

# ANALYZATION OF RISK FACTORS FOR THE DENGUE FEVER OUTBREAK WITH THE EFFECT OF DIFFUSION PATH FOR SPATIOTEMPORAL CRITERION

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**Abstract-** To analyze the diffusion path for spatiotemporal and the main various risk factors of dengue outbreak. And uses for microscopic with the mechanism spatiotemporal data mining. At first level the dengue fever life cycle is analyzed by using the various procedures least square fitting and derivative. Then other methods like spatiotemporal Mapping and spatial analysis will be used to analyze the spatiotemporal hot spots, diffusion path and outbreak phase of the dengue fever. At last this study analysis the relationship between dengue fever and meteorology population, Breteau Index and different factors during dengue outbreak. It can effectively identify risk factors of dengue outbreaks using spatiotemporal and efficient reference for division's provision and controlling the disease. The result from this study shows that life cycle of dengue outbreak can be partitioned into 4 various stages: initial, starting, outbreak and maximum extinction

**Keywords –** diffusion path, spatiotemporal, dengue fever, outbreak, meteorology, extinction, Breteau Index

## I. INTRODUCTION

Dengue fever is one of the most dangerous mosquito borne infection diseases and can be spread by the dengue virus. It is transmitted by the Aedes mosquitoes. It is the most widely adopted in south East Asia, several countries more than 120 and those areas in the tropical and subtropical regions of the world. Within last 20 years, it is spread very quickly and with a wide range. Millions of dengue fever cases are diagnosed every year and also about 30,000 patients die from this disease. This disease prevention and also control is a very difficult issue. The dengue cases have been reported with a lot of increase. There are about 1237 dengue fever outbreak cases in the city karimnagar within 10 years. There is a one more very serious dengue fever was occurred in karimnagar. The spatiotemporal transmission risk research on this dengue fever, it is needed that its diffusion path characteristics, and main factors analyzation on mechanism for the dengue information outbreaks for health significance on prevention and also control of dengue fever.

It is analyzed to enlarge the relationship between dengue and the geographical environment to find the risk factors which occur for diffusion of the disease explain its spatiotemporal prediction. It is found that the land use capabilities like risk fields, gas stations, woodlands, wetlands, garden lands and the various areas are covered by vegetation, and will provide a different potential habitat for mosquito vector and revealed Dengue Fever is related to population, rain fall, temperature, monsoon, drainage system and some other factors. And it is identified the impact of population, network for transportation, the dengue diffusion for water bodies through a geographical weighted regression model. And it is analyzed and reported the dengue fever is related to the climatic conditions and sociologic conditions. The Breteau Index which reaches its highest value after a heavy rain fall for 6-7, it is noticed that the temperature is an important factor affecting the dengue fever diffusion. A generic algorithm back propagation model based on complicated graphic environment factors for the purpose of spatiotemporal prediction and for simulation of dengue fever.

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The results achieved to provide a guide for preventing and also controlling dengue fever for the macro perspective. The micro analysis is a powerless for small area such as street, colony, village, state and country tee. This paper detects various risk factors of dengue fever which includes all factors like population density, humidity, transportation, rain fall, wind direction, Breteau Index and many more.

**II STUDY AREA AND ASSOCIATED DATASETS**

*A. Study Area:*

This study is located at Karimnagar district in Telangana. This state is located in India. According to reports of Indian Census, the population in Karimnagar in 2016 is 261,190 where the male and female are 131,817 and 129,368 respectively. The longitude is 79, 1500 (799°0.000"E) N and latitude is 18,4333 (1825'59.880"N). This district is bordered by other districts like Warangal ,Medak ,Adilabad and Nizamabad. It is also adjacent to state like Maharashtra. The population of 228, 770 people. The altitude of this district is 265 m. Hinduism the major religion in Karimnagar town is Hinduism about 78%, the next second most religion in town is Islam about 20%, next is Christianity followed by 1.30 %, Jainism with 0.02 %, Sikhism with 0.37 % and Buddhism with 0.37 %. And 0.00 % stated for other Religion. Approximately 0.46 % gives nothing related to any religion.

*B. Data Sets:*

*1) The Maps for both Topographic and the Division of Administrative Data:*

We considered a map for topographic in 2015, and the satellite image is also in the year of 2015, next Karimnagar town complete map in 2015. Karimnagar is one of the Municipal Corporation and District head Quarter of Telangana state. And it is situated with the two banks of Manair River and Godavari River. In this state Karimnagar is 4th largest and very fastest growing urban settlement according to 2011 census. The population growth rate is 45.4% and 38.8% for the past two decades. It is a major educational, more health hub and business center for Granite industries.

Table I STREETS IN KARMINAGAR DISTRICT

Sl .No	Name of the street	Area (km <sup>2</sup> )	Sl. No	Name of the street	Area (km <sup>2</sup> )
1	<u>Gandhi road</u>	5.2	6	<u>Vidya nagar</u>	4.6
2	<u>Sikhvadi karimnagar</u>	3.5	7	<u>Mankammathota</u>	5.2
3	<u>Vavilalapally</u>	4.2	8	<u>Thirimal nagar</u>	4.2
4	<u>Ramnagar</u>	5.3	9	<u>Hussainpura</u>	4.1
5	<u>Ramachandrapur colony</u>	3.6	10	<u>Karkhanagadda</u>	3.8

*2) Dengue Data:*

The dengue data which is reported in our paper is collected from July 2 to October 14, 2016 to achieve the space dengue coordinates cases the resolution for space defines the central actual coordinates of both latitude and also longitude of different buildings with the various patients are located. Here in this case the total number of 50 Temporal, next maps for spatial hotspots are used.

*3) Breteau Index:*

This Breteau Index data which contains 15 regions are collected from August 20 to September 10, 2016.

*4) Meteorological Data:*

The study area for the meteorological data is obtained from Karimnagar Meteorological Bureau. Here the wind speed ,wind direction, maximum temperature, minimum temperature, rainfall data, all these are released for every 4 hours and collected into some groups.

*5) Population Data:*

According to the reports of Indian census the population of Karimnagar town 261,190; in this both male and female are 131,820 and 129,370 respectively. And for urban and metropolitan population is 297,447. And in this both male and female are 149,937 and 147,510 respectively.

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### III. EXPERIMENT AND RESULT

The research starts with the various methods like initially; a trend fitting procedure is to analyze the entire process of Dengue Fever to find outbreak. Next spatial correlation is analyzed for Dengue Fever outbreak and also to identify the link between Dengue Fever and all its factors. Lastly the spatiotemporal diffusion path for dengue is identified from spatiotemporal hotspots with the help of spatiotemporal data.

*1) Determining the Dengue Fever Life Cycle:*

To calculate a function model first we can apply the least square polynomial fitting method which is used for giving a name to this is  $k=f(x)$  taking out an optimal fitting function it has to meet a discrete point (a, b) data distribution. And here the fitting model for the first order derivative fitting we take the rate of change function is used to identify the change rate of Dengue Fever for an actual point.

$$f_1(t_0) = \lim_{\Delta t \rightarrow 0} \frac{\Delta b}{\Delta a} = \lim_{\Delta t \rightarrow 0} \frac{f(t_0 + \Delta t) - f(t_0)}{\Delta t}$$

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$$f_1(t_0) = \lim \Delta b / \Delta a = \lim f(t_0 + \Delta t) - f(t_0) / \Delta t$$

Now we are going to find out the second process derivative which is utilized to define the change rate of the first process derivative.

$$V = df_1(t) / dt$$

2) *Determining the spatial correlation:*

Here, the autocorrelation degree for spatial is analyzed with the Moran's I Index for Dengue Fever spatial distribution.

Sample variance is given as

$$S^2_m = \sum_{i=1}^n (m_i - m_1)^2 / n - 1$$

Where

$S^2_m$  = sample variance of variable

$m_i$  = variables values

$m_1$  = sample mean for variable m

n = sample size

Sample covariance is given as

$$S^2_{mn} = \sum_{i=1}^n (m_i - m_1)(n_i - n_1) / n - 1$$

Where

$S^2_{mn}$  = sample covariance between m and n variables

$m_i$  = variables values  $m_i$  from i to n

$m_1$  = sample mean for variable m

$n_i$  = variables values  $n_i$  from i to n

$n_1$  = sample mean for variable n

Here n means to size if sample or number of spatial different positions. The values observed for spatial position are given by m and n and a weight matrix for spatial is  $w_{mn}$ . If a spatial autocorrelation is in any region the standard I is used. The positive

Autocorrelation is achieved when Z value is negative autocorrelation and when Z is equal to zero or very closed to zero the values are randomly distributed. And here Z is given as

$$Z(I) = \{I - E(I)\} / \sqrt{\text{var}(I)}$$

The spearman correlation value is further computed for achieving the link between the Dengue Fever occurrence and with its main impact factors which includes all population, meteorological conditions and the Breteau Index with the following equation.

TABLE 2 Global Moran Index

$$P = 1 - 6 \sum r_i^2 / n(n^2 - 1)$$

Where n defines to sample size and  $r_i$  defines to the order of rank difference with various samples a and b (i= 1,2,3..n).

The Spearman correlation coefficient is assigned for rank variables. The sample of size l, the l is changed into ranks. According to Pearson product-moment correlation coefficient is a estimate e of the linear dependence for two variables Rand C, which gives a value between +1 and -1 comprehensive, the 1 is all positive linear correlation, 0 is no linear correlation, and -1 is all negative linear correlation.

3. Dengue Fever Comprehensive Pattern Mapping:

With this spatial autocorrelation the optimal distance is computed for generating the mapping of spatiotemporal for spot density, kernel density. And to calculate the spatiotemporal diffusion path, spatiotemporal correlation and other analyses are required. In order to prepare the spatiotemporal. Dengue fever diffusion actual map the color path separation method is used.

The functions of correlation are the most useful for the distance measured in time and space.

And also used for measuring the distance between sample points. This is followed by the different set of rules for interpolating results at different points. Here the two possible random variables P (s) and Q (t) at individual point's s and t for space.

$$Co ( m,v) = Cor( (P(s),Q(t))$$

if P(s) is a random vector with x elements and Q(t) is a vector with y elements, then an x×y correlation matrix and this functions is element the autocorrelation of a unsymmetrical procedure is the correlation for procedure values at different times.

Let us consider P is the hypothetic process, t is some point for a given time. In this case t may be integer value for discrete method and a real value for continuous time. So P<sub>t</sub> value can be achieved by execution of process time t. for suppose we take the procedure is having a mean of μ<sub>u</sub> and variance σ<sub>v</sub><sup>2</sup> at a given time t. now the autocorrelation between time u and v is represented as

$$R ( s,t) = E [ ( P_t - \mu_u ) ( P_t - \mu_t ) ] / \delta 1 \delta 2$$

Moran' Index Representation(I)	Value of Z	Significant value
0.536	120.875	0.000

Algorithm:

Step 1: Begin

Step2: Analyze the Least Square Polynomial Fitting Procedure

Step 2.1: Take the derivative of the First Order Fitting procedure

Step 2.2: Now, take the second order derivative of first order procedure

Step3: Calculate the Spatial Autocorrelation

Step3.1: if Z value is positive then

It is positive spatial correlation and

If Z value is negative then

It is negative spatial correlation and

If Z value is 0 then

The random results will be generated.

Step 4: Now, implement The Spearman correlation which is based on population and some other conditions.

Step 5: Obtain the various spatiotemporal patterns.

Step 6: End

*A. Life cycle of the Dengue Fever:*

The fig. Shows the study area for the Dengue Fever temporal trend. Initially the first Dengue case is found in July 2, 2016 and after August 15, 2016 significantly the number increased over this time. Then the Dengue Fever is fully prevalent after August 20, 2016 until October 14, 2016 Here the number of Dengue Fever cases in various several cases shown in the table num. The Dengue Fever outbreak stage is occurred in Karimnagar from August 20 to October 14, 2016 starting from date, because of Telangana's government attention and medical department the control and also timeliness measures are taken into consideration.

*B. The examination results for spatial correlation:*

Table 2 explains the Dengue Fever Global Moran's I Index. Table 3 shows correlation with Dengue and population, meteorological risk factors and Breteau Index. Table 3 explains the Dengue Fever risk factors spatial regression analysis result.

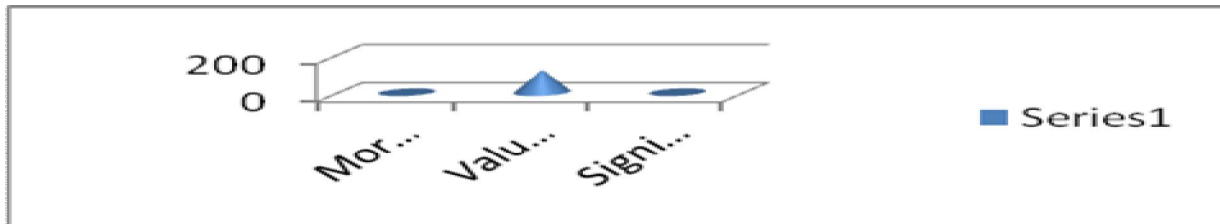


Fig 1. Study area

Table 2 shows spatial correlation for Dengue Fever and its Global Moran's I Index is greater than 0.6 the multiple neighborhood key factors are considered in the spatiotemporal comprehensive simulation of dengue.

TABLE 3 CORRELATIONS BETWEEN DENGUE FEVER AND FACTORS

Affecting Factor	Correlation factor	Significant value
Temp	-0.407	0.005
Rel Humidity	-0.104	0.487
Win Speed	0.176	0.224
Win Dir	0.187	0.196
Pop	0.154	0.001
Bre Index	0.454	0.004
Lag First order results	0.786	0.000

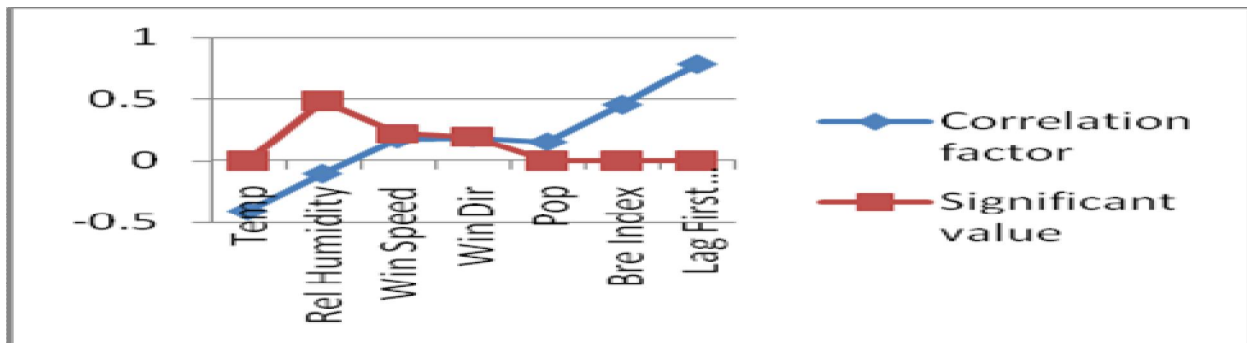


Fig 2. Correlation between Dengue and factors

The Table 3 and 4 explains that the spatial relation with Dengue Fever, temperature, the direction of wind, humidity, rainfall. Here the Breteau Index is during the outbreak dengue greater than normal value. And in this meteorological

fluctuation within short time can cause spatial correlation is not important correlated. And prevention of Dengue Fever likes clearing inert water and killing mosquitoes. The population of large dense will be increased in this particular area.

*C. Spatiotemporal Mapping Result*

In this context the Dengue is spread around karimnagar people hospital, when the diffusion path is along with the Northeast-South West direction. With land use of Karimnagar, we have determined that this town people’s hospital is located in a town area. The high people density area can be increased with the Dengue outbreak probability .This reflects the people density which plays a crucial role in the Dengue outbreak. And here a major role for the medical institution for the treatment of the Dengue patients to prevent infection.

Table 4. THE RESULT FOR SPATIAL REGRESSION

Summary						
R <sup>2</sup>	F	Significant value	ability			
0.489	9.562	0.002	62.7%			
Correlation coefficient						
	Temp	RHum	WinS	WinD	Brel	Lag I
Result	-0.101	-0.081	-0.11	0.201	0.759**	0.358**
Significant	0.498	0.599	0.922	0.210	0.005	0.004

Condition: \* represents significant value at 0.02 and \*\* represents significant value at 0.01

Table 5 Dengue Fever Diffusion Path

Time period	Beginning	Development	Prevalent	Extinction	Total
Time	02/06/2016	15/08/2016	20/08/2016	20/10/2016	
Dengue Fever number	1	5	383	401	790

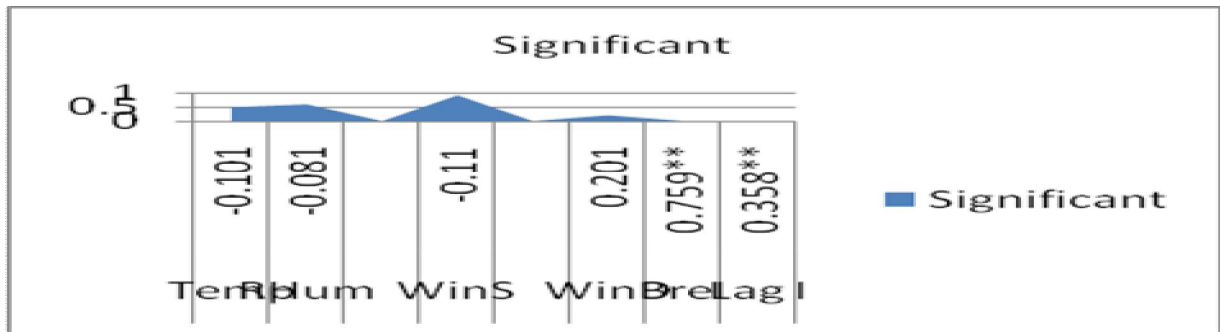


Fig 2. Dengue Fever Map

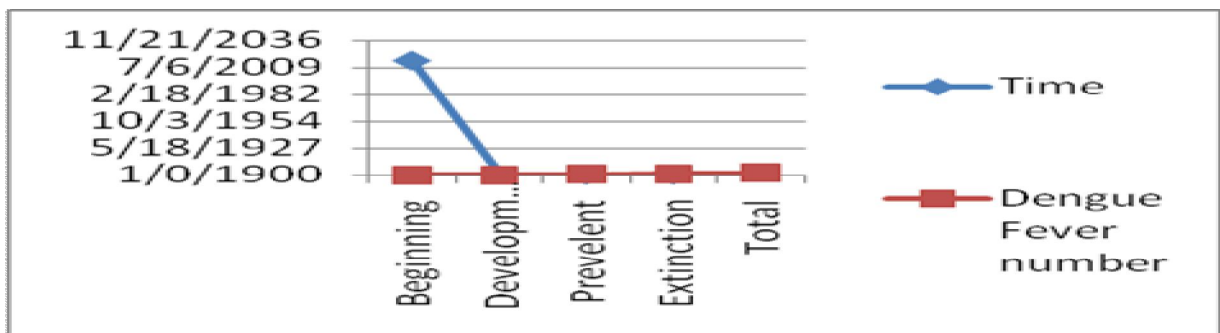


Fig 3. Result analysis

#### IV.CONCLUSION

this paper is analyzed for the comprehensive diffusion mechanism of dengue fever ,also its possible risk factors based on data mining perspective of the microscopic spatiotemporal this includes the risk factors like population density, humidity, transportation, rain fall, wind direction ,Breteau Index etc. This is described the method of least square, derivative procedure and spearman actual correlation analysis method to determine the change susceptibility and life cycle of dengue. The spatiotemporal survey is explained to recognize the hotspots and diffusion procedures for dengue.

The results are:

1. Dengue outbreak life cycle can be partitioned into various diffusion stages: initial, beginning, outbreak, and excitation.
2. population density and Breteau Index are the major risk factors of dengue from micro perspective point of view and in order to ahoy small influence on the short term outbreaks of dengue.
3. Very powerful spatial auto condition is occurred for dengue fever from the micro aspect. The Dengue Fever expanded around hot spots and dispensed a notable axial propagation constructive.
4. For the Dengue Fever prevention and control the Microscopic spatiotemporal mapping was efficiently and perfectly recognizes the Dengue Fever spatiotemporal diffusion path.

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