International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 6, Issue 7, July 2019

Analysis and Mapping of Air Quality in Kanpur City

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Abstract: *The study focuses on the mapping of the air pollution in Kanpur city with the help of seven stations by dividing the air pollution data in Pre monsoon (January to May), Monsoon (June to September) and Post monsoon (October to December) season. In this study GIS spatial analysis with Inverse Distance Interpolation was performed in order to identify the air pollution at different latitude and longitude of Kanpur city. Air quality parameters considered were SO_2, NO_2 and PM_{10}. The GIS IDW interpolation indicates the pollution level by $NAAQ_S$ criteria at different places of Kanpur city. The investigation done by using ArcGIS for grid wise mapping of air quality in Kanpur city.*

Key words- GIS, IDW, $NAAQ_S$, Spatial analysis.

1. Introduction

According to the report of World Health Organization, about 90 per cent of world's population is exposed to dangerous levels of pollution and 14 of world's 15 most polluted cities are in India. Kanpur is the most polluted city which came on top. In accordance with a study carried out by the centre for science and environment, New Delhi, air pollution is the environmental factor with the greatest impact on human health in India and is responsible for the greatest number of illness related to or due to environment. The mapping of air pollution in Kanpur city and interpolation of their data will be meaningful partially depends on what pollutant level you want to look at, and how they are spatially spread. The IDW is simple and intuitive deterministic interpolation method based on principle that sample values closer to the prediction location have more influence on prediction than sample values farther apart. In this paper the study has been done in monitoring the 7 stations in Kanpur city as per three year data available in UPPCB website. The study is focuses on the IDW interpolation and monitor the pollutants such as SO2,NO2,PM10 at all the places of Kanpur city by descritise the shape file in a cell size of 1'(minute).

2. Method

Inverse distance weighting (**IDW**) is a type of deterministic method OF INTERPOLATION with a known scattered set of points. The assigned values to unknown points are calculated with a weighted average of the values available at the known points.

$$z_p = \frac{\sum_{i=1}^{n}\left(\frac{z_i}{d_i^p}\right)}{\sum_{i=1}^{n}\left(\frac{1}{d_i^p}\right)}$$

Zi- value of known points
di- distance of known points
z_p- value of unknown point
p- power user selected exponent

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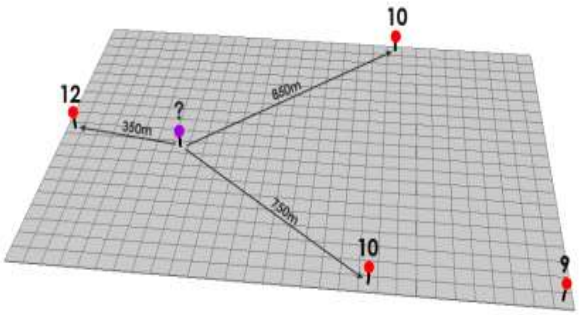

Fig-1. Inverse distance weighted description

$= ((12/350^2) + (10/750^2) + (10/850^2)) / ((1/350^2) + (1/750^2) + (1/850^2)) = 11.4$

2.1.1 Software used

ARC GIS is used to mapping the air pollution. The given data of each years divided as pre monsoon, monsoon, post monsoon. Calculate their indexes by taking their averages in three season of all the seven stations. ARC GIS with IDW interpolation calculate the pollution at different location of Kanpur city by descritise the shape file of Kanpur city in 1'(minute) cell size. The mapping of these pollutants in a shape file of Kanpur city as showing the pollutants by specific color i.e. pollution level moderate show green color at different location of Kanpur city. The standards are according to NAAQs criteria. Divide the mapping as different pollutants level at different locations by their specific longitude and latitude.

3. Results

Post-monsoon air quality was better than monsoon and pre monsoon for all air quality parameters. However, in the study it was found out that winter season has worst air quality. It is observed that PM10 is critical in all the three seasons at all the locations of Kanpur city i.e. monsoon, post-monsoon, pre monsoon. So2 concentration is quite good in all the seasons at all the locations.

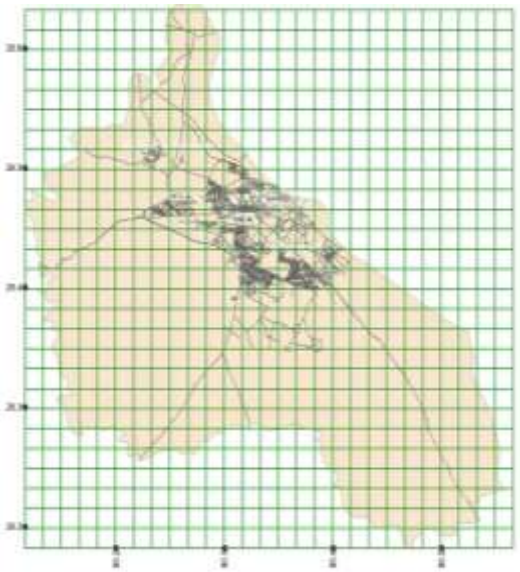

Fig. 2. Identified Stations in Kanpur City

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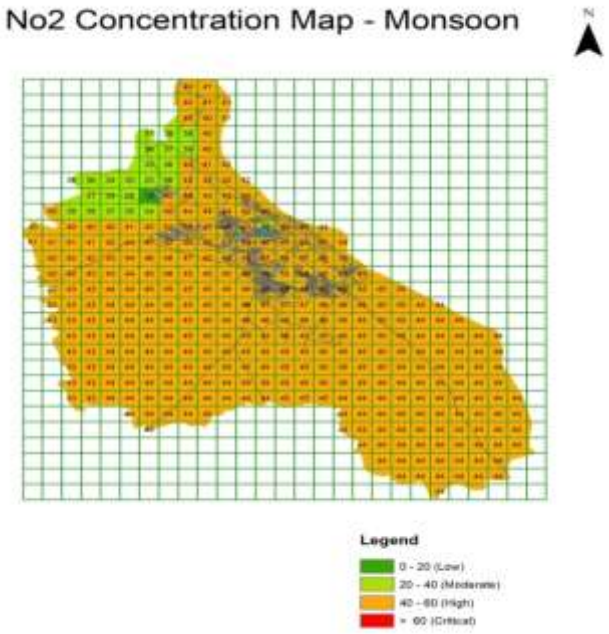

Fig. 3. NO_2 concentration on monsoon season

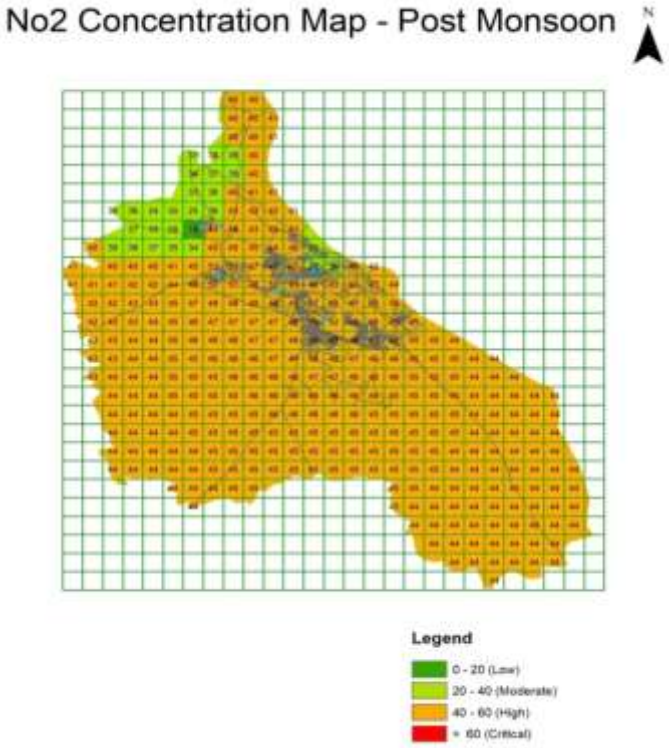

Fig 4- NO_2 concentration on post monsoon 1season

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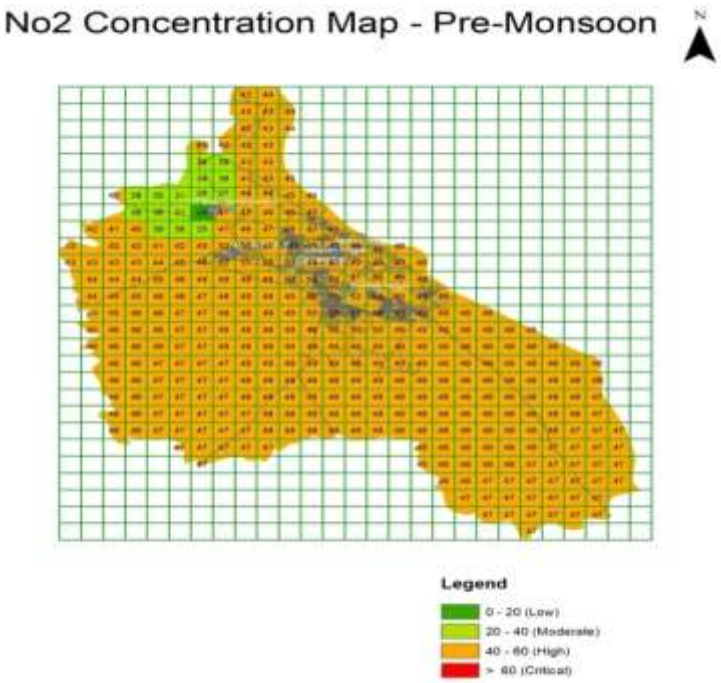

Fig 5- NO_2 concentration on pre monsoon season

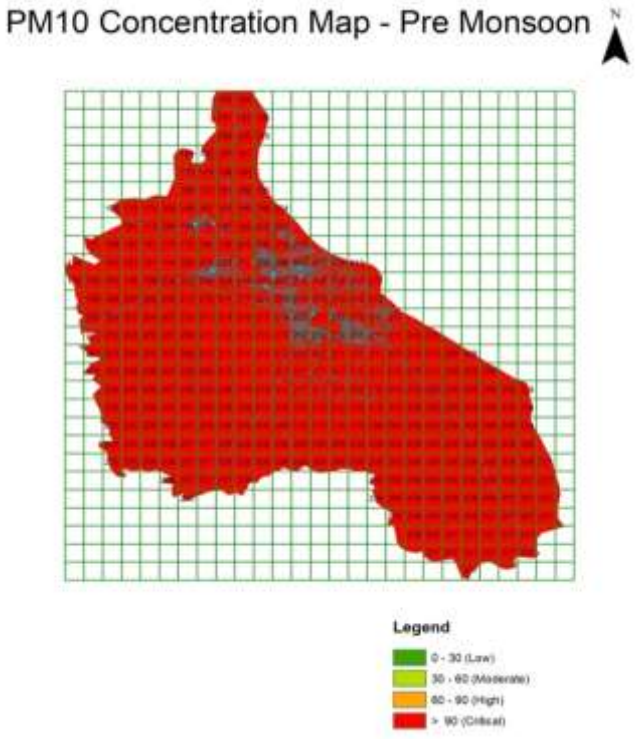

Fig 6- PM_{10} concentration on pre monsoon season

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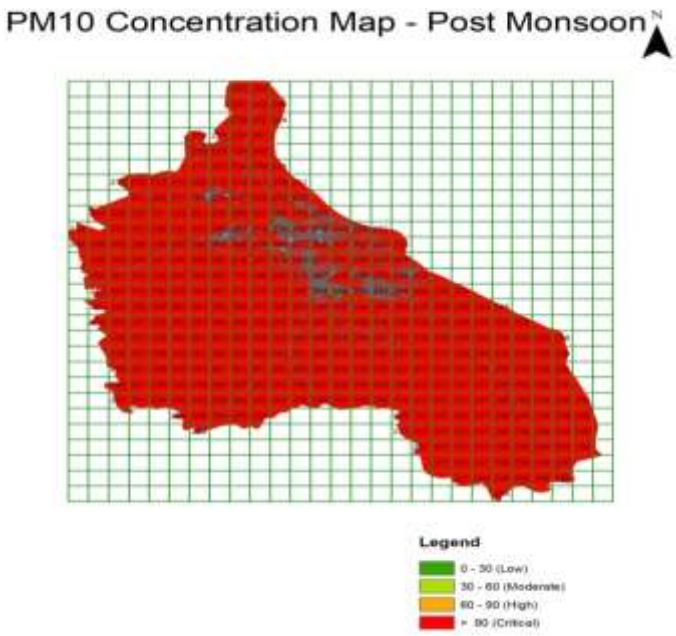

Fig 7. PM_{10} concentration on post monsoon season

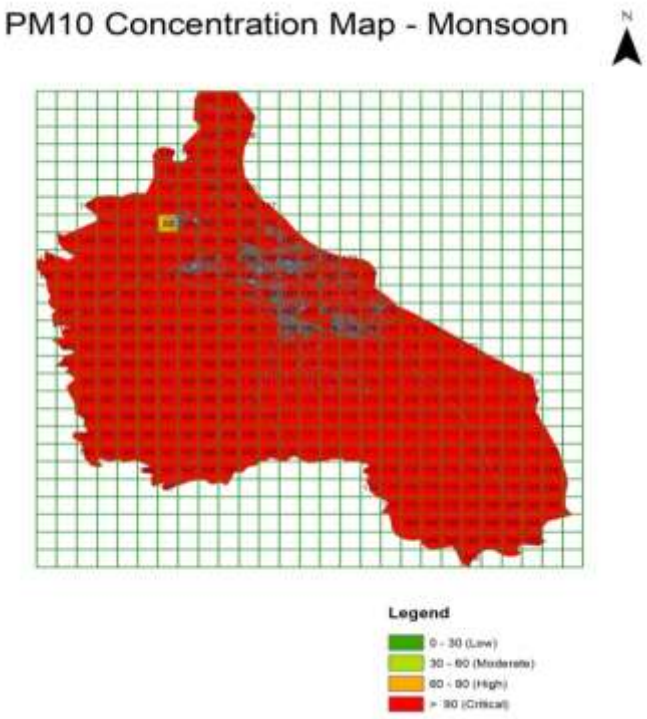

Fig 8. PM_{10} concentration on monsoon season

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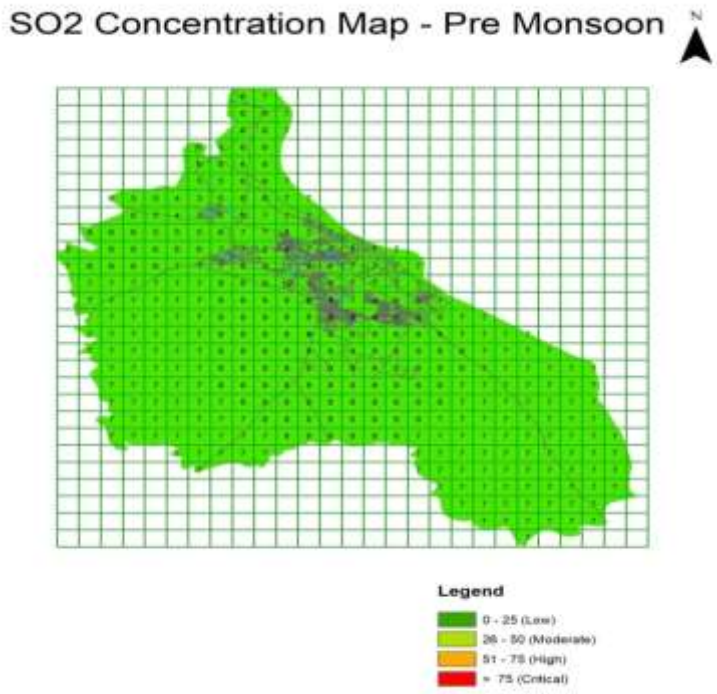

Fig 9- SO_2 concentration on pre monsoon season

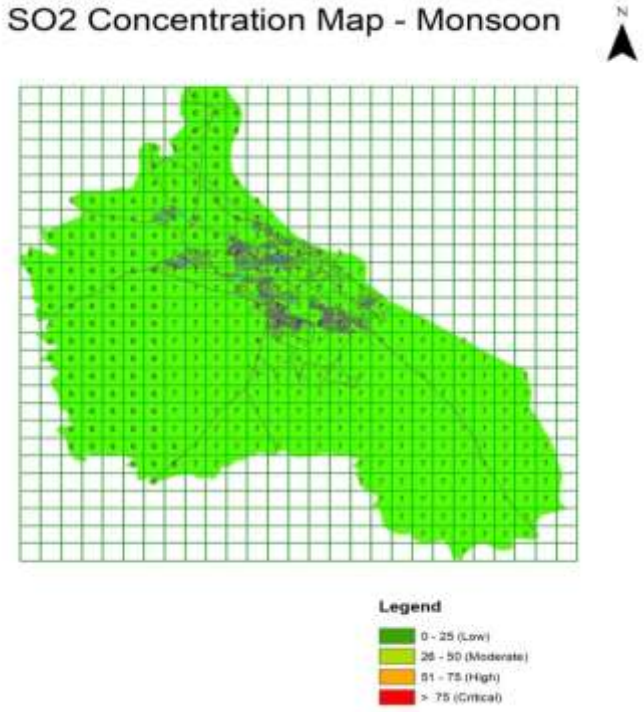

Fig 10- SO_2 concentration on monsoon season

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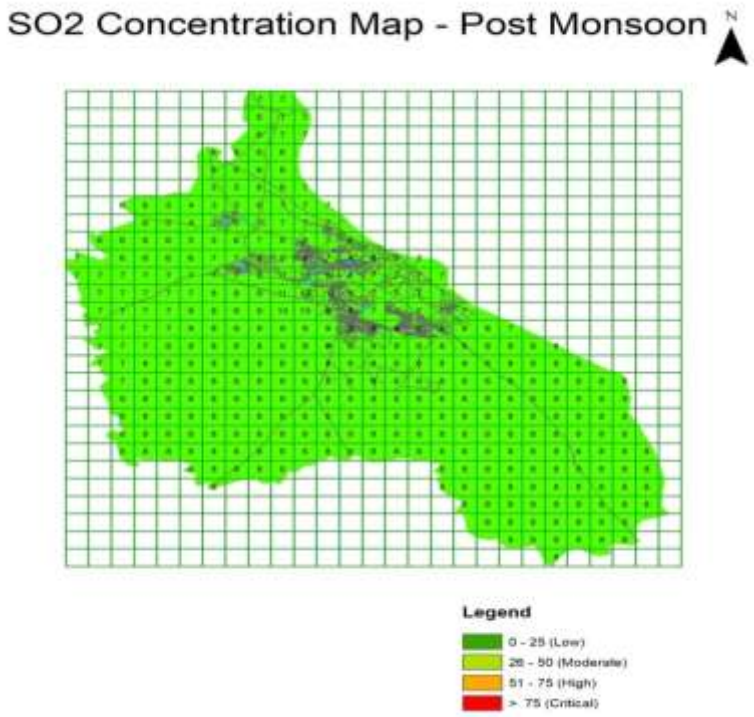

Fig11- SO_2 concentration on post monsoon season

4. Conclusion

4.1 Monsoon Season

1. NO_2 concentration in IIT Kanpur at latitude 26.51 degree and longitude 80.23 degree low (0-20) is and at latitude 26.5 degree to 26.6 degree and longitude 79.4 to 80.24 degree is moderate(20-40) and all other locations is high (40-60) in NO_2 concentrations
2. SO_2 concentration at all the locations of Kanpur city is low (0-25)
3. PM_{10} concentration in IIT Kanpur at latitude 26.51 degree and longitude 80.23 is high (60-90) and all other locations are very critical i.e. greater than 90

4.2. Pre-Monsoon Season

1. NO_2 concentration in IIT Kanpur at latitude 26.51 degree and longitude 80.23 degree is low (0-20) is and at latitude 26.52 degree to 26.62 degree and longitude 79.4 to 80.24 degree is moderate(20-40) and all other locations is high(60-90) in NO_2 concentrations.
2. SO_2 concentration at all the locations of Kanpur city is low (0-25).
3. PM_{10} is very critical more than 200 at all the locations of Kanpur city.

4.3. Post- Monsoon Season

1. NO_2 concentration in IIT Kanpur at latitude 26.51 degree and longitude 80.23 degree is low (0-20) is and at latitude 26.52 degree to 26.62 degree and longitude 79.4 to 80.24 degree is moderate(20-40) also in latitude 26.44 degree to 26.52 degree and longitude 80.31 degree to 80.32 degree is moderate and all other locations is high(60-90) in NO_2 concentrations.
2. SO_2 concentration at all the locations of Kanpur city is low (0-25).
3. PM_{10} is very critical more than 200 at all the locations of Kanpur city.

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