Puspendra Patel,2019, 7:6
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

ANN Based Prediction Water Quality Parameters in Bihar River Rewa City (M.P.)

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Abstract-All life on earth depends on water. Fresh water is a critical, finite, vulnerable, renewable natural resource on the earth and plays as important role in our living environment without it life is impossible .In this paper we are analyzed to monthly variation and comparative physio- chemical study of Baba Ghat of Bihar river of Rewa city (M. P.) In this paper a implementation of prediction model using artificial intelligence and deep learning method. Now observed result are show result and analysis section. In this article obtained accuracy at 91% using ANN and SVM is found 31%.

Keywords- ANN, PSO, Non linear model.

I. INTRODUCTION

Water is vital for sustaining life on Earth. Of all the matter on the Earth none is more basic than water. It is said that "Water is more precious than gold and more explosive than dynamite".

Water is thus an essential depends on it. Water should be safe and wholesome for drinking purpose. Various national and international agencies have prescribed standards for various beneficial uses in terms of water quality.

Water Quality Index present integrated effect of various parameters considering due to weight age to concentration of parameter and its significance by a single number for particular use of water.

Thus provides meaningful information about water quality to generate public and policy makers also. The terms standard applies to any definite rule principle on measure established by authority.

"A criterion designates a means by which anything is tried in forming a correct judgment concerning it". It seems obvious that progress toward improving man's health and welfare could result only from better control over his environment. The provision of better quality water was one logical step in direction.

The quality of surface water plays a significant role in the development of aquatic flora and Fauna. Many Hydro geochemical models (Ghalib, Yaqub& Al-Abadi, 2019) and water quality index method were used to assess the status of water quality.

Water quality index is a single numerical value used for determining the quality of water for human consumption (Asadi, Vuppala&Anji, 2007; Hoseinzadeh, Khorsandi, Wei &Alipour, 2014). The surface water being exposed to anthropogenic influences and atmospheric deposition of pollutants becomes a very sensitive and critical issue in many countries (Sener et al. 2017; Kumar and Singh 2018).

Anthropogenic influences, geochemical factors, chemical composition of river basin (Giridharan et al. 2010) and natural processes like interaction of water with lithogenic structure through which the river flows (Subramani et al. 2009; Sener et al. 2017) degrade surface water quality making it unsuitable for drinking, industry, agriculture and other purposes (Simeonov et al. 2003; Sánchez et al. 2007; Kazi et al. 2009).

According to Yaseen et al., (2020), Dams that break the river continuum play an important role in promoting economic and social development as well as providing important services such as flood control, agricultural expansion, domestic use and generation of electricity her ecologists have provided their valuable suggestion regarding such the study which

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are not cited here but, considered for the presentation of further study.

After having studies on various literatures of river, ponds, springs and anthropogenic dams it becomes essential to have a long course study of all these natural resources with are being affected by human activities. Thus, present study is intended to bridge the gap.

III. MATERIAL AND METHODS

Samples were collected regularly at monthly intervals by using plankton net and preserved in 5% formalin during Jan.2020 to Dec.2020 for water quality following the standard method (APHA,1999). The physico-chemical parameters of water quality samples were collected separately from fixed from five sampling sites (A, B, C, D and E) of the river to study the seasonal variations.

Water samples were collected monthly in the morning at 8 am to 10 am from surface layer of the river. Physico-chemical parametrs analysis of water samples were made following standard methods suggested by APHA, AWWA, WPCI (2005).

1. Temperature:
The fluctuations in temperature of different stations may be due to the influence of environmental temperature due to that point of time.

2. pH:
The pH is one of the most important factors that influence the aquatic production. In the present study the pH was found to be basic. The range of pH was 7.0-8.15.The higher basic state of pH at Station 6.

3. Electrical Conductivity:
Electrical conductivity is useful tool to evaluate the purity of water which is minimum at Stations 1 and 5 and maximum at Station 7.

4. TDS:
TDS are those which get dissolved in water cannot be separated from water by filtration. They may be chemically organic or inorganic. According to (Trivedi and Goel) TDS are composed mainly of carbonates, bicarbonates, chlorides, sulphates, calcium, magnesium, phosphate, nitrate, sodium, potassium and iron.

In the present investigation, the highest value of TDS was recorded at Station 7. The high value may be due to the evaporative loss of water and consequent increase in the concentration of salts present in water.

The ISI standard for dissolved solids is up to 500 mg/lit and the maximum permissible quantity is 1500 mg/lit (WHO Guidelines for drinking water quality). The results indicate that all the samples of water from all stations were less than permissible limit of ISI standard.

5. Total Hardness:
The total hardness of water samples ranges from (55.55-402.77) mg/lit. According to ISI, the acceptance limit of total hardness (as CaCO3) is 200 mg/lit which can be extended to 600 mg/lit. Ca++ & Mg++ are important ions contributing towards total hardness. Hardness has no known adverse effects.

Hardness above 200 mg/lit of water is not suitable for domestic use in washing, cleaning and laundry. The acceptable limit of Ca++ & Mg++ for domestic use are 75 mg/lit & 200 mg/lit respectively (ISI).But according to Ministry of Rural.

6. Alkalinity:
The phenolphthalein alkalinity of all the water samples is 0. But the total alkalinity is found between 225 to 662.5 mg/lit. According to ISI, the acceptable limit of total alkalinity of drinking water sample is 500 mg/lit and maximum desirable limit is 1500 mg/lit.

7. DO:
In the present investigation, DO was found to be in the range of 2.0-4.52 mg/l. This reveals that the DO at all Station is within the acceptable limit. Color: Color is vital as most water users, be it domestic or industrial, usually prefer colorless water. Determination of color can help in estimated costs related to discoloration of the water.

8. TSS:
Total Suspended solids are an indication of the amount of erosion that took place nearby or upstream. This parameter would be the most significant measurement as it would depict the effective and compliance of control measures e.g. riparian reserve along the waterways. The series of

sediment-induced changes that can occur in a water body may change the composition of an aquatic community.

The settling of suspended solids from turbid waters threatens benthic aquatic communities. Deposited particles may obscure sources of food, habitat, hiding places, and nesting sites.

IV. PREDICTION AND OPTIMIZATION ALGORITHM

1.Optimization Algorithm:

1.1 Neural Network Algorithms: Artificial Neural Networks arguably works close enough to the human brain. Conceptually artificial neural networks are inspired by neural networks in the brain but the actual implementation in machine learning is way far from reality. ANN take in multiple inputs and produce a single output. Point to note ANN's are inspired by the animal brain, but nowhere close to biological neural networks.

1.2 Neural Network Architecture: Neural networks consist of input, output layers hidden layers. Transformation of input into valuable output unit is the main job. They are excellent examples of mathematical constructs.Information flows in neural network happens in two ways.

1.3 Feedforward Networks – In these signals only travel in one direction without any loop i.e. towards the output layer. Extensively used in pattern recognition. This network with a single input layer and a single output layer can have zero or multiple hidden layers though. This method has two common designs as below

- At the time of it's learning or "being trained"
- At the time of operating normally or "after being trained"

1.4 Feedback Networks: In this recurrent or interactive networks can use their internal state (memory) to process sequences of inputs.Signals can travel in both directions with loops in the network. As of now limited to time-series/sequential tasks. Typical human brain model.

2. Architectural Components:

2.1 Input Layers, Neurons, and Weights: The basic unit in a neural network is called as the neuron or node. These units receive input from the external source or some ANNother nodes. The idea here is to compute an output based associated weight. Weights to the neuron are assigned based on its relative importance compared with other inputs. Now finally function is applied to this for computations.

2.2 Let's assume our task to it to make tea so our ingredients will represent the "neurons" or input neurons as these are building blocks or starting points. The amount of each ingredient is called a "weight." After dumping tea, sugar, species, milk and water in a pan and then mixing will transform it another state and colour. This process of transformation can be called an "activation function.

2.3 Hidden Layers and Output Layers – The hidden layer is always isolated from the external world hence its called as hidden. The main job of the hidden layer to take inputs from the input layer and perform its job i.e calculation and transform the result to output nodes. Bunch of hidden nodes can be called a hidden layer.

Continuing the same example above – In our tea making task, now using the mixture of our ingredients coming out of the input layer, the solution upon heating (computation process) starts changing colour. The layers made up by the intermediate products are called "hidden layers". Heating can be compared with the activation process at the end we get our final tea as output.

3. Neural Network Work Flow-Layers of Learning:

Neural networks learning process is not very different from humans, humans learn from experience in lives while neural networks require data to gain experience and learn. Accuracy increases with the amount of data over time. Similarly, humans also perform the same task better and better by doing any task you do over and over.

Neural Network Algorithms' underlying foundation of neural networks is a layer and layers of connections. The entire neural network model is based on a layered architecture. Each layer has its own responsibility. These networks are designed to make use of layers of "neurons" to process raw data, find patterns into it and objects which are usually hidden to naked eyes.

To train a neural network, data scientist put their data in three different baskets.

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- **Training Data Set:**This helps networks to understand and know the various weights between nodes.
- **Validation Data Set:**To fine-tune the data sets.
- **Test Data Set:**To evaluate the accuracy and records margin of error.

Layer takes input, extract feature and feed into the next layer i.e. each layer work as an input layer to another layer.

This is to receive information and last layer job is to throw output of the required information. Hidden layers or core layers process all the information in between.

- Assign a random weight to all the links to start the algorithm.
- Find links the activation rate of all hidden nodes by using the input and links.
- Find the activation rate of output nodes with the activation rate of hidden nodes and link to output.
- Errors are discovered at the output node and to recalibrate all the links between hidden & output nodes.

We outline a few main algorithms with an overview to create our basic understanding and the big picture on behind the scene of this excellent networks.

- Feedforward algorithm
- Sigmoid – A common activation algorithm
- Cost function
- Back propagation
- Gradient descent – Applying the learning rate

V. RESULT AND ANALYSIS

Bihar river of Rewa city (M. P.) Samples were collected regularly at monthly intervals by using plankton net and preserved in 5% formalin during Jan.2020 to Dec.2020 for water quality following the standard method (APHA,1999). The physico-chemical parameters of water quality samples were collected separately from fixed from five sampling sites (A, B, C, D and E) of the river to study the seasonal variations. Water samples were collected monthly in the morning at 8 am to 10 am from surface layer of the river. Physico-chemical parametrs analysis of water samples were made following standard methods suggested by APHA, AWWA, WPCI (2005).

Table 1. Sample collection with parameters.

S. No.	Parameters	Summer season	Monsoon season	Winter season	Average
1	pH	6.91	7.08	7.16	7.05
2	TDS (mg/l)	120	92	36	82.67
3	Carbonates (mg/l)	0	0	0	0
4	Bicarbonates (mg/l)	57	31	20	36
5	Chloride (mg/l)	16	36	8	20
6	Total Hardness (mg/l)	30	12	17	19.67
7	Calcium (mg/l)	6.3	3.3	6.7	5.43
8	Magnesium (mg/l)	1.9	0.94	2	1.61
9	Sodium (mg/l)	27	24	8	19.67
10	Potassium (mg/l)	1.2	1.2	1.2	1.2
11	DO (mg/l)	6.5	7.3	8.2	7.33
12	Free CO_2 (mg/l)	36	5.6	21.5	21.03
13	BOD (mg/l)	0.4	3.5	4	2.63
14	COD (mg/l)	1.3	3.6	8.7	4.53
15	Nitrate (mg/l)	0.37	0.32	0.06	0.25
16	Phosphate (mg/l)	0.05	0.037	0.03	0.039

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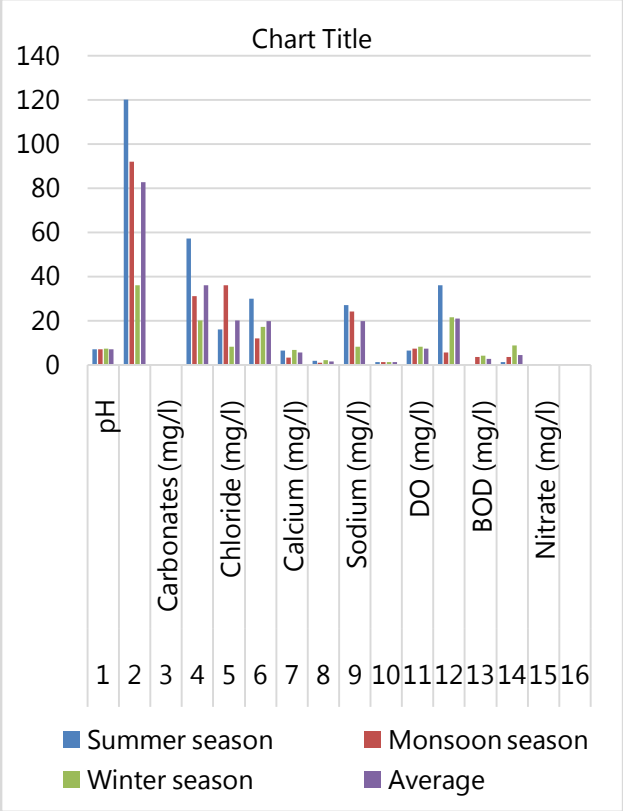

Fig 1. Bar graph of prediction model.

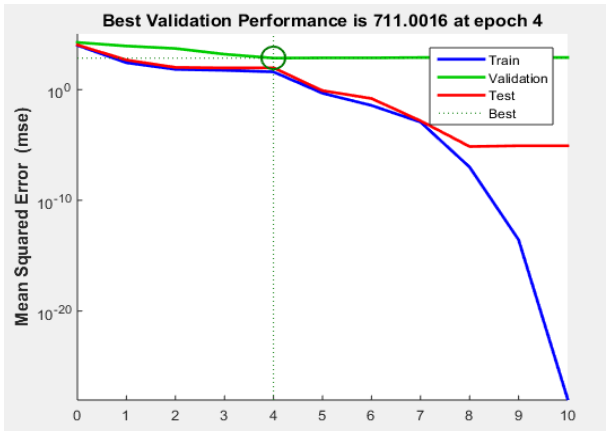

Fig 2. MSE based performance evaluation.

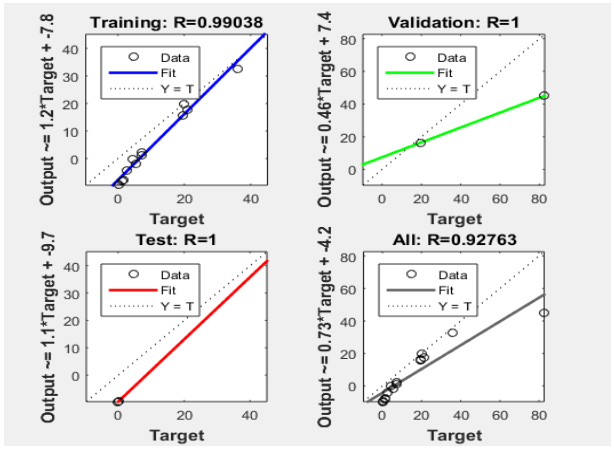

Fig 3. Regression factor variation.

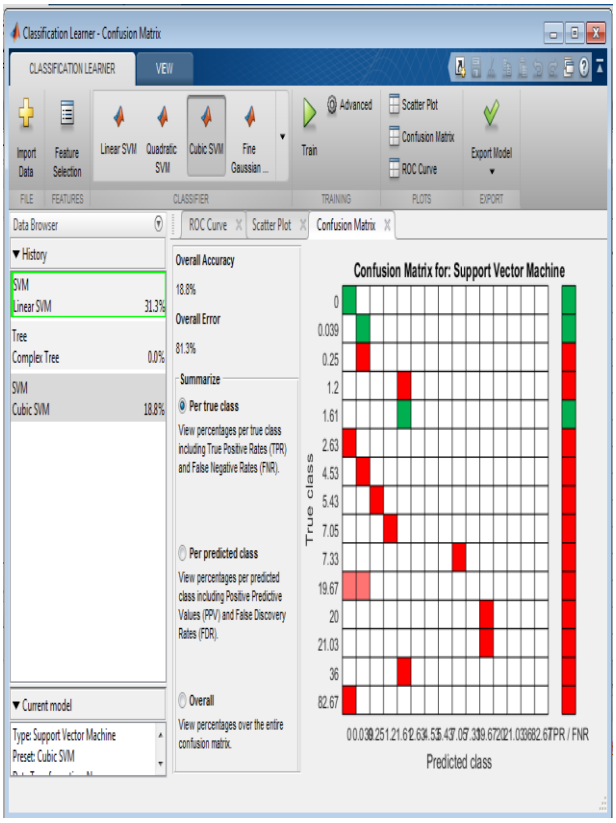

Fig 4. Confusion matrix using SVM.

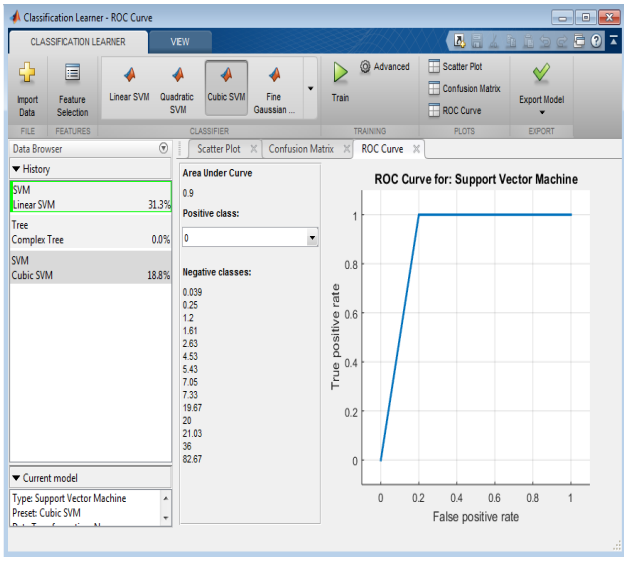

Fig 5. ROC curve.

VI. CONCLUSION

Modeling and prediction of water quality are very important for the protection of the environment. Developing a model by using advanced artificial intelligence algorithms can be used to measure the future water quality. In this proposed methodology, the advanced artificial intelligence algorithms, namely, NARNET and LSTM (long short-term

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memory) models were used to predict the WQI. Moreover, machine learning algorithms such as ANN,SVM and Naive Bayes were used to classify the WQI data. The proposed models were evaluated and examined by some statistical parameters.

For the WQI prediction, the result has revealed that the performance of the NARNET (namely nonlinear autoregressive neural networkmodel) is slightly better than the LSTM model based on the obtainedvalue.

However, the ANN algorithm has achieved the highest accuracy of the prediction of the WQC as compared with SVM and Naive Bayes algorithms. After examining the robustness and efficiency of the proposed model for predicting the WQI, in future work, the developed models will be implemented to predict the water quality in Bihar river of Rewa city (M. P.) for different types of water.

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