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# Application of Soft Computing Technique in Crop Information System Using Geospatial Data

Ujwal BS<sup>1</sup>, Ritika S Shetty<sup>2</sup>, Rahul R<sup>3</sup>, Mohammed Sahil<sup>4</sup>, Anusha Jain<sup>5</sup>

U.G. Student, Department of Civil Engineering, MITE, Moodbidri, India<sup>1,2,3,4</sup>

Assistant Professor, Department of Civil Engineering, MITE, Moodbidri, India<sup>5</sup>

**ABSTRACT**: In this study, various soft computing methods have been used to determine the crop information using Geospatial Data using MATLAB software. It is determined using the artificial neural technique (ANN) with the feed-forward backpropagation network (FFBP). The input data considered for the ANN modelling is the Precipitation, Temperature, Vapor Pressure, Diurnal Temperature Range, and Area for the simulation of the Production. We used the best ANN structure's RMSE (Root Means Square Error), NSE (Nash-Sutcliffe Efficiency), SI (Scatter Index), and CC (Correlation Coefficient) to validate the results of our project.

**KEYWORDS**: Artificial Neural Technique, Geospatial Data, Crop Information, Adaptive Neuro-Fuzzy Inference System.

# I. INTRODUCTION

Rainfall and temperature are two of the most important climatic drivers of vegetative development, and differences in both can restrict a crop's growth phases and hence reduce agricultural yield. Until recently, much of the research relied on changes in the mean value of climatic variables to determine the influence of climate change on agricultural production. Precipitation is regarded as the most vital component in this context. However, other climatic factors, such as Vapour Pressure and exposure to severe temperatures throughout particular stages of crop growth, capture parts of climate variability.

Agriculture accounts for more than 74% of total land utilization in districts such as Bidar, Bijapur, Gulbarga, Raichur, Dharwad, and Belgaum. Less land is utilized for agriculture in the malnad districts of Uttara Kannada, Kodagu, Shimoga, Chikmagalur, and Dakshina Kannada.

Belagavi is a high-producing maize and soybean district, having 1.3 million hectares of maize and 100,000 hectares of soybean. Farmers cultivate Paddy on 67,000 hectares and Cotton on around 37,000 hectares. Jowar, Maize, Paddy, Wheat, Millet, Gram, Sorghum, Groundnut, Sunflower, Sugarcane, Cotton, Tobacco, and other key crops farmed in the area include Sugarcane and Paddy, especially in places where water levels are declining.

# **II. TECHNIQUES OF SOFT COMPUTING**

A. Soft Computing

Soft that develops taxonomies to run each little element is a degree of similarity for all classes. It provides more illuminating graphics and potentially exact results, particularly for data classifications with unequal threedimensional resolution. Artificial Neural Networks, pattern recognition, Fuzzy Logic, Genetic Algorithms, Decision Trees, and other Soft Classification Methods are examples.

B. ANN model development

Artificial neural networks (ANNs) are data-processing algorithms based on biological brain systems that are used to solve a wide range of scientific and technical issues, particularly in areas where standard modelling approaches



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fail. One input layer, one or more hidden layers, and one output layer make up the network design, with multiple neurons in each layer transporting data from the input layer to the hidden layers and from the hidden layers to the output layer.

One of the most often utilized methods in ANN models is the backpropagation technique. Algorithms for back-propagation training Two of the most important variants of this method are gradient descent and gradient descent with momentum. Because consistent learning demands low learning rates, these algorithms are extremely sluggish. The Levenberg–Marquardt (LM) method is a more expedient method that employs standard numerical optimization techniques to address some of the previous flaws.

In an ANN model, the number of hidden layers, the number of neurons in each layer, the training approach, and the kind of transfer function should all be modified. The transfer function specifies the relationship between a neuron's inputs and outputs, as well as the network's inputs and outputs.



## III. MATERIALS AND METHODS

### A. Data Collection

The dataset utilized in this investigation came from Google Earth Interface- Climatic Research Unit Time-Series (CRUTS) version 4.05 for Meteorological Data and Agricultural Data was obtained from the Crop production statistics information system website [https://aps.dac.gov.in/APY/Public Report1.aspx]. The data was all in pdf format, which was subsequently converted to excel format using a variety of tools and procedures. To manage missing numbers, noise, and outliers, extensive pre-processing was necessary.

We pre-processed and chose just the variables necessary for our research from the dataset: Temperature, Diurnal Temperature Range, Precipitation, and Vapor Pressure of the Belgaum districts, as well as the cultivated area for each crop, analysed using the requirements.

Following the necessary dataset formats and pre-processing, the final version of our data comprises 400 Kharif Season (July–October) data sets from 1997 to 2018.

B. Input Variables

We chose a small number of critical input factors that have the greatest impact on agricultural output from the large original dataset. For the years 2009 to 2018, all inputs were examined.

1) The environmental factors:

a) Precipitation: The average annual precipitation in the Belgaum district was derived by averaging the monthly rainfall (mm). Typically, the year with the most average rainfall produces the most agricultural output.

b) Temperature: Temperature variations throughout the year have a major influence on agricultural yield for that year. As a result, we incorporate the Kharif season's average temperature in our research.

c) Diurnal Temperature Range: the difference between the daily maximum and lowest temperature, which represents within-day temperature fluctuation and reflects weather stability. The average temperature of the Kharif season is considered in our research.

d) Vapor Pressure: Relative humidity affects the partial pressure of water vapour in the air. Plants can only thrive if the humidity is just optimum. This suggests that humidity has an impact on plant production. As a result, the average vapor pressure for the Kharif season is considered.

2) Agriculture Area Input Factors:



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a) Cultivated Area: The area used to grow each crop also influences the quantity of agricultural production. The sizes of the plots were measured in hectares.

b) Crop production: The overall harvest of the plot is calculated by multiplying the total number of harvested units by the average unit weight. Crop productivity is measured by dividing total production by the region from which the produce originated.

# **III. METHODOLOGY**

A. Step 1. Normalization of Data

The input data set, which incorporates meteorological data from geographical data such as vapor pressure, precipitation, diurnal temperature range, and temperature, and agricultural data which includes production and yield, is normalized using the following equation so that data ranges between 0 and 1 and fed into MATLAB for soft computing.

Equation 1

# Xnorm= X-XminXmax-Xmin





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#### B. Step 2. Feeding Data into Soft Computing

0.8 0.6 0.4 0.2 0 0

50

100

In the MATLAB language version 8.5.0.197613 (R2015a), multiple program codes were developed, each with a different number of hidden layers and transfer functions. In other words, the number of hidden layers was calculated first, followed by an increase in the number of neurons from 3 to 6. As a result, the number of hidden layers was lowered, and 3 to 6 neurons were trained again to obtain different results. Finally, the best results were obtained by employing statistical factors. Data were divided into training (60 percent, 70 percent, 75 percent, and 80 percent of total data), validation (5 percent of total data), and testing data sets at random (35 percent,25 percent,20 percent,15 percent of the total data). Based on the testing methods, the best model was picked since a model can produce better results.

150

200

no of data

250

300

350

400

As a result, when the training procedure was completed, the findings were validated using 5% of the data that had not been included in the model building. Finally, the model was assessed using the remaining original data. C. Step 3. ANN model performance assessment

Statistical parameters such as root mean square error (RMSE) [Equation 2], Nash-Sutcliffe Efficiency (NSE) [Equation 3], Scatter Index (SI) [Equation 4], and correlation coefficient (CC) [Equation 5] were used to evaluate the performance of the networks. The predicting error, which is the difference between the observed and predicted values using the equations below, is a common way to represent these parameters.



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Equation 2. Root mean Square Error (RMSE)

RMSE=21Ni=0N(Pi-Oi)2

Equation 3. Nash-Sutcliffe Efficiency (NSE)

NSE=1-i=0nPi-Oi2i=0n(Oi-Pi)2

Equation 4. Scatter Index (SI)

SI=21Ni=0nPi-0i20i

Equation 5. Correlation Coefficient (CC) CC=i=0n(Pi-Pi)(Oi-Oi)i=0n(Pi-Pi)2i=0n(Oi-Oi)2

# V. RESULTS AND DISCUSSIONS

A. Evaluation and error analysis of ANN models

To anticipate a link between geospatial data and yield, many ANN models were created. A single-layer Backpropagation training network was employed for nonlinear mapping between input and output parameters. To get the best results for the network, different numbers of unique activation functions and different combinations of neurons in the hidden layer were utilized in the training of all ANN models.

The first layer consisted of five input variables: vapor pressure, precipitation, temperature, and diurnal temperature range, with Production as the output variable. The optimal network comprises five neurons in the input layer, three to six neurons in the hidden layer, and one output variable in the output layer. The four metrics used to assess the network's performance: are RMSE, NSE, SI, and CC. The hidden layers' activation function was selected to be tangent sigmoid in the optimum network design, whereas the output layer employed a linear function.

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## VI. CONCLUSION

Many ANNs models were created, however, the ANN model with 5 inputs, 70% training, 30% validation and testing, 4 Hidden Neurons, and 1 output structure produced the best results. The best ANN structure's RMSE (Root Means Square Error), NSE (Nash-Sutcliffe Efficiency), SI (Scatter Index), and CC (Correlation Coefficient) were determined to be 0.0527, 0.898, 0.656, and 0.948, respectively.

## REFERENCES

- 1. O. Makarynskyya, A.A. Pires-Silvab, D. Makarynskaa, and C. Ventura-Soares," Artificial neural networks in wave predictions at the west coast of Portugal," Computers & Geosciences, 2004.
- 2. V. Leemans and M.F. Destain," A real-time grading method of apples based on features extracted from defects," Journal of Food Engineering 61 (2004).
- 3. Veenadhari Suraparaju," Data mining Techniques for Predicting Crop Productivity A review article" 98 International Journal of Computer Science and Technology Vol. 2, Issue 1, March 2011.
- 4. Joana E. Gonzales Malaverri and Claudia Bauzer Medeiros," Data Quality in Agriculture Applications," January 2012.



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- Ramesh A. Medar and Vijay. S. Rajpurohit," A Survey on Data Mining Techniques for Crop Yield Prediction ", International Journal of Advanced Research in Computer Science and Management Studies, Volume 2, Issue 9, September 2014.
- 6. D Ramesh, B Vishnu Vardhan," Analysis of Crop Yield Prediction Using Data Mining Techniques," International Journal of Research in Engineering and Technology, Volume: 04 Issue: 01 Jan-2015.
- 7. Snehal S. Dahikar, Sandeep V. Rode, Pramod Deshmukh," An Artificial Neural Network Approach for Agricultural Crop Yield Prediction Based on Various Parameters," International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), Volume 4, Issue 1, January 2015.
- 8. A T M Shakil Ahamed, Nazmul Hossain, Kallal Das, Mohammad Rashedur Rahman, applying data mining techniques to predict the annual yield of major crops and recommend planting different crops in different districts in Bangladesh, 2015 IEEE/ACIS 16th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD), June 2015.
- 9. Giritharan Ravichandran and Koteeshwari R S," Agricultural Crop Predictor and Advisor using ANN for Smartphones," February 2016.
- 10. Klaus Lyko, Marcus Nietzsche, and Axel-Cyrille Ngonga Ngomo New Horizons for a Data-Drive Big Data Acquisition, 2016.
- 11. H. M. Vinaya Kumar, M. Shivamurthy, and M. M. Lunagaria," Rainfall Trend Analysis and Adaptation Strategies to Manage Climate-Induced Crisis in Coastal Zone of Karnataka, India," Journal of Scientific Research & Reports 13(5): 1-11, 2017.
- 12. Olakunle Elijah, Tharek Abdul Rahman, Igbafe Orikumhi, Chee Yen Leow and MHD Nour Hindia," An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges," IEEE Internet of Things Journal · June 2018.
- 13. Qamar Sultana Muffakham Jah Coll," Application of Soft Computing Techniques A Case Study of Reservoir," International Journal of Scientific Research and Review, Volume 07, Issue 05, May 2019.
- 14. Kai Sun, Yunqiang Zhu, Peng Pan, Zhiwei Hou, Dongxu Wang, Weirong Li and Jia Song," Geospatial data ontology: the semantic foundation of geospatial data integration and sharing," Bid Earth Data, 25 August 2019.
- 15. Kamal Murari, S Andeep Mahatao, Thiagarajan Jayaraman, Madhura Swaminatha. Extreme Temperatures and crop yields in Karnataka, India, Jan 2019.
- 16. Chunling Zhang and Zunfeng Liu," Application of big data technology in agricultural Internet of Things," Advanced Big Data and Artificial Intelligence Technologies for IoT Systems, 2019, Vol. 15(10).
- 17. Fathima1, Sowmya K, Sunita Barker, Sanjeev Kulkarni4, Analysis of Crop Yield Prediction Using Data Mining Technique", International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 05 May 2020.
- Kelvin López-Aguilar, Adalberto Benavides-Mendoza, Susana González-Morales, Antonio Juárez-Maldonado, Pamela Chiñas- Sánchez, Alvaro Morelos-Moreno," Artificial Neural Network Modeling of Greenhouse Tomato Yield and Aerial Dry Matter," Agriculture 2020, 10, 97.
- 19. Tanha Talaviya, Dhara Shah, Nivedita Patel, Hiteshri Yagnik, and Manan Shah," Implementation of artificial intelligence in agriculture for optimization of irrigation and application of pesticides and herbicides," Artificial Intelligence in Agriculture, Volume 4 2020, Pg number 58–73.
- 20. Pallavi Shankarrao Mahore and Dr. Aashish A. Bardekar," Crop Yield Prediction using Different Machine Learning Techniques" International Journal of Scientific Research in Computer Science, Engineering and Information Technology Volume 7, Issue 3 Page Number: 561-569, May-June-2021.





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