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Rainfall Prediction in Hilly Region Using Hybrid Ant Bee Algorithm Incorporated Fuzzy Expert System

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ABSTRACT

The weather on a mountainside varies based on the altitude (height). There could be a warm environment in the foothills (down at the bottom), whereas the peaks (the tops of hills) could well be blanketed with ice.It must be said that the region receives the most south west monsoon rainfall of about 35% in September, whereas August receives just 29%. The south west monsoon rains fall 18% and 20% in June and July, accordingly..Agriculture and related industries agro - climatic area management is primarily energy organization. In fact, the regional approach to climate modification is a desire to identify local risk, premised on which effective solution measures can be developed for sustaining natural equilibrium and environmental sustainability, especially in sub tropics under monsoon variation. However, the majority of research much further has been determined by the perceived variations in weather patterns global factors. As a result, we must migrate from broad generalities to local details in order to construct a credible impact estimate on a local scale.The two major goals of a fuzzy inference system driven microarray data categorization are efficiency improvement and complex reduction. To determine the fuzzy segmentation involved in gene predicting the value and generate a simplified rule - based system, ant colony optimization (ACO) with global and regional signal modifications is used. This work uses the artificial bee colony (ABC) algorithm to generate the elements of membership function in order to handle the mutare and uninterrupted expression patterns of a gene. In order to identify useful genes, mutual data is employed. Numbers of genomic data sets are used to assess the efficiency of the suggested hybrid Ant Bee Algorithm

1. INTRODUCTION

The work's main criterion is a recent issue on agriculture in Tamil Nadu, India's mountainous region. Nilgiri, Dindigul, Salem, Coimbatore, and Theni are some of the hill regions that have been targeted for improving agricultural output by focusing on habitat, hydrology, and crop productivity. One of the paper's key objectives is to develop methodologies for forecasting meteorological events, particularly rainfall, for agricultural production and growth. Research processed data for hilly areas is at a range of 2010 - 2020.The Nilgiris range in altitude from 900 -2636 m above sea level. Its longitudinal and latitudinal dimensions are 130 kilometresby 185 kilometres. The Nilgiris are bordered by Karnataka State on the north, Coimbatore District and Erode District on the east, Coimbatore District and Kerala State on the south, and Kerala State on the west. The geography in the Nilgiris District is uneven and hilly. Slopes consisting of up to 35% cover approximately 60% of the cultivable terrain.Dindigul is 420 kilometres southwest of Chennai, 100 kilometres from Tiruchirappalli, 66 kilometres from Madurai, and 72 kilometres from Karur, the state capital. Dindigul contains 200,000 hectares of cultivable land, and agriculture is still the primary source of income for the locals. Dindigul contains an 85-hectare forest reserve nestled between the Palani and Sirumalai Hill region. Dindigul has latitude of 10.3 and a longitude of 77.9.At an average altitude of 278 metres, Salem is positionedat 11.67°N 78.14°E. Nagaramalai, Jarugumalai, Kanjamalai, Godumalai and the Shevaroy Hills on the north, south, west, east and northeast respectively surround the city. Kariyaperumal Hill is located in Salem's southwest corner.The coordinates for Coimbatore are 11.0161°N 76.971°E. Coimbatore is at a distance of 490 Km south of Chennai, 190 km south of Mysore, and 330 Km south of Bangalore. Coimbatore is only 25 Km from Kerala's boundary. It is located in the western part of Tamil Nadu, close to the state's line with Kerala, and is encircled by the Western Ghats on all dimensions.Theni District is located at the base of the Western Ghats. Dindigul District is located to the north, Madurai District to the east, Virudhunagar District to the south, and Kerala State to the west.Theni has a latitude and a longitude of 10.01and 77.47 respectively.The several studies on this topic are vulnerable to the swings of the weather, but they could not include a clear illustration of agricultural growth and yield forecasts.

Table.1.Observation of parameters

Place	*Rainfall*	*Cloud*	*Temperature*	*Humidity*	*Wind speed*	*Wind direction*
Nilgiri (Uthagamandalam)	20.35	20	15.5	158	8.6	SW

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Dindigul (Kodaikanal, Sirumalai)	12.51	26	14.5	179	4.5	NW

Salem (Yercadu)	13.8	35.6	21	220	6.7	SW
Coimbatore (Valparai)	10	24.6	22	194	7.5	SW
Theni (Meghamalai)	8.2	43.3	21	241	4.5	SW

2.METHODOLOGY

In our proposed model we combined the Hybrid ant bee algorithm and fuzzy expert system and incorporate a new method HABF.

Fig 1 Architecture of HABF

2.1 HYBRID ANT BEE ALGORITHM

Ant colony optimization keeps track of a colony of ants as well as a series of permitted intervals for each input variable of the possible outcome. Every ant is given the option of selecting an acceptable route limit. After all of the ants in the colony have selected their way, the potential distinct value related with the path is used as the ant's proposal variable. The optimal solution is then determined by combining the proposed values of all the ants.

The artificial bee colony method operates with the location of the source of food as a reasonable option for the improvement challenge, and the optimal solution is examined in three segments: employed, onlooker bee and scout bee. Employed Bees are allocated to a source of food, Onlooker Bees are resting on the performance area for a judgment to have a food supply, and a Scout Bee is conducting a search strategy. The suggested Ant Bee Method integrates swarm intelligent algorithm and artificial bee colony algorithm strengths.

Produce a new solution v_{ij} by using equation,

$$v_{ij} = x_{ij} + \varphi_{ij} (x_{ij} - x_{kj})$$

For representing the response parameters of the fuzzy logic system, Ant bee algorithm employs a simplified type of description. The demand for a specific design is critical the discourse analysis of the text such as low, medium, and high. The layer's class designation and the transcriptional value are either normal or extreme.

2.2 FUZZY EXPERT SYSTEM

2.2.1 FUZZINESS

For determining the linguistics of inputs, the domain of every input is segregated into regions. Because the rule's goal is to figure out what is causing the fuzziness, I t is expressed using integers and is dependent on the measured variable of a gene. For each rule set, an integer number is assigned, overcomes the prior Genetic swarm algorithm posing peak issue a method based on binary strings. . The parameters that are depicted, as fuzzy sets in this paper are District (DI), Rainfall (RF), Temperature (TE), Humidity (HU), wind speed (WS), Wind Direction (WD) And Cloud Status (CS). The basic structure of the fuzzy sets, which has been used in this study, is shown in Table 2. In Table 2,

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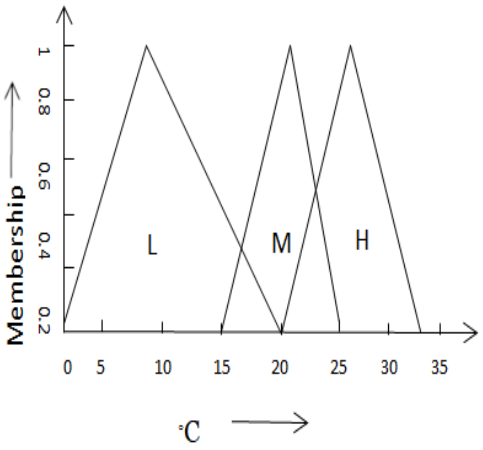
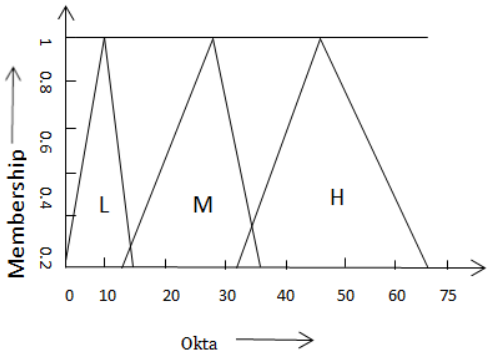
RF (°C /hour) is characterized by three categories, whether the atmosphere Rainfall is Low, Moderate and High. The WD have been classified into NW, W, SW, NE. Similarly, others have been defined. These fuzzy sets have been created from the qualitative study of Rainfall Event and quantitatively defined by membership functions. These functions contain a specified domain of the value of the system input and have been shown in Figure 2 in the form of singleton.

Table 2.

Parameter	District	Rainfall (mm)	Temperature (°C)	Humidity	Wind Speed (mph)	Wind Direction	Cloud Status (okta)
1	Nilgiri	Low	Low	Low	Low	NW	Scattered
2	Dindigul	Moderate	Moderate	Moderate	Moderate	W	Partily cloudy
3	Salem	High	High	High	High	SW	Partly Sunny
4	Coimbatore					NE	Overcast Cloud
5	Theni						





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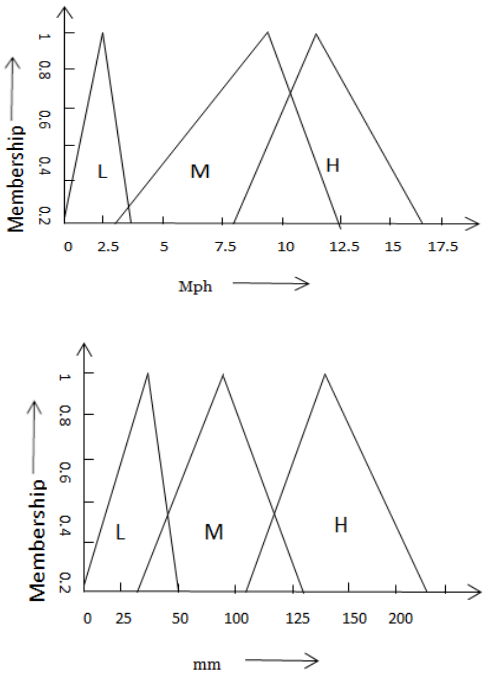

Fig 2 : The above results (a), (b), (c) and (d) are the simulations of the membership functions obtained for the parameters speed of temperature in ◦C , cloud status in terms of Okta, wind in terms of mph and rainfall in mm respectively.

2.2.3 FUZZY RULE

'IF A, THEN B,' where A, B are identifiers for fuzzy rules with correct parameter, are fuzzy IF-THEN rules. Combining language factors and fuzzy membership, a fuzzy IF-THEN rule could easily represent the concept of a humanistic thumb rule. According to the coastal regions of interest and the range of rainfall, many IF-THEN rules have been constructed.

We've compiled a list of some of the IFTHEN rules that have been prepared for prediction. After the rainfall event, the IF – THEN rules developed to anticipate the proceeding weather event that occur. The total number of rules is the product of the number of fuzzy sets in the system. In other words, the number of rules equals all possible permutations of categorized system inputs. From Table 2, Five sets are associated with the DI, three with the RF, three with the TE, three with the HU, three with WS, four with WD and three with the CS. The total number of rules that completely define the set then is 5X3X3X3X4X4 = 6480. These rules are defined in such a way that if six parameters are RF, TE, WS, WD and CS with high, low, high, low, now and Scattered respectively then there will be a very high probability of Flood formation. In a similar way, other rules have been defined. These rules are shown in tabular form in Table 3. The prediction of Rainfall Event is based on the degree of the membership of the inputs from the evaluation of a set of predefined rules. The strength of a rule is derived from the corresponding degrees of membership of the inputs. Since an input can be a member of multiple fuzzy sets, then another set of rules involving these sets can be applied. The higher degrees of membership result in corresponding rules, which have more strength in the final computational process. In particular, to be able to deploy fuzzy logic in a rule-based system, one needs to be able to handle the operators „AND' and „OR' and carry out inferencing on the rules. Therefore, we need to be able to perform the intersection and union of two fuzzy sets. To calculate the intersection of a pair of fuzzy sets there are a family of functions, triangular norms or *T*-norms, that meet certain requirements such as monotonicity, commutativity and associativity and the intersection of a fuzzy set.

Rule no.	District	Rainfall	Temperature	Humidity	Wind Speed	Wind Direction	Cloud Status	Rainfall Event
75	Nilgiri	High	Low	High	Low	NW	Scattered	Flood
654	Dindigul	High	Low	High	Moderate	W	Partly Cloud	Heavy Flow
1789	Salem	High	Low	High	Low	NW	Partly	Flood

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							Sunny	
4009	Coimbatore	Low	Low	High	Low	NW	Overcast Cloud	swathe of paddy field
5087	Theni	Mode rate	Low	Mode rate	Low	NW	Scattere d	Flood

Table 3

3. RESULT AND DISCUSSION

3.1 Performance of FES for Rainfall Event.

It is possible to forecast using a variety of techniques. The method used by a forecaster is determined by the forecaster's experience, the amount of information available to him, the difficulty of the forecast situation, and the degree of accuracy or confidence required in the forecast. We used the persistence method of estimating input values to test our FES model with the developed dataset. Four categorizations of the predictions derived from the constructed model are used to calculate the accuracy, precision, and recall values. "Events anticipated in exact, "Events anticipated in imprecise, "Events anticipated incorrect," and" Events anticipated correct" are the four categories.

Accuracy can be calculated as,

$$\text{Accuracy} = \frac{\text{(Events anticipated in exact + Events anticipated correct)}}{\text{(Events anticipated in exact + Events anticipated in imprecise +Events anticipated correct + Events anticipated incorrect)}}$$

Precision can be calculated as,

$$\text{Precision} = \frac{\text{(Events anticipated in exact)}}{\text{(Events anticipated in exact + Events anticipated in imprecise)}}$$

Recall value can be calculated as,

$$\text{Recall value} = \frac{\text{Events anticipated correct}}{\text{(Events anticipated correct + Events anticipated incorrect)}}$$

Thus the accuracy, precision and the recall value of the proposed method can be calculated as 91%, 96% and 86%.

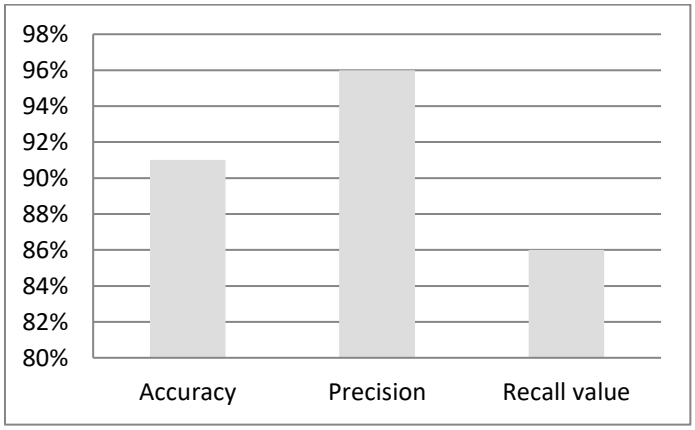

Fig 2

4. CONCLUSION

By our proposed model HBAF we get the accuracy result of 91% in Hilly Region. Regardless of the reality that multiple studies agree that rainfall in the hilly region varies, these investigations do not make a unique, uninterrupted overview of rainfall . Differences in observed seasonal rainfall could be explained by the significant instability of rainfall, as well as differences in the periods and locations evaluated. While the research provide a good picture of climate trends in Tamil Nadu's hilly regions overall, they mostly omit several of the climate factors that are important for rising crop production in the hilly region.

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