An Review on Flood Forecasting over Shivnath River Basin Near by Rajnandga on Region of chhattisgarh

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Abstract—Floods are a natural disaster that has become a major threat worldwide. Floods cause damage to people's lives and property. Therefore, accurate valuation of flood water levels is very important in flood modeling as it allows sufficient time for nearby residents to recognize the flood for emptying purposes. However, the water level is not very linear due to flood dynamics.This paper reviews various features of flood forecasting, consits models used, techniques for gathering inputs and presenting results, and warnings. Establishing deep learning-based models predicting river flow can effectively reduce extreme flood damage. This paper proposes a MLPBPN (Multi-Layer Perceptron Back Propagation Network) forecasting model based on multiple input and multiple output strategy and this model is applied to the river basin flood forecasting process at Shivnath, which measures river basin discharge. Accurately predicts trends. The MLPBPN model improves the reliability of flood forecasting and improves the internal interpretation of the model, which is very important to effectively improve the effectiveness of flood forecasting.

Keywords-Flood forecasting, deep learning, Shivnath River Basin,multi-layer perceptron back propagation network.

I. Introduction

Several flood forecasting studies have been contributed along the Shivnath River in recent years due to frequent floods.

The area is damaged and growth is hindered. Floods are caused by rivers, streams,lakes or by excessive rainfall. There is a possibility of massive damage to property, human suffering and loss of life. It is important that the forecast is accurate, especially for flood control and proper timing to avoid major losses and disasters during the reservoir.Floods are naturally occurring events, usually when an area suddenly dries up or the land is submerged. Simply put, a flood can be well-defined as the flow of large amounts of water over usually dry land. Flooding can occur in a number of ways, either by overflowing rivers,lakes or by excessive rainfall. A warning system is needed to take precautionary measures and be more prepared to deal with its effects.

According to dissimilar types of floods, flood forecasting systems require different types of structures, and flash floods and storm surges are not common to floods, but have high social impacts. Flood warning systems have been in place for many years. This system can reduce the risk of flooding. A flood warning should contain more information than a flood forecast. Sometimes the performance of flood forecasting and flood warning systems is unsatisfactory due to poor performance of connecting components. A successful system requires adequate integration of components. This review focuses on the application of algorithms, models, techniques and systems for flood forecasting and flood warning systems.

Objective

In this paper, We study about NN model for flood forcasting of Shivnath river which present in Chhattisgarh state.

i. In depth study of Multi-Layer Perceptron Back Propagation Network (MLPBPN) for identification of internal dynamics of highly non-linear dynamic system like weather data time series.
ii. To recognize correlated ocean/earth surface predictors i.e. meteorological parameters those are physically connected with long-range SW monsoon rainfall over Rajnandgaon region geographically located at 21.10°N 81.03°E.
iii. Optimization of parameters of MLPBPN architecture before training the network.
iv. Development of a MLPBPN model for Flood forecasting over Shivnath River nearby Rajnandgaon region..

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II. Flood Problem in Indian River

The major flood problems in India are drainage congestion due to flooding, urbanization and riverbank erosion (Diaconu, Costache, & Popa, 2021). Problems depend on the river system site topography and flow phenomena. Being a large country, the flood problem in India can be seen on a regional basis.

A.Basin of the Brahmaputra river

The first region is the catchment area of the Brahmaputra and Barak rivers and their tributaries. It includes the states of Assam, Arunachal Pradesh, Meghalaya, Mizoram, North West Bengal, Manipur, Sikkim, Tripura and Nagaland. Heavy rains fall in the catchment area of these rivers. As a result, flooding in the region is frequent and severe. The general tectonic envelopment of the northeast region has also had a significant impact on the Brahmaputra River. Almost all northern tributaries of the Brahmaputra are affected by landslides in the upper basins. Additionally, the rocks of the hills from which these rivers originate are fragile and eroded, so the rivers carry exceptionally high levels of sediment. In addition(Prasanna, Subere, Das, Govindarajan, & Yasunari, 2014), the region is prone to violent and frequent earthquakes, causing numerous landslides in the hills, disturbing the river regime. Significant issues in the area are riverbank runoff, drainage congestion due to natural and man-made structures, and flooding due to changes in river flow. In recent years, erosion of the banks of the Brahmaputra has occurred on a large scale and is of great concern to water resources engineers. The major flood problem (Wang, Wang, & Cui, 2019) in Assam is flooding due to overflow of the Brahmaputra and Barak rivers and their tributaries. Additionally, erosion is a serious problem along the banks of the Brahmaputra River.

B. Ganges Basin

The Ganges and its many tributaries (Yamuna, Sun, Ghaghara, Gandak, Kosi and Mahananda) form the second region. This region includes Uttaranchal, Uttar Pradesh, Bihar, southern and central parts of West Bengal, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh and parts of Delhi(Nandargi & Shelar, 2018). The region's normal annual rainfall ranges from 60 cm to 190 cm, more than 80 percent of which falls during the southwest monsoon. Precipitation increases from west to east and from south to north.

The problem of flooding is mainly confined to areas on the northern banks of the Ganges. The northern tributaries of the Ganges were damaged by overflowing their banks and altering their course. Although the Ganges discharges large volumes (57,000 to 85,000 m3/s), water and erosion problems are confined (Acharya & Prakash, 2019) to a few areas. Generally, the flood problem increases from west to east and from south to north. There is a drainage problem in the northwestern parts of the area. The southern parts of West Bengal also have drainage problems.

C. Northwest River Basin

It is the third region and includes the basins of northwestern rivers such as Sutlej, Ravi, Beas, Jhelum and Ghaggar. Compared to the two mandals above (Acharya & Prakash, 2019), the problem of flooding is less in this mandal. The main problem is insufficient surface drainage, which leads to flooding and waterlogging. Another cause of flooding is inundation of irrigated areas and change in river regime due to rising groundwater level (Gamage & Ilmini, 2019). At present, Haryana and Punjab mainly face drainage congestion and waterlogging. The Ghaggar River flows through Punjab and Haryana and merges with the sand dunes of Rajasthan. In Kashmir, frequent flooding from Jhelum raises the level of Wular Lake, causing flooding in marginal areas of the lake.

D. Central India and the Deccan River Basin

The important rivers of the fourth region are Narmada, Tapi, Mahanadi, Godavari, Shivnath, Krishna and Kaveri. Most of these rivers have well-defined stable courses. The medium slopes of the bed are able to carry significant floods in their lower course and their natural banks, except in the delta areas where they are very flat (Tian, et al., 2009). Dams have been built in the lower reaches of major rivers on the east bank. This region covers all the southern states like Andhra Pradesh and Chhattisgarh.

Karnataka, Tamil Nadu, Kerala, Orissa, Maharashtra, Gujarat and parts of Madhya Pradesh. Except for a few rivers of Orissa (Brahmani, Baitarani and Subarnarekha), the region has no serious problem. The delta areas of the Mahanadi(Kar, Lohani, Goel, & Roy, 2015), Godavari and Krishna rivers on the east coast face periodic flooding and drainage problems after cyclones. Tapi and Narmada are sometimes subject to heavy flooding affecting the low lying areas of Gujarat. The problem of flooding in Andhra Pradesh is limited to small rivers flowing along Kolleru Lake and flooding of marginal areas. Rivers like Budameru and Tammileru not only overflow their banks into Kolleru Lake, but the surrounding lands are submerged due to rising levels. Mahanadi, Brahmani, rivers cause flooding in Odisha.

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Water levels and rivers often overflow their beds or break new channels, causing huge losses. The lower parts of the Golden Line were flooded and congestion of pipes. Small rivers in Kerala often cause major damage due to heavy flooding. Apart from this, there is also the problem of silt from the hills.
It causes enormous damage..

III. Study Focused Area: Shivnath River Basin

Sheonath River also known as Shivnath originates near Panabaras village in Rajnandgaon district. The basin lies between latitude 200 16' N to 220 41' N and longitude 800 25' E to 82035' E. The catchment area of the river up to its confluence with the Mahanadi is 30,860 square kilometers. The length of the river is 380 km. The foremost tributaries of shivnath river are Tandula, Kharun, Arpa, Hump, Agar and Maniari rivers.

Figure 1: Shivnath River Basin in Chhattisgarh India

The topography of the watershed is almost flat. The slope ranges from 1% to 2% and the average slope of the watershed is 1.6%. The Shivnath Basin has (Swain, Verma, & Verma, 2018)a tropical wet and dry climate; Temperatures are very hot from March to June, but moderate throughout the year. The annual average rainfall of this basin is 1150 mm. It rains during the rainy season i.e. from June to early October.The annual average rainfall in the basin ranges from 1005 mm to 1255 mm.

IV. Forecasting Model used in India

Accurate flood forecasts must be provided in advance to allow sufficient time, known as lead time, to evacuate people from flood-prone areas (Kang, Lee, Hong, Oh, & Jeong, 2010). The time available for flood forecasting is very short. This makes it very difficult to implement an evacuation plan during floods. Technologies available for real-time flood forecasting can be classified into four groups:

A. Statistical Method

A statistical approach is the simplest method to find the relationship between stage and discharge upstream and downstream gauging stations. This method is less effective (Jain, et al., 2018), but gives better results during heavy rains due to the influence of tributaries in the main stream.

B. Deterministic Modeling

One of the main areas of hydrology is the study of changes in the temporal distribution of rainfall. This conversion study first directly relates the amount of precipitation to the amount of surface runoff, thereby determining the time distribution of excess precipitation, and then converts it directly into a discrete or continuous mathematical model for the time distribution of runoff.

C. Stochastic Modeling

Several stochastic/time series models have been proposed to model hydrological time series and generate synthetic stream flows. Time series models are best suited for real-time forecasting, as online updating of model estimates and parameters can be achieved using various updating algorithms (Tang, Liang, Hu, Li, & Wang, 2020). A dynamic stochastic time series model was found to be the best fit for online flood forecasting. These models also provide a means of measuring forecast error, which can be used to estimate the risks involved in making decisions based on these forecasts. In addition, these models are also applicable to interrupted data sequences and are easy to implement on computers and other computing devices.

D. Computational Techniques

i) K-mean : The K-means clustering method is described as a partitioning method. It partitions the data into k , each providing a vector of unique clusters and indices indicating which k-clusters are assigned to which observations.

ii) Fuzzy
Mathematical models based on physical considerations or statistical analysis have been developed to predict floods from small and large catchments. Current flood forecasting models are highly data specific and complex. Unlike mathematical models(Kar, Lohani, Goel, & Roy, 2015), which require precise knowledge of all contributing variables, fuzzy logic, on the other hand, provides a simple, less assumption-dependent and self-contained approach to modeling inherently complex flood processes. and non-linear. and

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dynamic. Fuzzy reasoning-based models can be used to model processing behavior even with incomplete information. Fuzzy logic is widely regarded as an effective approach to effectively deal with inherent non-linearities in hydrological processes.

iii) ANN
An artificial neural network (ANN) is introduced to model real-time problems in which the non-linear relationship between precipitation and runoff processes is modelled (Dtissibe, Ari, Titouna, Thiare, & Gueroui, 2020). Many ANN architectures and algorithms have been developed in the artificial network world, such as recurrent networks(Gamage & Ilmini, 2019), self-organizing feature maps, multi-layer feed forward and counterpropagation networks. However, multi-layer feed forward networks are commonly used for hydrological applications.

V. PROPOSED METHODOLOGY

The architecture of an ANN depends on the type of ANN used. In this study, a multi-layer perceptron back-propagation (MLP-BP) neural network, which is the most common ANN used in prediction studies, is used. The popularity of MLP-BP reflects its simplicity, ease of implementation, and success in study assessment. Figure 1 provides an example of the MLP-BP architecture. MLP-BP consists of three layers (Kauffeldt, Wetterhall, Pappenberger, Salamon, & Thielen, 2016), input layer, hidden layer and output layer. There can be only one input level and one output level; However, there may be more than one hidden layer. Neurons are stored in each layer and the total number of neurons is set by the user. The number of neurons in the input layer is equal to the number of data inputs selected in the study. The number of output neurons in the output layer is usually one, resulting in a prediction output. The number of neurons in the hidden layer is subject to user choice. Often, the number of input neurons and hidden neurons is determined by trial and error. Additional dummy neurons called bias neurons are added to the input layer and each hidden layer. The bias neuron acts as a threshold value so that the estimated output value is between 0 and 1. Neurons are interconnected between layers as shown in the figure. The link direction is from the input layer to the output layer and these links represent the computational process in the ANN architecture.

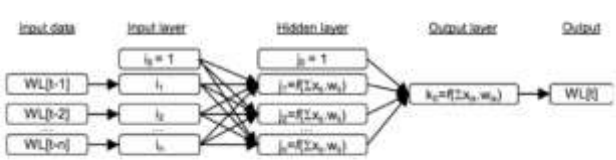

Figure 2: Multi-Layer Perceptron Back-Propagation

The actual computation process takes place in the neuron, where the activation transfer function given to the neuron is used to estimate the incoming value and produce the output. In an input neuron, the activation transfer function transmits the incoming data input to the output. In the hidden and output neurons, the activation transfer function calculates the incoming value and produces the output. In input neurons, the activation transfer function is a linear transfer function.

Multilayer Perceptron
A multilayer perceptron is a feed-forward neural network with three types of layers: input, output, and hidden. The input layer receives the input signal for processing. The output layer performs tasks such as classification and prediction. The accuracy computation engine of a multilayer perceptron contains of an uninformed number of hidden layers between the input and output layers. Similarly, data flows from the input layer to the output layer in a multilayer perceptron. Neurons in a multilayer perceptron are trained using backpropagation learning algorithms. Multilayer perceptrons are designed to approximate any continuous function and can solve problems that are not linearly separable.

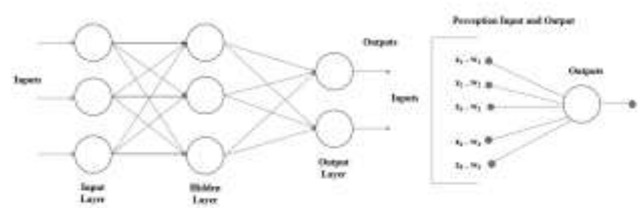

Figure 3: Multilayer Perceptron architecture

VI. EXPECTED OUTCOMES

The ability to predict river flow can help predict future floods, leading to better preparedness to prevent loss of life and minimize property damage. Forecasting studies usually require historical time based datasets so that future events can be predicted based on past events. Good quality river flow data should be maintained for local or government agencies such as water authorities to facilitate reliable river flow estimation.
In the study, we use a multi-layer perceptron back propagation network to solve long-range flood forecasting. The model helps predict the flood situation a month before the rainy season.Better data training will help improve the accuracy of flood forecasting in the Shivnath river basin and

thereby monitor future floods. For future research on applying the linear transfer function to output neurons and MSC hidden neurons, it is highly recommended to find a better and more flexible optimization technique that can reduce the disadvantage of large hidden and output neurons in weight settings. The difference can be resolved. Backpropagation. Algorithm.

VII. Conclusion

In India, most of the techniques for flood forecasting are based on statistical approach. For some pilot projects, network models and multiparameter hydrological models are used. Traditional communication systems are frequently used to transfer data in real time. Automated data communication systems such as telemetry systems are being used in limited scale pilot projects. Arid and semi-arid regions commonly experience flooding. Hence there is no flood forecasting system in this area. This is causing huge loss of life and property.India's real-time flood forecasting system needs significant improvement. An efficient automated communication system should be established for real-time data exchange. Deterministic models such as deterministic models, stochastic models, ANNs and fuzzy logic methods should be studied and suitable method for field applications can be recommended based on performance evaluation criteria and data availability and prediction purpose. People likely to be affected by floods should be informed about floods in advance so that emergency relief plans can be prepared and properly implemented. Need for hydrological information system should be developed for all river basins in India.

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