Ambient Air Quality Status & GIS Mapping Of Jalandhar

[1]Sakshi Mohindra, [2]Vipasha Sharma
[1]Student, [2]Assistant Professor
[1]Environmental Engineering,
[1]Lovely Professional University, Jalandhar, India

Abstract : The study reports the Air Quality Index and GIS Mapping of Jalandhar City for the year of 2016. The four sites that were used for analysis (using PPCB Data) are: Focal Point (Industrial Area), ESI Hospital (Sensitive Area), M.C Tube well near Municipal Corporation Jalandhar (Commercial Area), PWSSB near Manbro Chowk (Residential Area) for the Analysis of RSPM (Respirable Suspended Particulate Matter), SO_x (Oxides of Sulphur) and NO_x (Oxides of Nitrogen). AQI (Air Quality Index) was found by utilizing the system proposed by 'CPCB (Central Pollution Control Board)' on the premise of various pollutants present in the 'Jalandhar City'. The 'AQI (Air Quality Index)' was determined yearly with the help of 'IND-AQI (Indian Air Quality Index)'method. ArcGIS Software was used make the pollution chart. The mapping was done by spatial analysis in ArcGIS software. In Spatial Analysis the IDW method was selected for the mapping of pollutants. It was found out that for the Sensitive area (ESI Hospital) was found to be moderate in all months but in January the air quality index is Poor. In Residential area (PWSS) the air quality index is moderate in all months. In Industrial area (Focal Point) the air quality index is satisfactory in August but in November and December the air quality index is Poor it has been viewed that in rest of the month the air quality index was moderate. In Commercial area (M.C Tube well) the air quality index from January-April was satisfactory and in August the air quality index was satisfactory but in Rest of the months the quality of air is moderate.

***IndexTerms* – AQI,RSPM,SOX,NOX**

I. INTRODUCTION

Air pollution has become intense topic of debate at all levels. In India the quality of air is deteriorating day by day, from last five years the air pollution in India rises by 13% it is mainly due to the Industrial chimney wastes, Thermal power stations, emission of automobiles and the compounds produce are Carbon Monoxide (CO), Sulphur di oxide (SO_2), Nitrogen Oxide (NO_2), Ozone (O_3), Fluorocarbons, Hydrocarbons, Metals, Particulate Matter, Photochemical products and toxicants. The studies revealed that there is several effect of air pollution on human health such as asthma or bronchitis.

There is a big challenge in controlling the air pollution especially in growing cities. The systematic monitoring programme in all over the world is needed.In every city the level of air pollution deteriorating because of quick increase in vehicle development, burning of garbage, fast industrialization. A few urban communities confront the extreme air pollution issues, with yearly normal levels of Total Suspended Particulate no less than three times high as 'World Health Organization' measures. An investigation led by the World Bank demonstrated that the unexpected losses of individuals in Delhi are because of abnormal abnormal amounts of air pollution. (CPCB, 2003).

II. STUDY AREA

Jalandhar city is one of the oldest cities and its roots lies during the times of "King Kanishka". The area covered by Jalandhar cities is 2632Km^2 .The location of the Jalandhar is 30^{0}19$^{'}$ latitude and 75^0 36$^{'}$ 48$^{"}$ longitude and its elevation above mean sea level is 780m. According to the recent census report (2011-2012) the population of district was 2193590 persons. Jalandhar is very famous for Sports Goods, Hand Tools, Leather Goods, Pipe Fittings and Surgical Implements

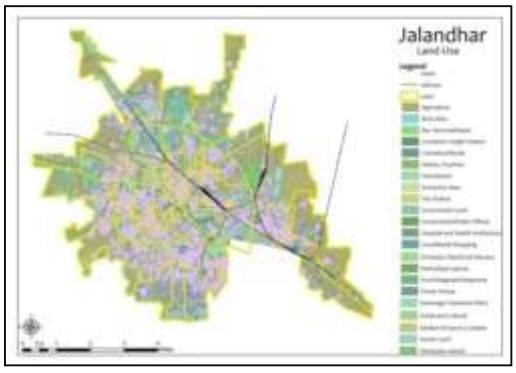

Figure:1 Land Use Plan

III. MATERIALS & METHODOLOGY

For the analysis of Air Quality Index, the data is collected from Punjab Pollution Control Board for the period of 1st January 2016- 1st January 2017. The data is collected for Jalandhar city area. In Jalandhar there are 4 monitoring stations of PPCB are there. The monitoring is done for 3 pollutants i.e. RSPM (Respirable Suspended Particulate Matter), SO_x (Oxides Of Sulphur), and NO_x (Oxides Of Nitrogen). The monitoring station are divided into four categories i.e. Sensitive, Commercial, Industrial, Residential. The names of the stations are Focal Point (Industrial Area), ESI Hospital (Sensitive Area), M.C Tube well near Municipal Corporation Jalandhar (Commercial Area), PWSSB near Manbro Chowk (Residential Area). The IND – AQI (Indian Air Quality Index) method is used to calculate the Air Quality Index. After finding out the analysis the pollutants are mapped in ArcGIS 10.2 software. On the basis of these data we do the analysis of the pollutants with the help of spatial analysis tool including Interpolation Method with the help of IDW(Inverse Distance Weighing) in the Arc GIS 10.2.We generate the different maps pollutant wise to show the Spatial Analysis of the pollution within the Municipal Corporation of the city.

3.1 CALCULATION FOR IND-AQI (INDIAN AIR QUALITY INDEX)

For finding IND-AQI following two steps are involved: (Source: CPCB)

i) Calculation of Sub – Indices

ii) Aggregation of Sub-Indices to get overall AQI

Step 1: Calculation of Sub Indices

Mathematically the Sub-Index value may be found as:

$$I=\alpha X+\beta$$

Where, α =slope of the line, β = intercept at X=0.

General Equation for the Sub Index (I) for a given pollutant concentration is based on "Linear Segmented Principle" is calculated as

$$Ii = [\{(IHI - ILO)/(BHI - BLO)\} * (Cp-BLO)]+ ILO$$

Where,

BHI= Breakpoint concentration greater or equal to given concentration.

BLO= Breakpoint concentration smaller or equal to given concentration.

IHI =AQI value corresponding to BHI

ILO = AQI value corresponding to BLO

Cp = Pollutant concentration

Step 2: Aggregation of Sub Indices:

For finding AQI i.e. Air Quality Index a maximum operator system is selected

$$AQI = Max (I_a,I_b,I_c,,,,,I_n)$$

Figure:2 AQI Chart

3.2 Location Of Analysis:

The four sites that were used for analysis (using PPCB Data) are:-

a) Focal Point (Industrial Area)

b) ESI Hospital (Sensitive Area)

c) M.C Tube well near Municipal Corporation Jalandhar (Commercial Area)

d) PWSSB near Manbro Chowk (Residential Area

3.3 Pollutants Under Analysis:

1. RSPM (Respirable Suspended Particulate Matter)
2. SO_x (Oxides Of Sulphur)
3. NO_x (Oxides of Nitrogen)

IV. Results & Discussions

4.1 RSPM (Respirable Suspended Particulate Matter)

(RSPM Analysis Map) reveals the average concentration of Respirable Suspended Particulate Matter (RSPM) over the built-up extent of Jalandhar city. It shows that as we move from the MC tube-well location which is low range of RSPM, the concentration of RSPM drastically changes towards all the directions. It goes to the highest point towards the north on the location of Focal Point. At this point the range of RSPM is 174-186 µg/m3which highly effected area of the Jalandhar city. It is also high in ESI hospital which affects its surrounding area. Apart from these, it is has average range towards south of the urban extent of the city i.e. PWSS location.

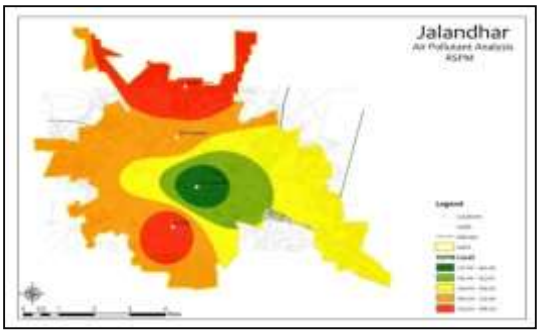

Figure:3 Analysis Of RSPM

4.2 Oxides Of Sulphur (SOx)

(SOx Analysis Map) reveals the analysis of SOx pollutants in the urban extent of the Jalandhar city. It depicts that the range is high in the northern and southern part of the city i.e. 12.5 µg/m3. In the middle part of the city it goes to the below average range of the interpolated values of the Sox pollutant. At the point of ESI hospital, it has minimum concentration range i.e. 11.3 µg/m3.

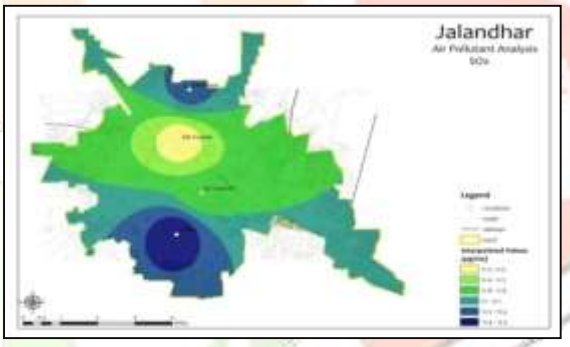

Figure:4 Analysis Of SOx

4.3 Oxides Of Nitrogen (NOx)

(NOx Analysis Map) depicts the analysis of NOx in the urban extent of the Jalandhar city. The interpolated values shows that the concentration of NOx pollutants is high in the southern part i.e. PWSS location. Here the average range of pollutant level is 22.7 µg/m3. As we move towards the north direction it changes with the distance. At the point of ESI hospital and MC tube-well locations it goes at the minimum level of pollutants range i.e. 21 µg/m3. From these points it again rises up to the level of 22 µg/m3 which is a location of focal point of the city.

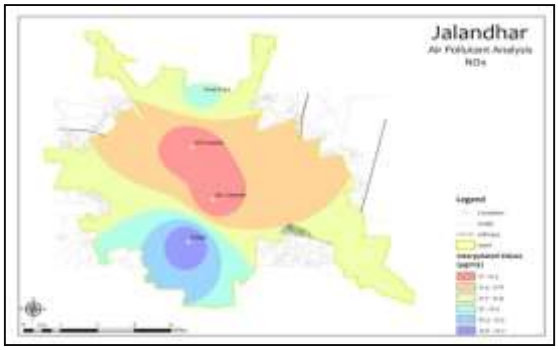

Figure:5 Analysis Of NOx

4.4 Air Quality Index (AQI):

(AQI Analysis Map) discloses the average concentration range of interpolated values of Air Quality Index in Jalandhar city. It shows that the concentration of AQI is high in outer part of the city and as we move towards MC tube-well location it decreases.

At the focal point it is 147-156 and at the ESI hospital area it is 141-146. On the south side at PWSS location it is between 141-146 ranges.
From the FIGURE: 6 Analysis of AQI it was seen that the highest AQI is in the Industrial area i.e Focal Point range from147-156. it showed that the AQI is in Moderate category
From the FIGURE:.6 Analysis of AQI it was seen that the lowest AQI is in the Commercial area i.e M.C Tube well range from 111-121. it showed that the AQI is in Moderate category
In moderate Condition in this condition older people, children will suffer the breathing problems and the people who are already suffering from lung and heart disease have to suffer from the breathing problems

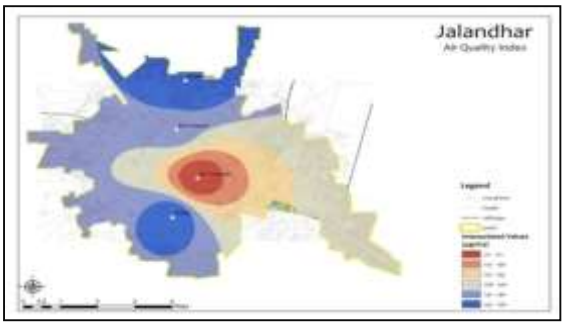

Figure:6 Analysis Of AQI

V. Discussions

It was observed that in the Sensitive Area the AQI was poor in the month of January and rest of the months the quality of air is moderate whereas in residential area the quality of air moderate in all months. In the industrial area the quality of air is poor in the month of November and December rest in all of the months the quality of air is moderate. In Commercial Area from the month January to March the quality of air is satisfactory and in rest of the months the quality is moderate.
It was concluded that in winter the quality air is mostly Poor to satisfactory in different area it is due to the temperature inversion phenomenon.
The RSPM is the responsible pollutant in all areas for increase AQI

VI. Effects

1. Increased in RSPM increase many problems i.e it increases the respiratory system problems, Coughing in normal breathing, Asthma problems, premature death of people.

VII. Reasons

1. Cow dung used for cooking and domestic purposes
2. Dust from paved roads.
3. Garbage burning in open
4. Heavy transportation activity in the Industrial area

VIII. Suggestions

1. Public awareness for environment protection should be done .
2. Green plantation along highways should be done.
3. Regular air monitoring should be done.
4. Encouraging people for public transport.
5. Use of CNG vehicles for auto should be done
6. Phasing of older vehicles from the area
7. Periodic vehicle maintenance should be done.

IX. References

1. Goyal P.et al., 2003.Air Quality Monitoring Vol.,1, Measuring of SO2, NO and NO2.

2. CPCB (2000). 'Parivesh' Annual report for session 1999-2000, from Environmental Information System from Central Pollution Control Board.

3. CPCB (2003), 'Guidelines for Ambient Air Quality Monitoring' Report Under Central Pollution Control Board, Ministry of Environment & Forests.
4. Prakash Mamta, Bassain, J.K,.'Analysis of Ambient Air Quality using Air Quality Index –A Case Study'. International Journal of Advanced Engineering Technology.Vol-1.Pg-106-114
5. PPCB (Punjab Pollution Control Board)
6. www.jalandhar.nic.in
7. Ziauddin A. and Siddiqui N. A. 'Air Quality Index (AQI) - A Tool to Determine Ambient Air Quality'.2006. *Poll Res.*, 25: 885-887.
8. Goyal P., Sidhartha. Present.' scenario of air quality in Delhi: a case study of CNG implementation., Atmospheric Environment'. Vol 37, (2003): 5423-5431.