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Development of Air Quality Mapping in Oragadam using RS and GIS

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Abstract: ***Air pollution causes a serious impact on all living organisms. It creates harmful diseases to human beings, animals and plants. Due to increase in vehicle movement, industrialization and urbanization, vehicles movement has started to increase which causes more harmful to the people around the industries. In this a detailed comparative study has been done by relating the air pollution and human's health. It was investigated by using Geographical Information system as a tool and digital topographical map also developed by using Arc GIS software. the data used for developing the map was collected using High Volume Sampler for a period of six month for two seasons for 5 locations. The sampling was carried out as per the Central Pollution Control Board Guidelines. Based on the analysis it was inferred that the location which was selected in Oragadam area had high concentration of Particulate matter (PM10). This may be due to high industrial emission in that location. The thematic map also highlights the Oragadam area having high concentration of PM10 and different colour coding was provided to highlight each of air pollutant impact. This kind of study can be further improved in different industrial locations and periodic air quality sampling and mapping will help to improve the air quality in the particular area and Air Quality index can be developed.***

Keywords: GIS, Mapping, Air Quality, Remote Sensing, PM10

I. INTRODUCTION

Environment plays an important aspect in everyone's life. The pollution affects the whole world by means of air, water, noise and soil. In this air pollution is the major issue that the whole world is being affected. The rapid growth in the industrial, power, and transportation sectors nationally, combined with growth in urbanization, both planned and unplanned, have contributed to the rapid increase in AAP levels in India.[1][2]. A substantial increase in vehicle stocks and a large number of old, inefficient, ill- maintained and obsolete vehicles result in emission of vast quantities of pollutants annually in gaseous and particulate forms into the atmosphere. [3][4]

In the developing countries like India, the air pollution has increased a lot due to Industrialization and urbanisation. Variety of pollutants are emitted into the atmosphere by natural and anthropogenic sources, of which particulate matters, sulphur oxides and oxides of nitrogen are having the significant role and increasing impact on urban air quality [5][6]. The massive increase in emissions of air pollutants due to economic and industrial growth in the last century has made air quality an important environmental problem throughout the world.[7][8] Air pollution is a major environmental health problem causing approximately three million deaths per year in the world, as result of exposure to particulate matter (PM) [9][10]. The identification and characterization of particulate matter (PM) concentrations from industrial activities pose major challenges due to the diverse characteristics related to different aspects, such as concentration, particle size and particle composition. Moreover, the characterization of particulate matter is influenced by meteorological conditions, including temperature, humidity, rainfall and wind speed [11][12].

"By the middle of the 19th century, coal smoke filled many British cities, yet few people saw it as detrimental to either human health or to the wider environment,". In their view, pollution came not from energy use or industry, but from natural biological processes. They blamed disease on miasma … Many people not only considered coal smoke to be harmless, but actually thought of it as an antidote to pollution" [13][14].

The strategic direction for air quality improvement in India is hampered by the lack of adequate inventories on emissions and uncertainty in the pollution mixture in ambient air[15].

Spatial scales may range from the very local scale (e.g. street level, direct surroundings of a chimney) to the global scale (up to 100 km); time scale may range from minutes (estimation of peak concentrations) up to days (estimation of trends). Those models can be distinguished on the treatment of the transport equations (Eulerian, Lagrangian models) and on the complexity of various processes (chemistry, wet and dry deposition).[16]

Increased mortality, morbidity and impaired pulmonary functions are associated with elevated levels of particulate matter in the atmosphere. Exposure to sulphur-dioxide (SO_2) impairs the respiratory function, respiratory diseases and decreases the ability of the lungs to clear foreign particles. From the recent studies which was done in many countries have confirmed that the person who is in long-term exposure to common air pollutants and living in urban areas may be associated with increased incidence of respiratory infections, lung function disturbances, cardiovascular irregularities and rising adult and infant mortality[17].

It is well established that high levels of particulate matter (PM) are significantly associated with adverse health effects and ecosystem damage [18].

The challenge of estimating exposures of traffic-related air pollutants has been tackled by a variety of methods, e.g., simple proximity assessments, statistical land-use regression models, source-oriented models incorporating mechanistic sub-models (for emissions, dispersion, transformation, exposure), and hybrid approaches combining several approaches. [19,20]

The development of GIS techniques, however, offers considerable potential to Downloaded improve upon this situation. Digital data on urban road networks, for example, are now becoming increasingly available, providing a valuable data source for pollution modelling [21].

II. METHODOLOGY

For each study we need to follow a framework. In this study we had the followed the methodology which is shown in figure 1.

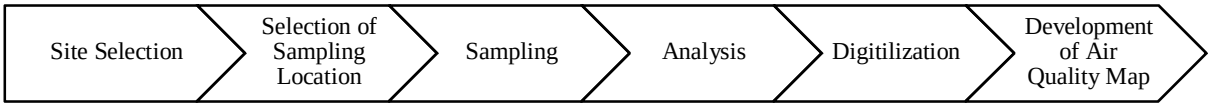

Figure 1 Methodology

After the literature survey is done, we must select the area in which the study is going to be done. The proper geographical parameters must be considered. The latitude and longitude must be measured using Geographical Positioning System(GPS). Then the sampling location must be selected based on few parameters such as production, movement of vehicles, Campus location of the industry. Then the instrument for taking the sampler must be taken to the sampling location and instrument must be calibrated. After Calibration, the instrument must be setup for taking the samples. The empty filter paper must be weighed in weighing machine before keeping it the instrument. Then the instrument must be started. Once the smpling is over, the samples must be taken out to find out the concentration. Datas are feed into the software for producing the digital map using ArcGIS software.

III. STUDY AREA

Oragadam is an industrial corridor which is located in Kanchipuram district of Tamilnadu, India. It is located 55kilometers southwest from capital city of Chennai. It is also known as Automobile Hub of South Asia because few of automobile industries such as Bharat Benz, Renault Nissan, Apollo Tyres are located in this area. Oragadam is very near to Sriperumbudur in Chennai – Bangalore Industrial Corridor. The area also contains Residences, Temples of worship, Hospitals and educational institutions. The map of oragadam is shown in figure 2.

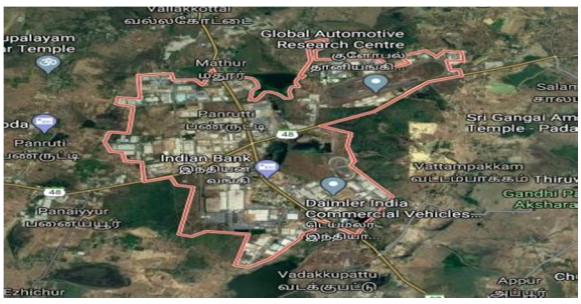

Figure 2 Study Area- Oragadam

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IV. RESULTS AND DISCUSSION SITE SELECTION

The site selected for the purpose of this study is Oragadam which is Chennai, the capital city of TamilNadu. This site was selected as it has more industries which was developed few years ago.

A. Selection of Sampling Location

In this study, 5 locations have been identified for finding out the concentration of pollutants.

B. Sampling

In all the selected locations, the sample of pollutants will be taken through the Sampler. We need to know all the working procedures, details of the instrument, etc. As we are going to find the concentration of Particulate matter, we used the device High Volume Sampler (HVS). Figure 3 shows the picture of High- Volume sampler used.

Figure 3 High Volume Air Sampler (PM 10)

C. Analysis of air quallity

From the samples collected from the sites the air quality is analysed by using proper given method. In this study the parameter used is PM10.

For calculating concentration, the Particulate matter, the following formula is to be used.

$PM= ((W2 – W1) / V) X10^6$

Where

PM = concentration of particulate matter

W2 = weight of filter paper after taking the sample W1 = empty filter paper

V = Volume

From the formula, the list of concentration of PM10 was found out. The table 1 shows the concentration of PM10.

Table 1 List of pollution level

Location	PM10 level in $\mu g/m^3$
1	70.4
2	90.3
3	40.4
4	63.39
5	50.3

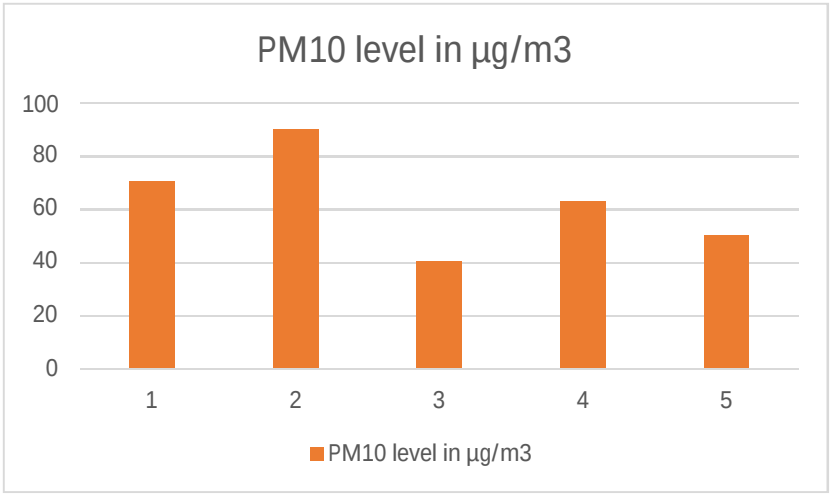

Figure 4 Comparison of PM level in various locations

From the above comparison, it is inferred that location 2 has more PM10 concentration compared to other locations because there are more vehicle movement as there more industries. In the location 3 the concentration of PM10 is less because the movement of humans and vehicles is less as there are less industries present.

D. Digitilization

The data analysed form the sample are to be digitalised for the purpose of mapping. All the data which was got from the analysis is typed in the Arc GIS 10.3 software.

E. Developing a Air Quality Map

Using ArcGIS software the boundary of the area will be plotted and map was developed. The Map is been developed in this software. Figure 5 show the boundary area of the sampling location in ArcGIS software and Figure 6 show the map which shows the air quality mapping in Oragadam area.

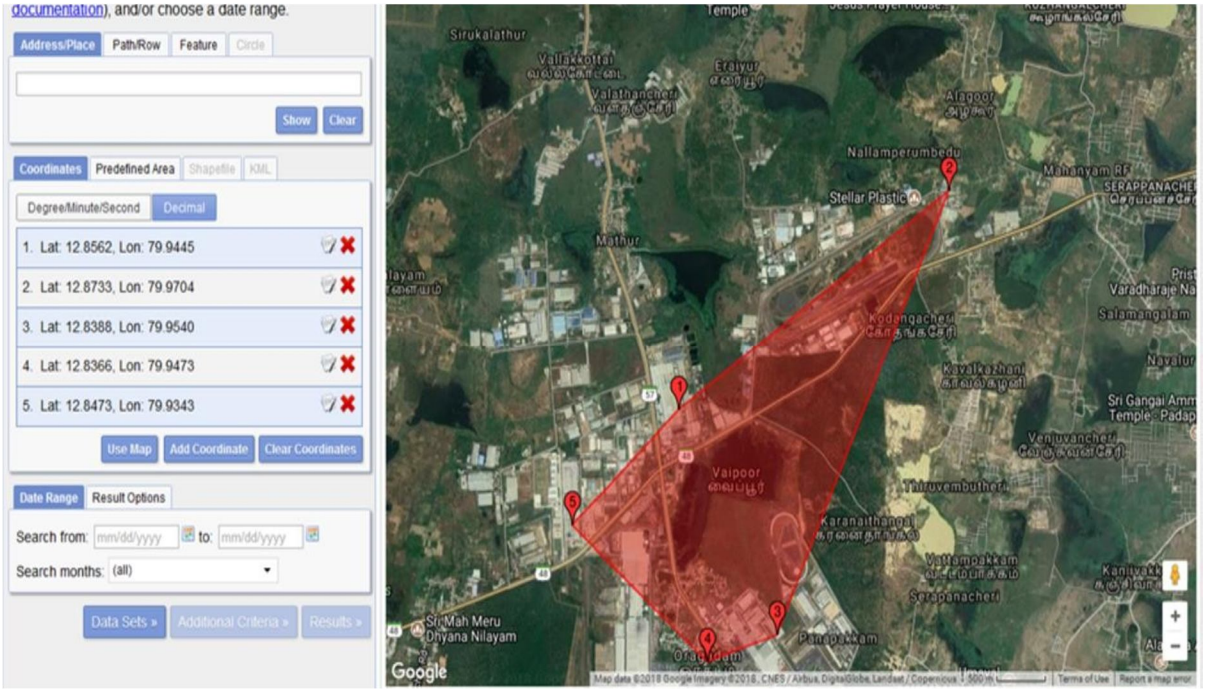

Figure 5 Boundary Area of Sampling Location

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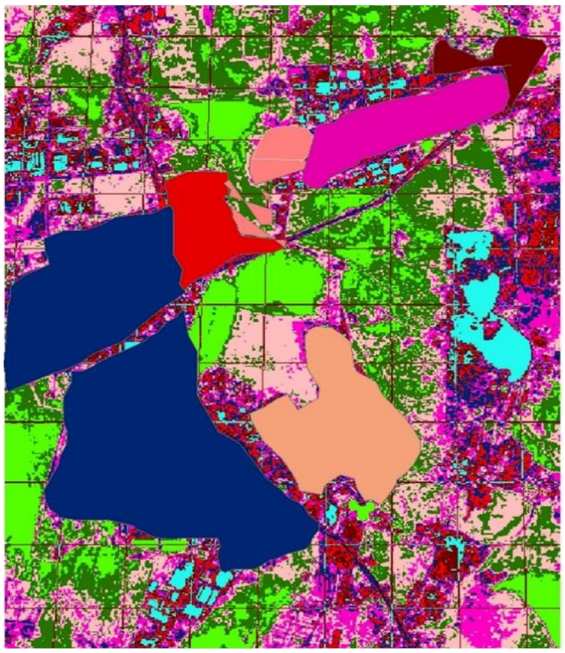

Figure 6 Air Quality map in Oragadam Area

The colour code which was given in this map are as given in table 2.

Table 2 Colour Code legends

Colour code	PM10 range in µg/m^3
	0-5
	5-15
	20-35
	35-50
	50-65
	65-80
	80-95
	95-100
	100 and more
	Lake

From Fig 6 the PM10 spatial distribution shows a major concentration is near the industrial and residential area due to heavy traffic movement and human concentration. Green shade shows the least value as there are tree covered area. Thus, the air pollution is majorly absorbed by the trees and vegetations. The PM10 concentration reduced to next level around the industries and human populated area. Which implies that the pollution is in and around the industry and residential area and it does not disperse to nearby areas.

V. CONCLUSION

In this present scenario, the developing cities and also developed cities is being polluted by air which causes harmful impacts to the environment. It also increases the health issues such as asthama, etc. From the study we could see that air pollution has been severely affected to the nearby areas due to industries developed in the Oragadam area. From the data, it can be seen that some of the location, the concentration of PM10 (Particulate Matter) has been more affected due to more vehicle movement and more movement of people and in some area the concentration of PM10 is less due to only movement of people. In some areas due to the length of the exhaust from the generator and also machine in the industries has been increased to reduce the concentration. The digital map which was developed highlights the location been affected by the pollutants.

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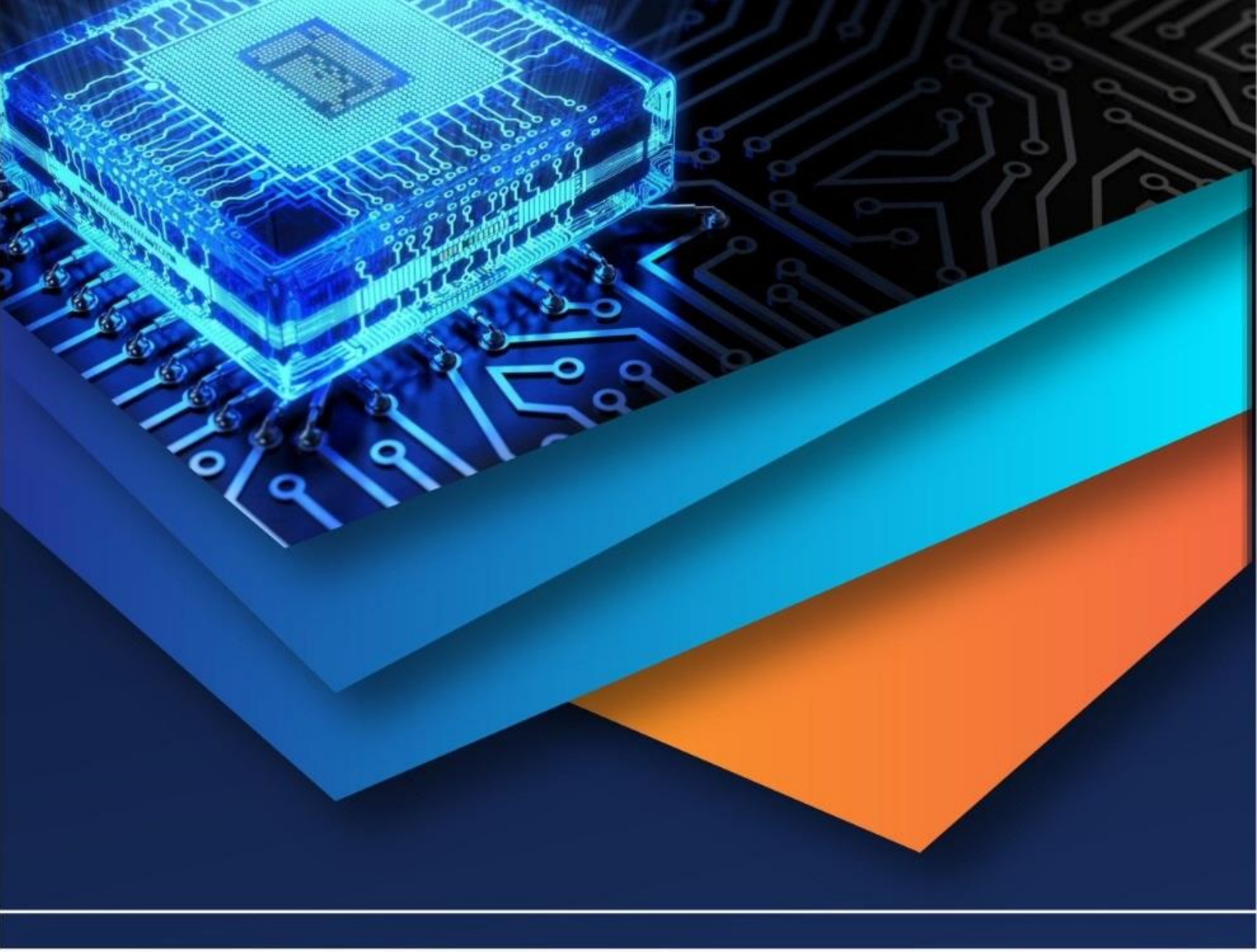

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