-20	25-33	700-1000
Corn	7.5-8.5	60-120	5	13-30	500-600
Wheat	6-8.5	80-150	15-20	16-22	25-180
Rice	5.5-8.5	50	50-20	22-25	1000-1500
Groundnut	6-7.5	25	20	24-27	500-1250

IV. CONCLUSION

In this way we concluded that ANN is beneficial tool for crop prediction. In this paper includes the parameter of their regional soil parameter. Then it is analyse by using feed forward back propagation ANN. Analyse in matlab ANN approach to make it more efficient.

REFERENCES

[1] Aggarwal Sachin (2001). Application of Neural Network to Forecast Air Quality Index. Thesis submitted in partial fulfillment of requirements for a degree in Bachelor of Technology, April 2001.
[2] B. J I ET AL Artificial neural networks for rice yield prediction in mountainous regions. Journal of Agricultural Science (2007), 145, 249–261.
[3] B.A. Smith et al,.Artificial Neural Networks for Automated Year-round Temperature Prediction. Computers and Electronics in Agriculture 68 (2009) 52–6.
[4] Cheng, B. and Titterington, D. M. (1994). Neural networks: A review from a statistical perspective Statistical Science, 9: 2-54.
[5] D.L. Ehret et al, Neural network modeling of greenhouse tomato yield, growth and water use from automated crop monitoring data. Computers and Electronics in Agriculture 79 (2011) 82–89.[
[6] Enfield, D. B., 1996. Relationships of inter-American rainfall to tropical Atlantic and Pacific SST variability. Geophysical Research Letters 23(23): 3305-3308.
[7] Everingham, Y. L., R. C. Muchow, R. C. Stone, and D. H. Coomans, 2003. Using southern oscillation index phases to forecast sugarcane yields: a case study for Northeastern Australia. International Journal of Climatology 23(10): 1211-1218.
[8] Handler, P, 1990. USA corn yields, the El Niño and agricultural drought: 1867-1988. International Journal of Climatology 10(8): 819-828.
[9] Hansen, J. W., J. W. Jones, C. F. Kiker, A. W. Hodges, 1999. El Niño-Southern Oscillation impacts on winter vegetable production in Florida. Journal of Climate 92-102.
[10] Hansen, J. W., A. W. Hodges, and J. W. Jones, 1998. ENSO Influences on agriculture in the southeastern United States. Journal of Climate 11(3): 404-411.
[11] Haykin, S, 1999. Neural Networks: A Comprehensive Foundation (Second Edition). Upper Saddle River, NJ: Prentice Hall.
[12] Izaurralde, R. C., N. J. Rosenberg, R. A. Brown, D. M. Legler, M. T. Lopez, R. Srinivasan, 1999. Modeled effects of moderate and strong 'Los Niños' on crop productivity in North America. Agricultural and Forest Meteorology 94(3): 259-268.
[13] Jain, A., R. W. McClendon, G. Hoogenboom, and R. Ramyaa, 2003. Prediction of frost for fruit protection using artificial neural networks. American Society of Agricultural Engineers, St. Joseph, MI, ASAE Paper 03-3075.
[14] Jain, A., R. W. McClendon, and G. Hoogenboom, 2006. Freeze prediction for specific locations using artificial neural networks. Transactions of the ASABE 49(6): 1955-1962.
[15] Jones, J. W., G. Hoogenboom, C. H. Porter, K. J. Boote, W. D. Batchelor, L. A Hunt, P. W. Wilkens, U. Singh, A. J. Gijsman, and J. T. Ritchie, 2003. The DSSAT cropping system model. European Journal of Agronomy 18(3): 235-265.