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Precipitation Interpolation of Kozhikode District Using QGIS

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Abstract:- This paper deals with employing IDW interpolation technique in carrying out precipitation interpolation of Kozhikode district in Kerala, India using QGIS and assessing the output to understand the general trend of rainfall pattern seen in that area.

Keywords:- QGIS, Spatial Interpolation, IDW, Rainfall Mapping, Precipitation Interpolation

I. INTRODUCTION

Interpolation refers to the process of estimating the unknown data values for specific locations using the known data values for other points.

In many instances we may wish to model a feature as a continuous filed (i.e. a 'surface'), yet we only have data values for a finite number of points. It therefore becomes necessary to interpolate (i.e. estimate) the values for the intervening points.

The interpolation technique is employed for interpolating the precipitation data. Spatial variability of rainfall is one of the inputs for hydrological model, such as shallow water model and runoff model, may give significant influence to the hydrograph and shape, and that the importance varies as a function of the catchment rainfall properties. Precipitation is the most important input in a hydrological model, therefore it is crucial to find the optimal spatial distribution for the uncertainty rainfall variability.

The accuracy of the precipitation measurement is dependent upon the number of rain gauge stations employed in a particular area. Because of the data collection issues, such as time to travel to each gauge and check the rainfall amount, only a limited number of rain gauges are used. Since there is a spatial correlation between rainfall amounts in various locations, spatial interpolation technique can be used to map the rainfall data for a study area such as Kozhikode district.

Many spatial interpolation methods can be used to estimate the rainfall distribution, such as Fourier series, Thiessen, Spline, Kriging, weighting method. Inverse Distance Weighted (IDW) method is most widely used in mathematics, while kriging is most commonly used in hydrology, but actually there is no single preferred method for data interpolation, as the performance of each model depends on the actual data, accuracy, and computation efficiency.

The study employed the use of three rain gauge stations and the use of one month of rainfall data over the span of five years (2010-2014) for the computational purpose.

II. LITREATURE REVIEW

According to Yunhua Gu, Lingmei Sun and Ging Wang, the validity of temperature maps obtained by means of single and mixed interpolation methods. In this context, several interpolation methods are used for the temperature mapping: inverse distance square (IDS), ordinary kriging (OK) and co-kriging (CK) and mixed methods (combined global, local and geostatistical methods). And the validity of the maps is checked through the cross-validation error statistics presented in terms of Mean absolute error (MAE) and root-mean-square error (RMSIE). The results show that the spatial temperature distribution formed by IDS, OK and CK show similarity in general while the CK method better reflects the temperature distribution.

III. PROPOSED METHODOLOGY

A. ***Objective of the study***

The project deals with:

Rainfall mapping of Kozhikode district using QGIS.

B. ***Procedure***

The methodology involves selecting a suitable study area and obtaining the rainfall measurements from the chosen rain gauge stations. The data is processed and analysed using the various techniques in QGIS. The interpolation technique is finally employed to obtain the required rainfall map showing the variations of rainfall pattern over the past five years.

C. ***Study Area***

Kozhikode district is bounded on the north by Kannur district, on the east by Wayanad district, on the south by Malapuram district and on the west by Lakshadweep Sea. It lies between North latitudes 11º 08' and 11º 50' and East longitudes 75 º 30' and 76 º 08'. The district has one corporation (Kozhikode) and two municipalities namely Koyilandy and Vadagara. It has a total of 79 revenue villages. The district is drained by six rivers of which one is of medium nature and all others are minor ones. Chaliyar, Kuttiyadi, Mahe, Kadalundi, Kallayi and Korapuzha are the six rivers.

The average annual precipitation is estimated to be 3236mm. The study is conducted based on the rainfall measurements obtained from three rain gauge stations. The first one being located in CWRDM (Centre of Water Resource Development and Management), Kunnamangalam. The second one being the IMD stations at Beach Road and Quilandy.

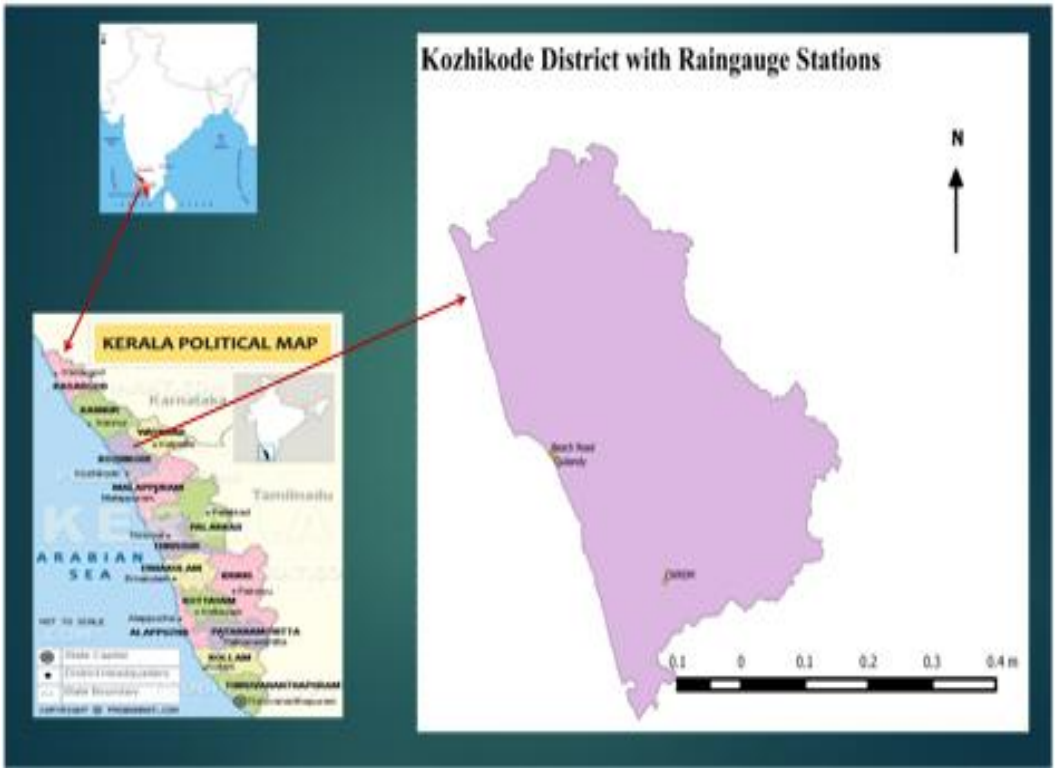

Fig 1. Location of the study area (Kozhikode)

IV. DATA ACQUSITION AND PREPARATION

A. ***Data Acquisition***

The data acquisition process involved collecting the data from Centre of Water Resource, Development and Management (CWRDM), Kunnamangalam, Kozhikode and Indian Meteorological Department (IMD) Calicut stations (Quilandy and Beach road) for the period 2010 to 2014. The administrative boundary map of Kozhikode was obtained from the Town Planning Office, Kozhikode, Kerala.

B. ***Data Preparation***

The data collected were organized into various layers using QGIS software. The following thematic layers were prepared:

- Administrative boundary map
- Rain gauge stations
- Rainfall data

V. PROCEDURE

C. *Shape file generation of the Rain gauge stations*

The individual point shape files of the selected rain gauge stations were directly obtained from the website (bhuvan.nrsc.gov.in) using the 'Draw' tool.

D. *Merging of Shapefiles*

The individual shapefiles were merged into one using ' Data Management Tools' in the 'Vector' tab. The attribute table was edited to include the Name and Rainfall values for each station.

E. *Interpolation using IDW technique*

By selecting a particular rain gauge station using ' Identify' tool , the interpolation was performed using IDW technique .

F. *Masking*

The interpolated output was masked and clipped using the shapefile of administrative boundary of Kozhikode.

G. *Contour Generation*

The interpolated output was edited to give colour coding and contour based on the rainfall values was generated using the 'Extraction' tool from the 'Raster' tab.

H. *Rainfall Map Generation*

Map generation was done using 'New print composer' tab. Rainfall maps showing average monthly rainfall for the month of June were generated with adequate legends, scalebar and North direction indicator.

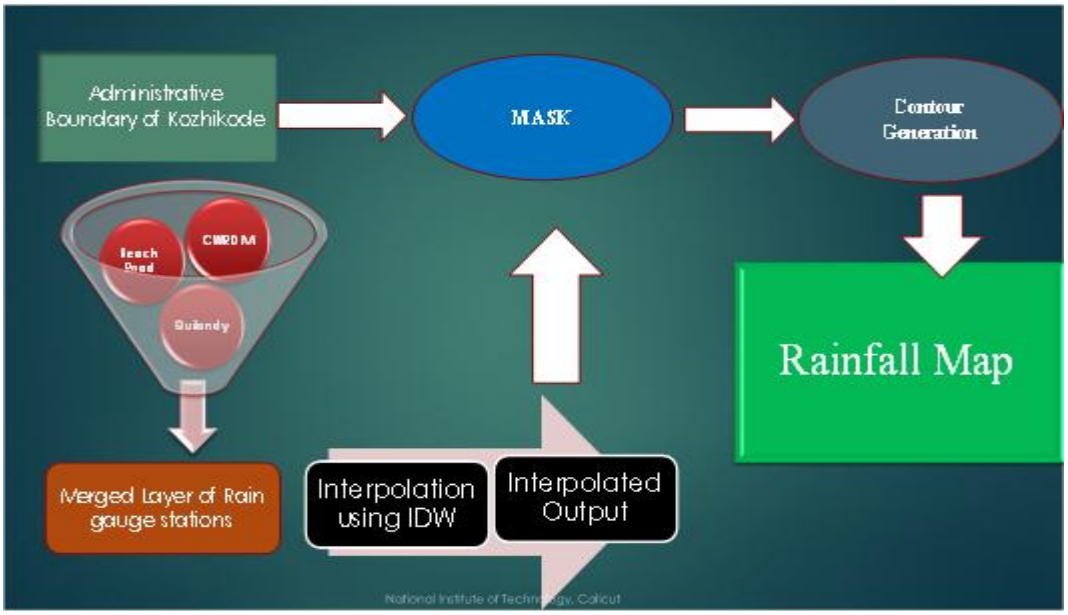

Fig.2. Overview of the process

V. RESULTS

The prepared rainfall maps give a better understanding regarding the general variation of the rainfall pattern in Kozhikode district over the span of five years (2010-2014).

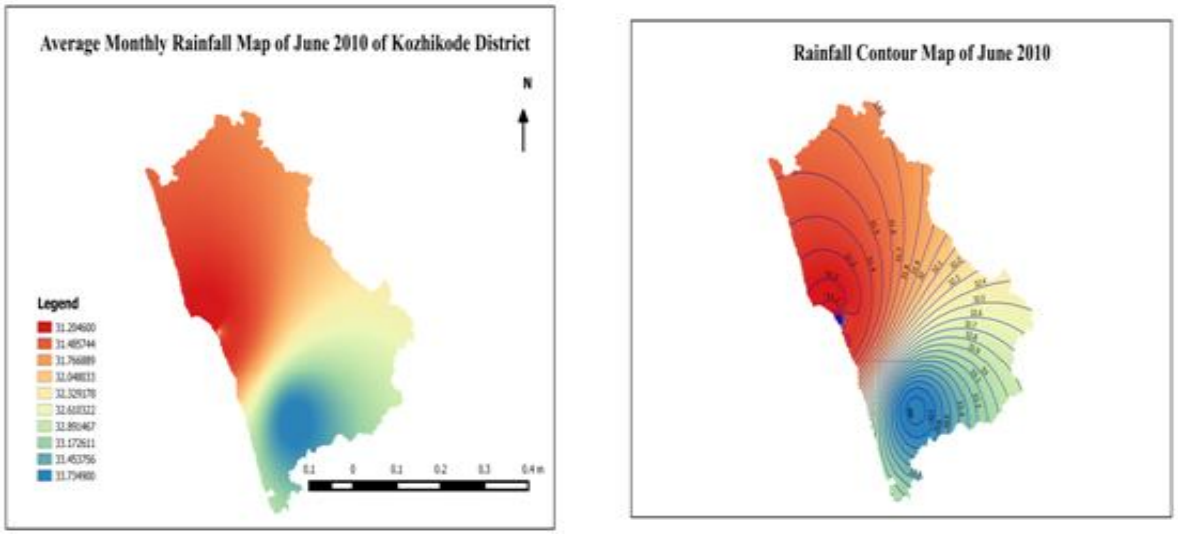

Fig.3. Maps showing the Average monthly rainfall of June 2010 and the Rainfall contour of June 2010.

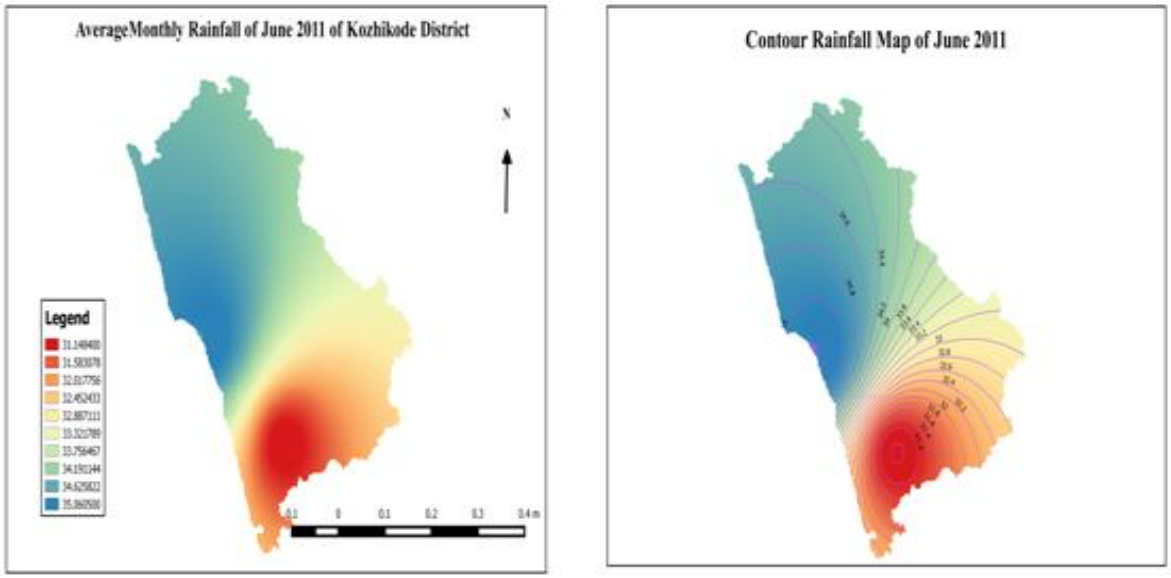

Fig.4. Maps showing the Average monthly rainfall of June 2011 and the Rainfall contour of June 2011.

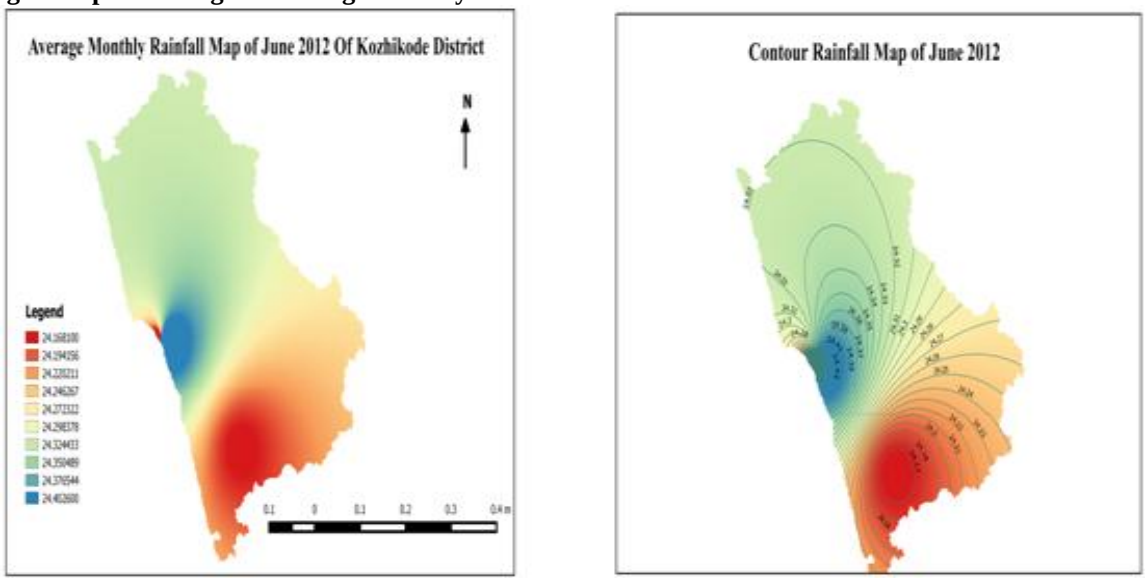

Fig 5. Maps showing the Average monthly rainfall of June 2012 and the Rainfall contour of June 2012.

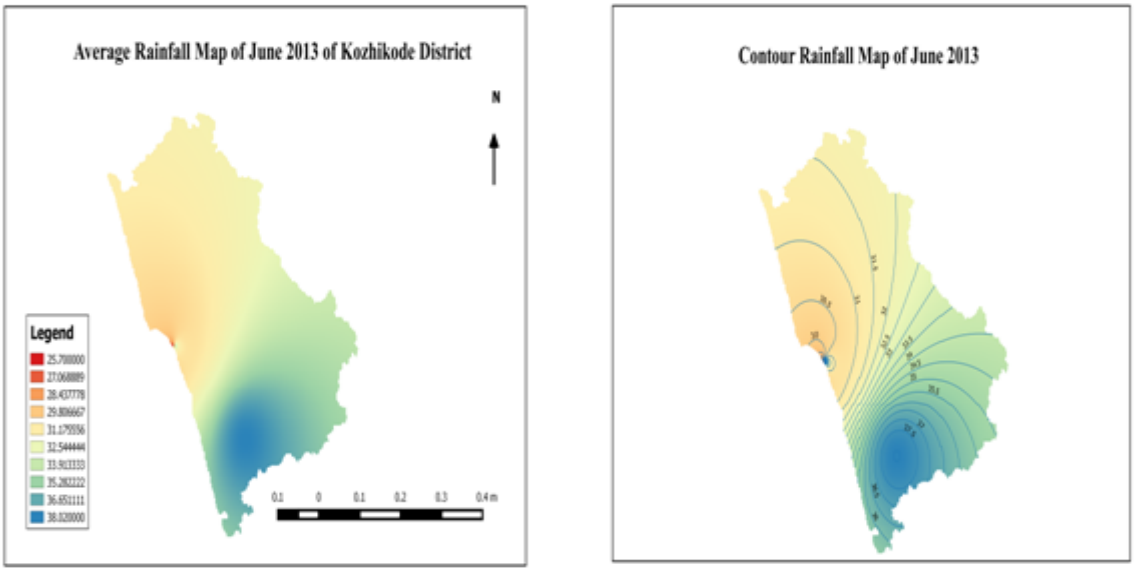

Fig 6. Maps showing the Average monthly rainfall of June 2013 and the Rainfall contour of June 2013.

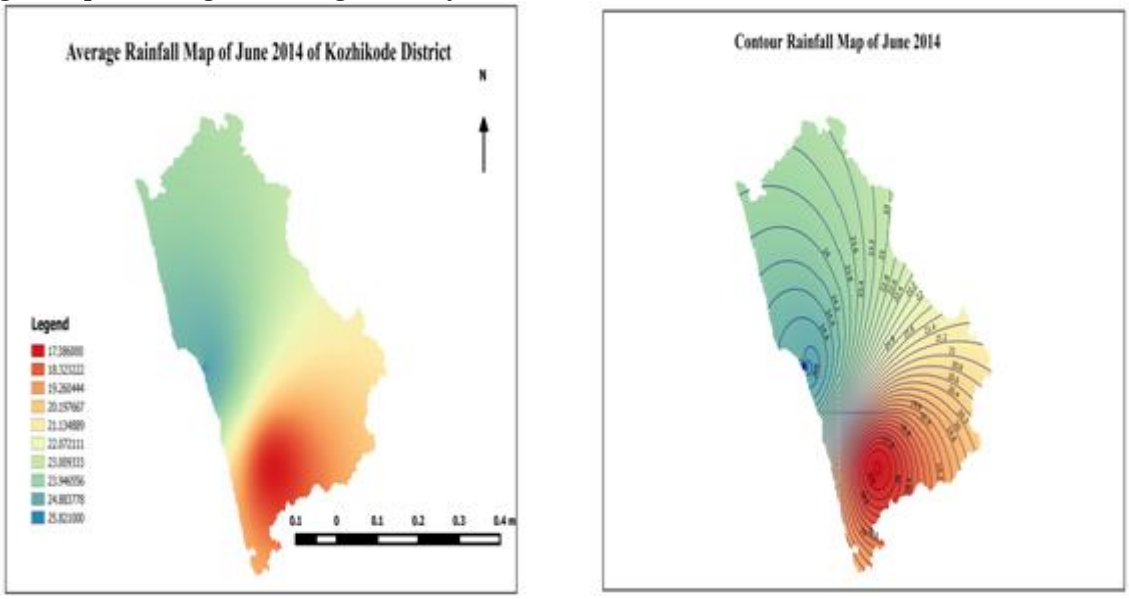

Fig 7. Maps showing the Average monthly rainfall of June 2014 and the Rainfall contour of June 2014.

VI. DISCUSSIONS

Comparing the rainfall maps of 2010 and 2014, we can observe an overall decrease in the precipitation amount.

We can also observe that the variation in rainfall was minimal in 2012 across the entire district. Based on the generated maps , the maximum and minimum rainfall were tabulated as shown :

Table.1. The Maximum and Minimum rainfall in mm for past 5 years(2010-2014)

Year	Maximum rainfall (mm)	Minimum rainfall (mm)	Difference (mm)
2010	33.73	31.20	2.53
2011	35.06	31.14	3.92
2012	24.40	24.16	0.24
2013	38.02	25.7	12.32
2014	25.82	17.38	8.44

Further the use of QGIS software for carrying out this project further enables the promotion of this freeware. At reduced cost and with comparable efficiency the tasks can be performed very easily for obtaining appropriate outputs for various research oriented projects.

The results of this project can be utilized for creating inputs for various hydrological models which can be considered as the suitable future scope of development.

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