CHAPTER 1

INTRODUCTION

The capital of the Republic of India has been in the news recently, and not for **a** valid justification either. India is the second most populated nation on the planet after China. Along these lines, Delhi being the capital is packed, with the two individuals just as enterprises. While on one hand the mechanical development is useful for the economy, the equivalent can't be said for the earth. Lately, it has become exposed that the air contamination in Delhi is perilously high it is in reality the most dirtied city on the planet. Delhi is National Capital of India, an Association Region, however since couple of years Capital of India is considered the most dirtied state in the nation. Delhi is a city which suits in excess of one hundred seventy lakhs individuals. Air contamination has turned out to be such a major issue in the city that administration needed to close down schools and universities because of dread of certain respiratory infections. Individuals were cautioned to not to step out of their homes for specific days. There have been reports of high number of passings because of the such a low quality of air. Adding to this the changing whether conditions aggravate it even by securing the poisons noticeable all around. Individuals are relying upon air refining covers and machines to expend the most essential Oxygen.

Delhi's air contamination are features each winter. This is for the most part because of air contaminations conveyed from different states like Punjab and Haryana, where consuming of harvests is completed. Air quality list of Delhi is commonly Moderate level between January to September, and after that it definitely crumbles to Poor, Extreme or Dangerous levels in a quarter of a year between October to December, because of different components including stubble consuming, sparklers consuming during Diwali and chilly climate. In November two thousand seventeen, in an occasion known as the Incomparable exhaust cloud of Delhi, the air contamination spiked a long ways past worthy levels.

The Air Quality Index level at hundred is considered as should be expected, yet in Delhi for the most part the AQI was two fifty to three fifty, which is considered as unfortunate and fall under poor extend. The brown haze impacts the perceivability of vehicles causing mishaps at parkways, retraction of flights and prepares. Substances, for example, copper, magnesium, Nickel, Zinc structure significant wellsprings of particles contaminating the air. The harmful particulate issue is under two point five microns, which can undoubtedly go into the lungs of a person. Medicinal specialists state the degrees of contamination in the city is equivalent to smoking fifty cigarettes in a day. The air quality in Delhi has decayed to such a level, that it is dangerous to wellbeing. In November two thousand eighteen, the air quality was even under the least favourable conditions, contacting the Serious in addition to crisis. The AQI levels came to over three hundred. The air quality in Delhi, as per a WHO review of sixteen hundred world urban communities, is the most noticeably awful of any significant city on the planet. Air contamination in India is evaluated to murder one and a half million individuals consistently; it is the fifth biggest executioner in India. In Delhi, low quality air irreversibly harms the lungs of two million or fifty percent everything being equal.

India’s Service of Earth Sciences distributed an exploration paper in October two thousand eighteen crediting practically forty one percent of particulate matter two point five air contamination in Delhi to vehicular outflows, twenty-one-point five percent to residue and eighteen percent to ventures. Specialists state if this proceeds, Delhi will be the most noticeably terrible city and most contaminated city on the planet. Air quality file is for the most part watched moderate between January to September, at that point it radically changes to Poor/extreme or even risky in the long periods of October to December and this is chiefly a direct result of consuming of yields, sparklers and cold and clammy climate. As per sources thirty six percent of Delhi’s contamination comes structure the city itself, thirty four percent from national capital territory and staying from neighbouring states or even global outskirts. As per the worldwide Condition Execution File environment performance index in year two thousand and eighteen, India is positioned at one seventy seven with an environment performance index of thirty point five seven, and it is unsettling to hear that Delhi, the national capital of the nation, is being labelled as one of the most intensely contaminated capital urban communities on the planet. It is the world’s most noticeably terrible city as far as air contamination, with an undesirable air quality file for most of the year. Along these lines, today, probably the greatest risk to the welfare of the individuals of Delhi and the city in general is contamination of different sorts.

The air contamination in Delhi is for the most part caused because of mechanical waste and vehicles. Ordinary just about eighty thousand trucks handle on the streets of Delhi and the greater part of them are extremely old trucks consuming diesel and lamp oil. The haze around Delhi is a mix of dangerous gases with a high centralization of nanoparticles, which are in charge of respiratory medical issues. Aside from the exhaust cloud we can see, there are a few other harmful gases in the environment that are totally undetectable to us! The spring season brings clear looking air, however this season is really when daylight responds with gases, for example, nitrogen dioxide and volatile organic carbons to make ground level ozone, introduction to which is practically identical to scouring sandpaper on the internal parts of our lungs. A occupied street on Delhi would now be able to be likened to Hitler’s gas loads as the degrees of volatile organic carbons, Sulfur dioxide, nitrogen oxide, carbon monoxide and ground level ozone are exceptionally high when one is on the streets of Delhi! The contamination appears to be ordinary to us, as days pass by. Our capacity to see contamination to reduce step by step because of the human body’s inclination to numb out aggravating scents. Living in Delhi is said to be equivalent to smoking twenty or more cigarettes each and every day. The poisons in Delhi are developing so that the human body can never again sift through these dangerous, cancer-causing contaminations. Poisons like the particulate matter contain particles that are under ten and two point five microns in size and are called shrewd contaminations. They give contamination simple access to our lungs, causing serious respiratory issues. Industrial contamination is likewise one of the guilty party, which contributed in Air Contamination in Delhi. Industrial facilities all through city territory discharge unsafe and harmful synthetic concoctions in air and close by water bodies. As indicated by sources, Power plants and the well known Badrapur warm Power Station contribute around eighty to ninety percent of contamination. Looking at the present circumstance, essentially planting more trees will be almost futile against the contamination

issues of Delhi. Contamination levels of Delhi are too thick to ever be broken up by simply planting trees. Delhi Contamination kills in excess of ten thousand individuals consistently. Winter season is particularly awful in Delhi and demonstrates an expansion in contamination actuated disease.

After the celebration of Diwali in year two thousand sixteen, the contamination in Delhi has arrived at aggravating levels, and individuals are being exhorted not to step outside because of the seriousness of the contamination levels. Seniors and kids endure even more in such a circumstance. Air contamination prompts numerous medical issues, the absence of unadulterated air to inhale is a noteworthy worry in the present period. Indian Medicinal Affiliation has cautioned open to retrain themselves structure going out and proclaimed a General Wellbeing Crisis in Delhi, couple of years back. Individuals began wearing veils to shield themselves from breathing in dangerous gases present noticeable all around.There are numerous wellbeing dangers related with air contamination, for example, Respiratory issues, similar to dry hack, wheezing, sinusitis, sore throat, windedness and so forth. Threat to lung working, decreased lung limit, lung malignant growth. Head hurts, eye aggravation.Heart infections. Certain gasses forestall oxygen in blood and this can prompt decrease in stockpile of oxygen to heart, Asthma. Premature birth or birth surrenders in specific cases. While the legislature is finding a way to control the contamination and its belongings. These means are to be taken direly to lessen the contamination, as it is causing genuine wellbeing impacts to residents and all common life.

Steps which could be taken to eradicate or minimise the problem could be possibly.The above all else step is to plant more trees. The new can help in lessen the contamination and produce sound gasses. Pollution check of the considerable number of vehicles by vehicle division, and empowering eco-friendly autos. Encourage vehicle pool or open vehicle to help diminish stream of more vehicles on streets. Residents should step up to the plate for vehicle pooling with their loved ones. This will likewise help in rush hour gridlock control. To dishearten open from utilizing their very own vehicles specialists have chosen to raise the leaving expenses. Burning of any trash or leaves or wood is being restricted. Prohibition on Sparklers is being actualized upon the arrival of Diwali. Halt on all the development exercises. This will likewise mean restriction on every single stone smasher, diesel generator sets, to anticipate the residue originating from the exercises. Mechanical sweepers and water sprinklers ought to be presented, to clean the streets.

Air purifiers in workplaces, even property holders are urged to introduce purifiers in their homes to adapt up to the terrible air. Long term estimates, for example, prohibition on consuming and closeout of fireworks totally. Air Contamination and Water Contamination are a noteworthy rising worry in Delhi and numerous pieces of India. In the ongoing years, Delhi has endured the most because of air contamination. Numerous children and grown-ups needed to confront genuine medical problems because of air contamination and awful nature of air. There have been reports of passings as well. Settling this circumstance is both in the hands of government just as open. In the event that this circumstance proceeds with it will prompt numerous wellbeing dangers among all ages including pregnant ladies and unborn children. Numerous perilous gasses, for example, hydrocarbons, nitrogen dioxide, sulfur are

being discharged. The nature of air in Delhi was awful to such an extent that it brought about crossing out of cricket test coordinate, this was first time in Indian history where a match was dropped because of contamination as the players were not ready to remain in the dirtied air in the arena, making it even hard to relax. In spite of numerous measures by government, the air quality isn't improving in any way rather it weakens each season. This is because of open and applicable specialists are not co-working. Yet, there is a murmur of alleviation Delhi recorded its most minimal contamination levels since October a year ago on Tuesday after substantial rains and quick breezes washed away the toxins and purified the air, getting the air quality the 'good' class, specialists said.

As indicated by the **Focal** Contamination Control Board information, the general air quality file in the city was ninety-eight, which falls in the 'good' class. Since October a year ago the air quality has been recorded in the 'palatable' class. It is additionally the city's best air quality index of this current year, the central pollution control board information appeared. Delhi saw overwhelming downpours compelling the temperature to drop in a few pieces of the city. Substantial rains radically decreased the contamination level of the national capital, which recorded the best air nature of this current year on Tuesday, specialists said. As per the Focal Contamination Control Board information, the general air quality list in the city was one hundred thirty three, which falls in the 'moderate' class. This is the first run through this year that an AQI as low as one hundred thirty-three was recorded, the CPCB information appeared. In first seven day stretch of January as well the air quality had improved to 'moderate' classification for a concise timeframe. Individuals everywhere throughout the globe experiences the issues of neediness, imbalance, foul play, money related emergency and It's a disgrace that the resident of India's capital are struggled with the air they take in for endurance. Numerous means have been taken to take care of this issue of contamination. It is simply disallowing certain exercises which lead to air contamination, contingent upon the conditions right then and there of time. In this way giving an impermanent arrangement, however this issue need a perpetual answer for farthest point the awful nature of air go into the environment. This requires a consistent observing and preventive strides to limit the risky contamination levels. Steady checking of human exercises. Dynamic estimates must be taken, and paid attention to, if there's ever any desire for salvation for Delhi.

CHAPTER 2

LITERATURE REVIEW

In the course of recent years, the individuals included principally in paying heed to everyday air varieties that they are presented to. Affected by the expanding attention to Condition regarding the air contamination the administration is concentrating basically on sub-populaces, for example, youngsters and old individuals, nearby specialists are giving increasingly more momentary advantages of air estimating. The air nature of a specific area is described by air quality index of that spot. In different metropolitan urban areas of India air quality index is demonstrated to be a proficient and beneficial strategy to discover the varieties in the nature of air by contrasting earlier day air quality index and the present air quality index and meteorological varieties by utilizing Guideline Segment Relapse procedure. The investigation proceeds in each of the four seasons in particular summer, winter, storm, post rainstorm. Just those parts having the Eigen esteems short of what one is utilized to ascertain air quality index. The presentation and investigations of PCR model in the computation of AQI were preferable for winter over some other season as concentrated through factual blunder examination. The estimations of standardized mean square blunder were seen for winter, summer, post-storm, rainstorm separately. (P. Goyal and AnikenderKumar (2011) Air contamination is essentially characterized as the tainting of our encompassing air which contains gases, dust particles, exhaust or undesirable smells in high amounts that surpasses its typical focus and demonstrated to be unsafe to the strength of people and creatures or terrible enough to make harm plants and even materials.Air contamination is demonstrated to be the best executioner focusing on the respiratory tract of the individuals generally more established individuals and kids. Not just air contamination numerous sorts of Ecological contamination issues are demonstrated to be a danger to human presence. To turn away the future issues numerous researchers and specialists have led the related inquiries and revelations and thought of Air Contamination Determining. They are of the thought that if the climate can be anticipated through climate estimating why not Air quality can be resolved and checked through Air Gauge, however this will require high information of air contamination, air gauging models and broad control measures and precise determining which not a simple errand is. Air estimating is made by joining three unique angles which are factual anticipating strategy, numerical gauging techniques and man-made brainpower techniques. Luckily, with the assistance of our financial, ecologic and human toll Air gauging expected to lessen the developing air contamination can be formulated. Air contamination anticipating is a commendable speculation performed on various levels – singular level, network level, national level and just as worldwide level. This system will assist the individuals with planning ahead, diminishing the impacts on wellbeing and the earth. Air anticipating can possibly make a perfect situation and a solid populace. The Administration ought to likewise utilize early anticipating to kick start the methodology that can diminish the seriousness of contamination levels.(Lu Bai,Jianzhou Wang,Xuejiao Mama and Haiyan Lu (Walk 2018)) .From the previous couple of years there is a consistent increment of populace in the urban zones, and in this manner with developing populace a progression of issues identified with conditions, for example, deforestation, arrival of lethal

materials, unsafe outflows from vehicles, enterprises and manufacturing plants, strong waste transfers and some more, have stood out a lot more prominent than any time in recent memory. It is pinnacle time to make some move to spare the mother earth before it's past the point of no return. The issue of air contamination in urban communities has turned out to be serious to such an extent that there is a need to assess and get activity the innovation that can illuminate about the progressions and variety in contamination level opportune. The air contamination scattering is a perplexing and extreme issue. It covers the toxin transport and dispersion in the air. The poison scattering in the climate depends generally on the highlights of the toxin like meteorological, outflow and territory conditions. Physical and numerical models are defined to portray air contamination scattering. Physical models are completed in wind burrows on little scale portrayals of the barometrical stream. Scientific models are separated into factual and deterministic models. Factual models rely upon the investigation of past observing air quality information. Deterministic models depend on a scientific depiction of physical and compound procedures occurring in the air. These models depend on numerical conditions, express preservation laws of mass, force and vitality. (P. Goyal and AnikenderKumar (2011) Air quality demonstrating assumes a noteworthy job in articulating air contamination control and the board approaches by giving headings to better and better oversaw and systematized air quality arranging. In the previous couple of years, a few air quality scattering models are utilized to assess and keep a mind the urban air quality to diminish the reason for weakening of the air we relax. The exhibition and productivity of an air quality model principally rely on the precise translations of the correspondence between barometrical, outflow and topographic parameters associated with the air contamination issue. In this paper, four condition of-workmanship air quality models like AERMOD, ADMS-Urban, ISCST3 and CALINE4 and two codes for example GFLSM and DFLSM (in light of Gaussian rule) have been utilized to anticipate the air nature of a urban convergence of Delhi city, India. These models are applied to foresee the convergence of Carbon monoxide, Nitrogen dioxide and particulate matter which are one of the real segments of vehicular fumes outflows. Khare et al. 2012 A wide scope of angles are secured, to decide different wellsprings of air contamination, essential and optional poisons, climatic science, barometrical compound vehicle models, PC programs for scattering demonstrating, on the web and disconnected air quality displaying, information osmosis, parallel figuring, utilizations of geographic data framework in air quality demonstrating, air quality file, just as the utilization of satellite and remote detecting information in air quality demonstrating. Many significant business and non-business scattering bundles are additionally audited and point by point advantages and disadvantages of their applications are put front. Moreover, the paper gives valuable sites, where perusers, analysts, students and specialists can get additional data with respect to air quality models. This paper may fill in as a gathering for researchers who work in air quality demonstrating field. It might likewise be utilized as a kind of perspective source by numerous researchers working with air quality displaying. (El-Harbawi, 2014) Because of the weakening of urban condition and discharge of over the top toxins from vehicular, modern and business parts bringing about making Air unfit for breathing; the individuals of the nation are taking an unmistakable fascination for air contamination examination. The air contamination model is an integrative subject when the whole urban areas are thought about, urban arranging and the geometric region is

demonstrated to be intricate which requires an enormous number programming bundles to be created like OSPM model and CALINE arrangement. On review different elements the air poison scattering on the urban roads and all connected wonder, for example, wind stream, temperature, grouping of toxins and so on. For the most part relies on the speed and heading of the breeze, statures and thickness of a structure, length and width of the street, the focus, source and force of air contamination, meteorological elements like temperature and moistness and so forth. Consolidating every one of these elements a one of a kind case is watched inevitably. The main rule of this examination is to fake the barometrical poison scattering for the given contamination carbon monoxide,oxides of sulphur and nitrogen as for the given environmental conditions like the speed and bearing of the breeze. The scattering of the poisons pursues the patternSO2 >CO> NO2. Computational liquid elements recreation for breaking down the barometrical toxin scattering is done after normal wind stream examination. (Vinay Prabhakar,S.K Singh (February 2019)).This is the most effortless and first of the means that any of the air quality organizations can embrace. An assortment of screens are accessible for all toxins but there is a genuine absence of scaling up this progression in numerous urban communities, including the megacities. The checking of air contamination is urgent not just for the administrative bodies yet additionally for the scholarly and other supporting organizations .This progression unites the logical information for deciding poison emanations and administrative angles to define the city's response to air contamination emergency. Likewise, it is critical to comprehend the geology of the urban areas, and how the outflows from different sources will interface and effect the watched air contamination designs. In a perfect world, any establishment worried about contamination is relied upon to have a discharges stock for all poisons. As much as it is critical to set up a standard, it is additionally imperative to recognize the vulnerability of the inventories. Like the outflow’s standard improvement, scattering displaying is an extraordinary exercise, which requires both computational power and information absorption. The displaying frameworks are bounty accessible, with shifting limit and unpredictability to address physical and compound parts of air transport of toxin. While the accessibility of applicable information on air contamination is troublesome, a developing test is with the dispersal of the data to the policymakers and the general population. As a major aspect of a coordinated AQM, the blend of guidelines, mindfulness and limit building, and associations between partners (counting craftsmen) contribute similarly towards improving air quality. (Guttikunda et al., 2011)

2.1 Research Gap

With increase in population traffic infrastructure development construction projects burning of parali in neighbouring areas or districts, industrial emission from unauthorized sites and emission of hazardous pollutant concentration has substantially increased in certain areas while because of ongoing Environment protection remedial measures like ban on construction during winters ,ban on entry of commercial vehicles during winters inspection and shutdown of unauthorized emission sources open burns ban on fireworks proper and careful construction activities with proper permission from environment authorities and many other steps has led to variation in air quality index of different locations where monitoring stations set but in intermediate non monitored stations it is needed to study the pattern of

pollutant variation with respect to each other over the year 2016, 2017 and 2018 variation in non-monitored location is needed to be analysed on yearly basis to identify alarming and improving condition in different zones main pollutant observed from sources are particulate matter 10 particulate matter 2.5 ,Carbon monoxide, Sulphur dioxide, Nitrogen dioxide ,ambient air quality with respect to these pollutant is needed to be calculated and their concentration at non-monitored location is required to carry out conclusive results from selected pollutants. Air quality index is required to be calculated for non-monitored area to get the status of Air quality index of such areas. Any improvement or deterioration in such nominated area is identified and effect of particular pollutant can be estimated to take necessary steps if problem goes alarming.

2.2 Objective of Research

- To undertake temporal study of air quality in Delhi for three years.
- To conduct spatial distribution of ambient pollutants using AQI at selected locations of Delhi
- To create AQI contour maps using ARC GIS
- To compare concentration of air pollutants with NAAQ standard limits

CHAPTER 3

METHODOLOGY

3.1 MONITORING LOCATIONS

Study area

Study is done in Delhi in East ,North East ,West and North districts.

Details of sampling points

Data is taken from six monitoring locations located at Anand Vihar ,Ihbas Dilshad Garden ,Punjabi Bagh Shadipur Mandir Marg and RK Puram.

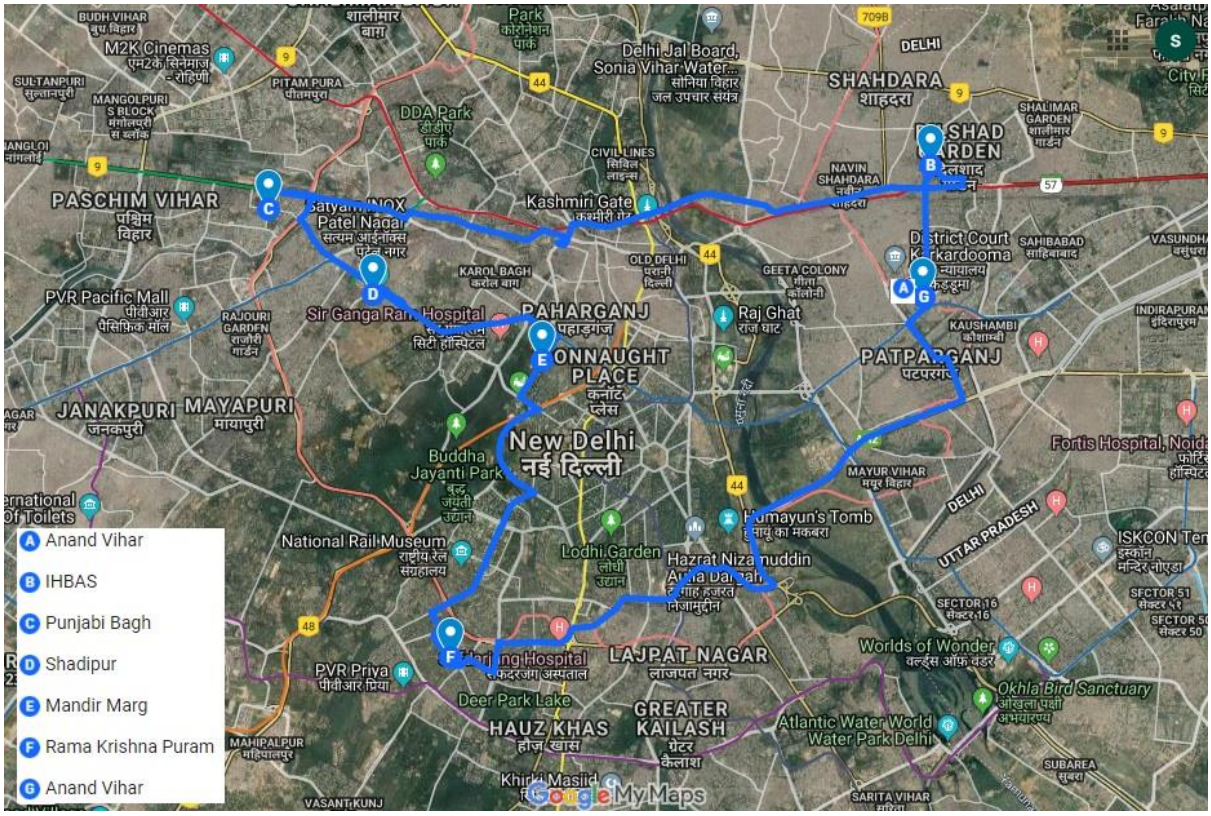

Figure 1 Monitoring Locations of Delhi

Data source

To carry out comparative geo statistical ambient air quality analysis of Delhi raw data was taken from CPCB from six monitoring stations located at Anand Vihar,Ihbas Dilshad Garden ,Punjabi Bagh, Shadipur Mandir Marg and RK Puram in different districts of Delhi.

Raw data of pollutant PM10 ,PM 2.5 Nitrogen dioxide Sulphur dioxide and carbon monoxide for year 2016 ,2017 and 2018 was taken on daily basis which is average to annual average data in Microsoft Excel for a particular pollutant air quality was obtained using formula of indices given in annexure then data for each pollutant is processed in similar way and above steps was repeated to get respective sub indices values of all pollutants , which shows air quality index with respect to that pollutant then this data is imported to Arc GIS to carry out interpolation and obtain conclusive results ,steps used in GIS are shown below.

3.2 PRINCIPLE USED FOR STUDY

INVERSE DISTANCE WEIGHTING (IDW)

The interpolation technique was adopted using the geostatistical analyst extension within the geographical information system ArcGIS 10.1. The IDW interpolation uses the concept

adopted by Thiessen polygons (THIESSEN, 2006)by moderately changing the surface trend. The predicted value which is closer to measured value gives more reliable results compared to prediction of farer value. IDW is based on assumption that local effect reduces as distance increases from a point.Standard expression of IDW is given as

$$\hat{Z}(s_o) = \frac{\sum_{i=1}^{N} w(d_i) Z(s_i)}{\sum_{i=1}^{N} w(d_i)}$$

Where $\hat{Z}(s_o)$ and $Z(s_i)$ shows the predicted and observed value at location s_o, s_i,

N is the number of measured sample points which we have used while predicting,

w(d) is the weighting function and $d_i$is the distance from s_o to s_i.

Weighting function based on the framework of IDW expression will cause changes in the interpolation of our results(Luo, Taylor and Parker, 2008).

IDW interpolation could be used to create raster of elevation, rain, heat and chemical dispersion or any other spatially based phenomenon. Output of interpolation is raster analysis based on triangulation /regular network. Other methods we use are inverse distances, weights, spline, nearest neighbor and kinging. Interpolation helps us in realistic representation of any geographic change which could be experienced by other means and also adopted, when measurements if small units are not possible. one of the most reliable interpolation technique based on assumption that things which are close to each other are alike in nature those farer are not. It helps in prediction of any unmeasured location of surroundings from the measured values. In IDW we are assuming that each point has a local effect that goes away as we move far. Weight is greater for a nearby point whose prediction is done and weight decreases as, prediction point distance decreases.

So we termed it as inverse distance weighted. It is quite advantageous as its easy to get through and no values are produced outside are measurements but we need to take care that if sampling point is uneven, results will be effected. Shape of surface obtained depends on exponent n. We can get smoother surface if results are obtained from sufficiently large number of points. Results obtained after interpolation could be used for prediction of values at a point where sample is not possible and that point is of our interest. Time efficient and economical and give results of restricted areas. Data can be obtained for the points where data is lost. Other variables can be predicted at such locations. IDW is a perfect interpolation tool

which give results with distance. In spleen surface can exceed known value range and also pass through all sampling points. Complex interpolation can be done by kinging, which reads relation between sampling data of points and then it predicts. Surface created can exceed value range but it does not pass through sample points.

3.3 STEPS OF INTERPOLATION

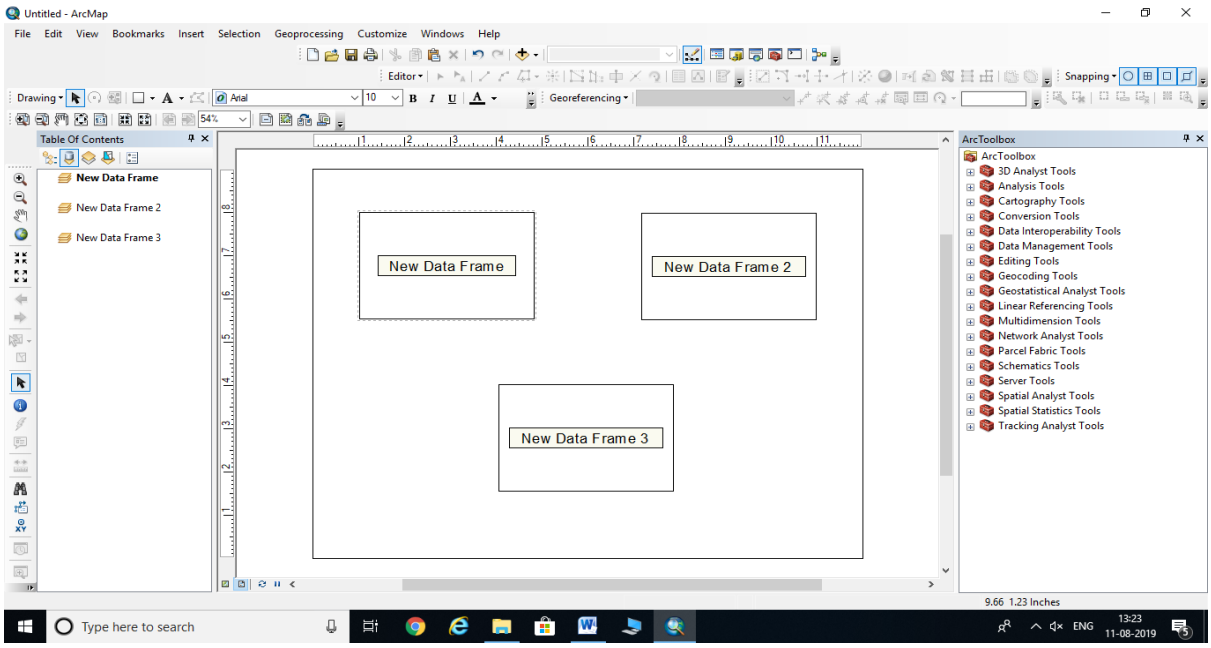

Figure 2a Arc Map Data Frame

Open arc map 10.1 in arc GIS.Take landscape page of 9 inches by 12 inches for layout preparation. Insert data frame which represents a geographic location and contains layer of data by selecting insert then data frame. Data frame for year 2016, 2017, 2018 then add data from arc gis online into the map. Add Delhi outline map in data frame as shown in red color in figure.

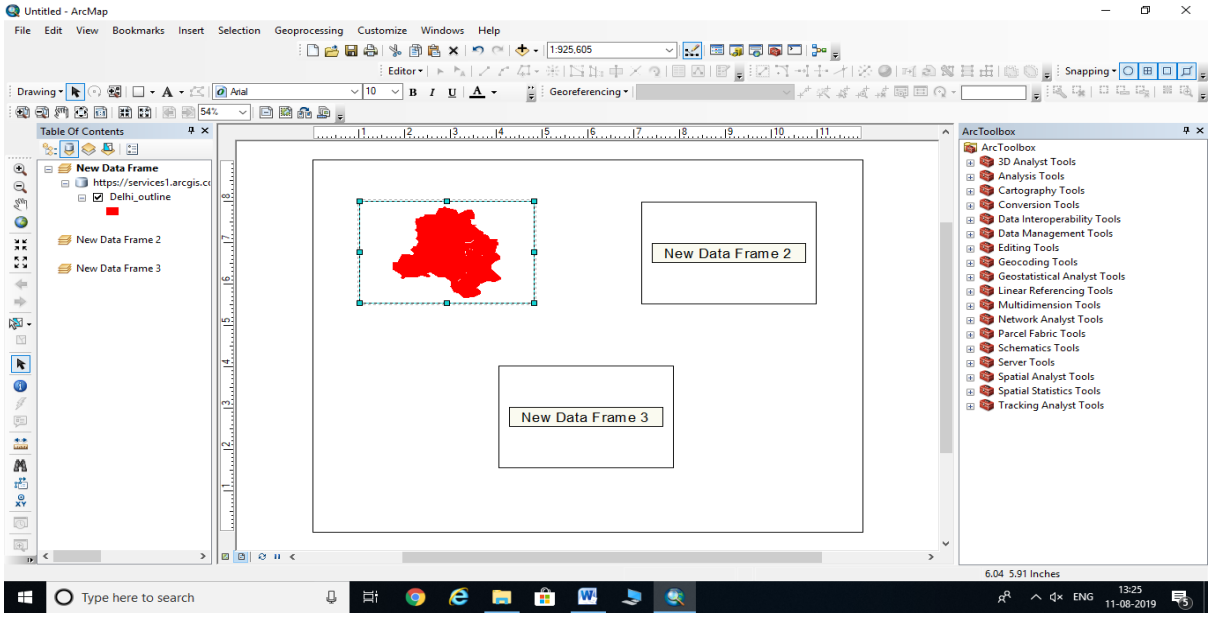

Figure 2b delhi outline map on map layer

Now add data in Delhi outline map go to add data in file then add xy data which adds a new map layer based on XY events from table

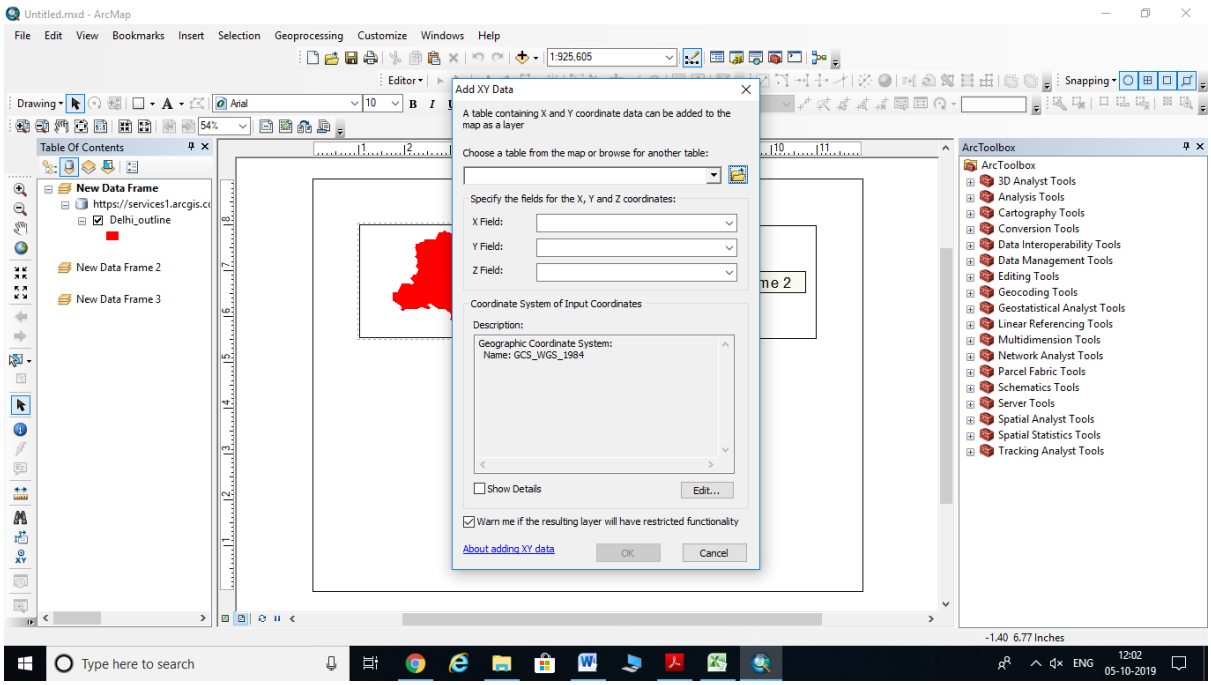

Figure 3 insert x y data from table

Choose the table from where X and Y coordinates data can be inserted adopt Geographic coordinates system as gcs_WGS_1984.

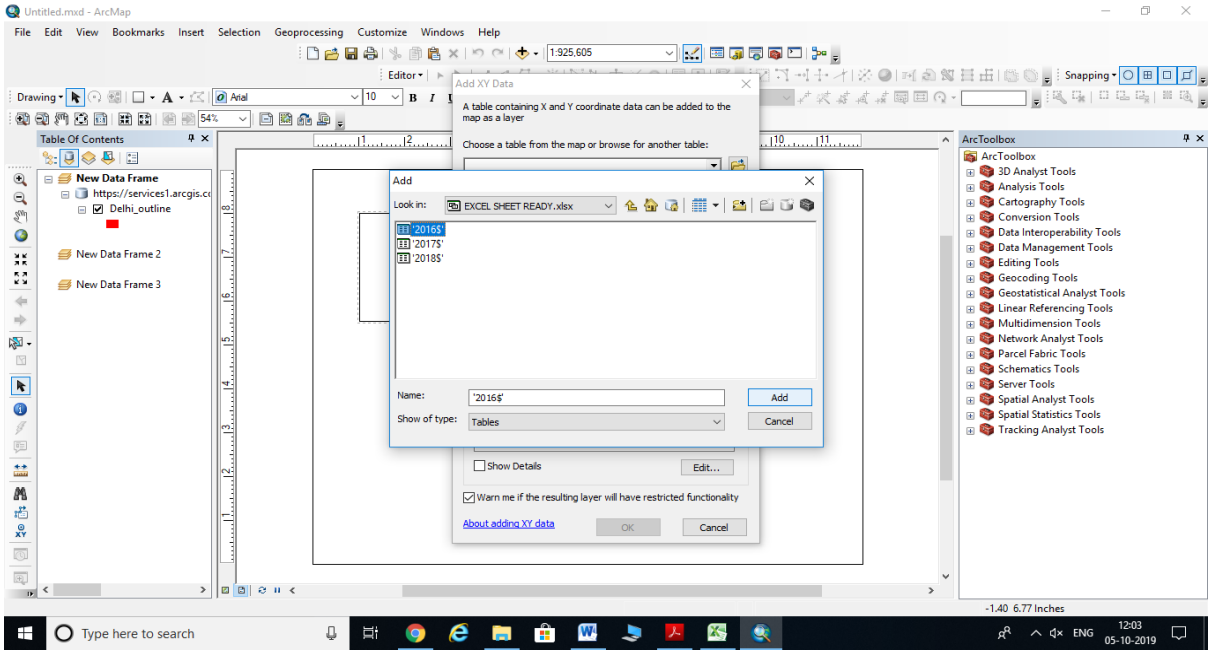

Figure 4 add data from excel sheet

Add data from Excel sheet made area having xy events initially at data for 2016 or whichever is needed. Eg '2016$' , as shown in figure.

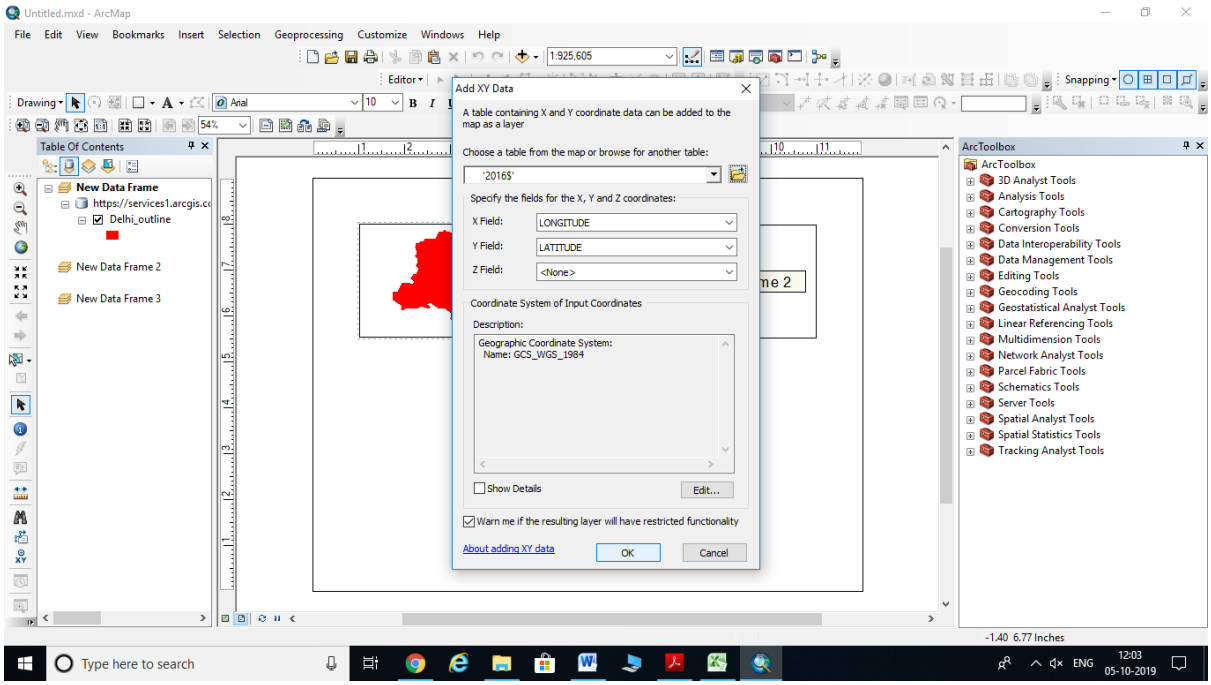

Figure 5 select latitude and longitude

In dialogue box in textfield select longitude and NY field select latitude after this latitude and longitude points will be seen in Delhi outline map.

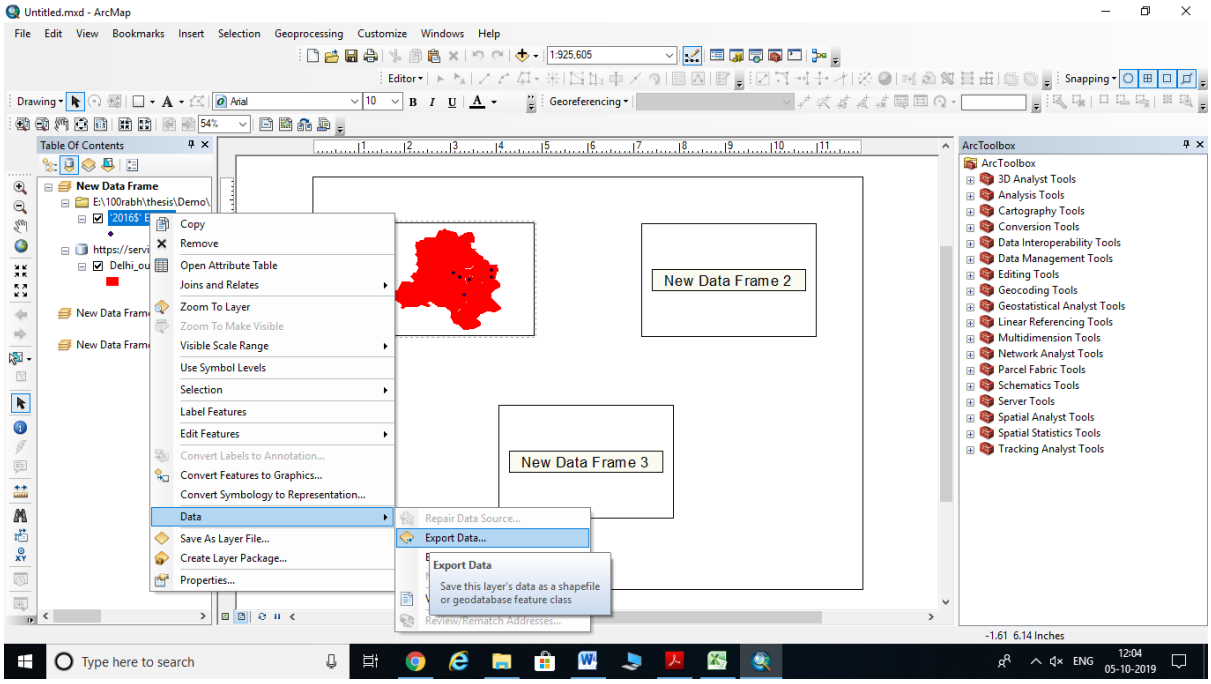

Figure 6 select layer to export data

Now go to data and click export data which saves layers data as a shapefile or geo data base class. Name file according to convenience which is a shapefile then by selecting this layer source data export data.

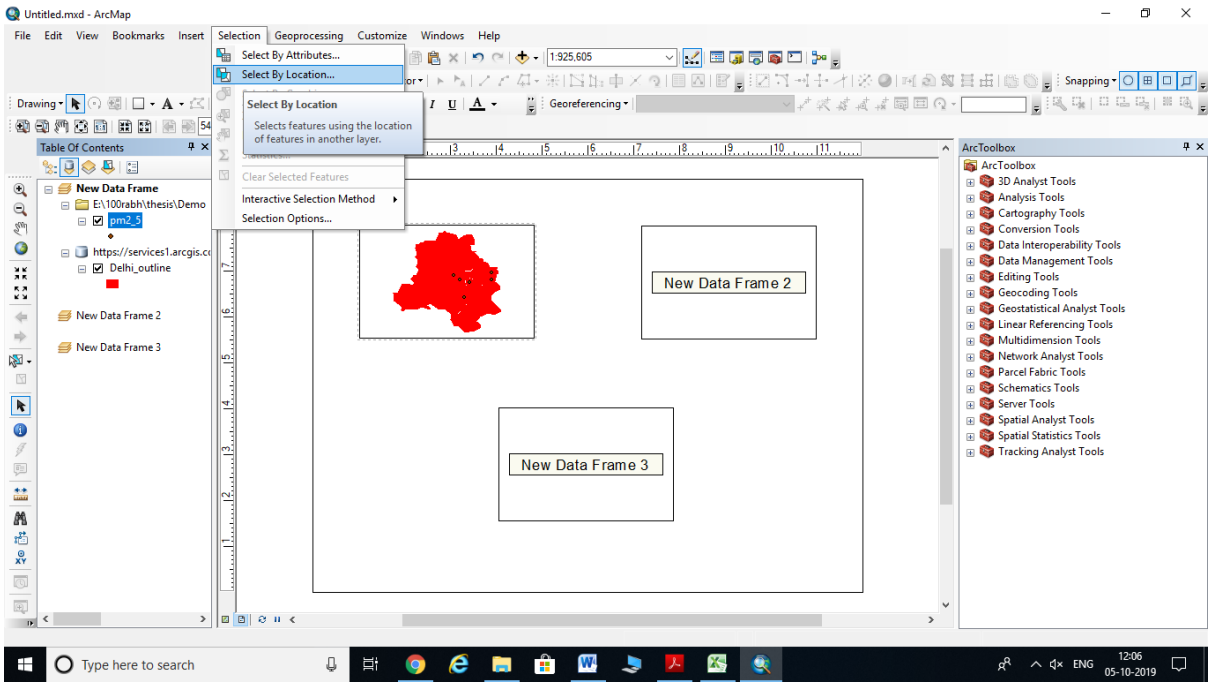

Figure 7 select location

Select features using the location features in another layer this is done in selection tab in select by location feature then select source layer and make sure you have centroid in source layer feature.

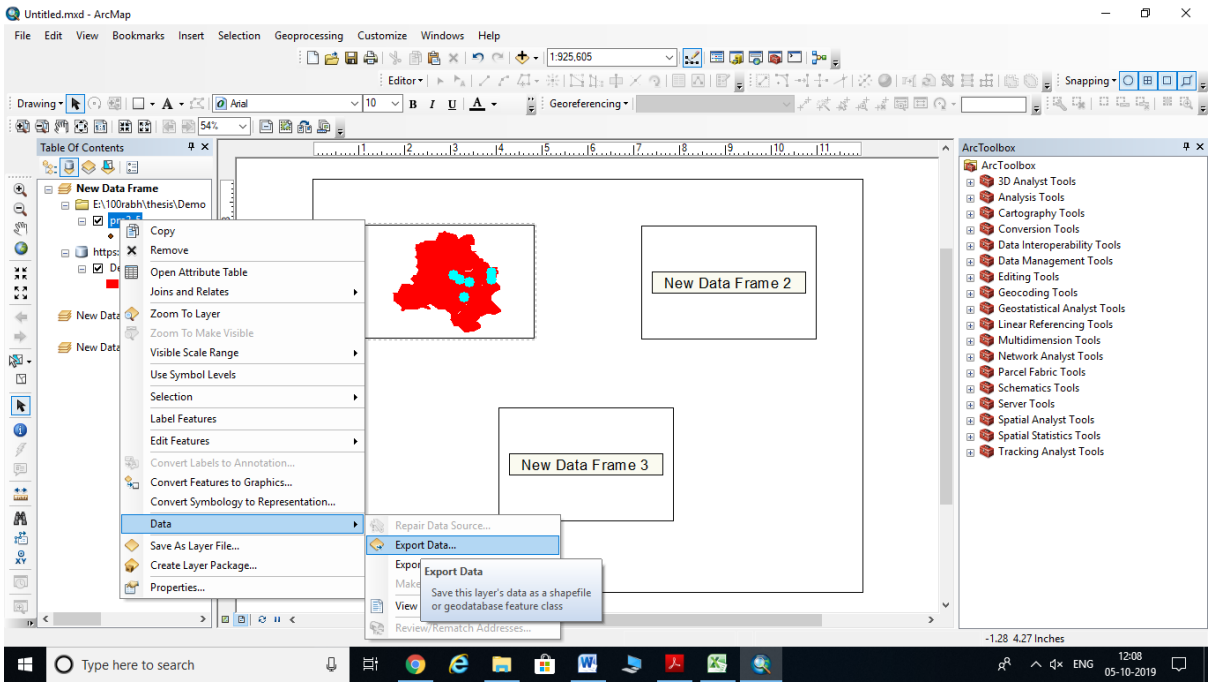

Figure 8 export data

Go to data export data and same file by giving suitable name for convenience which is a shapefile.

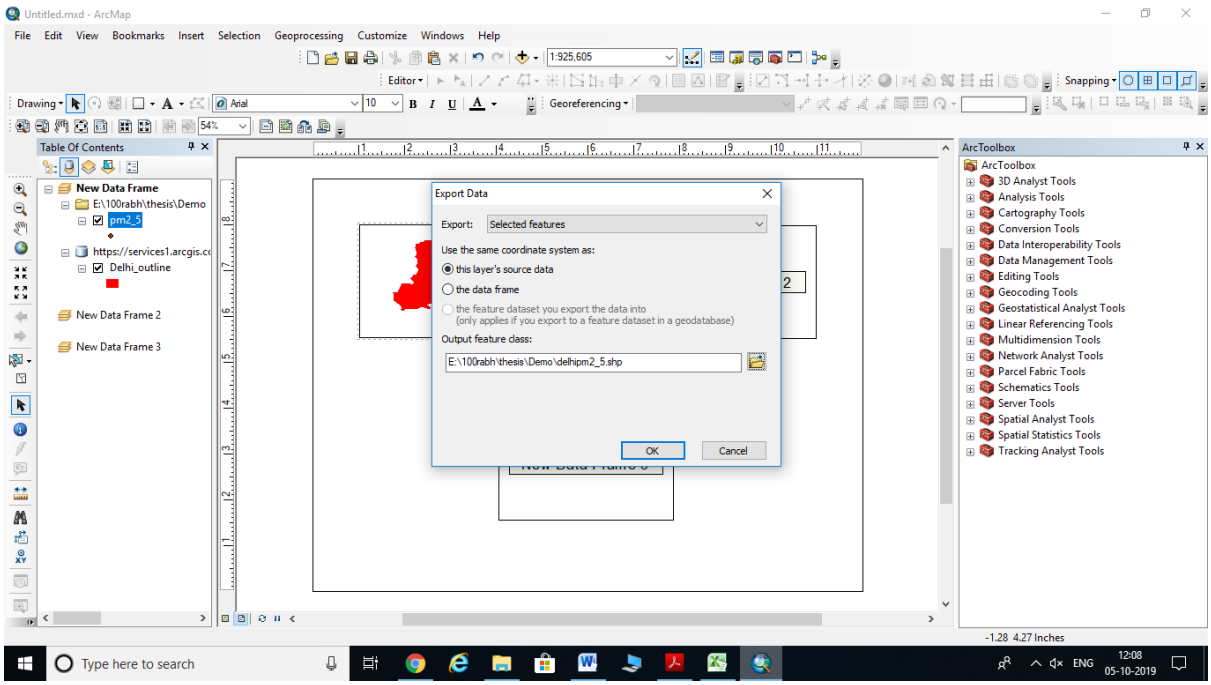

Figure 9 export data to map layer

Now export data using the same co-ordinate system as their source data add exported data to the map as a layer.

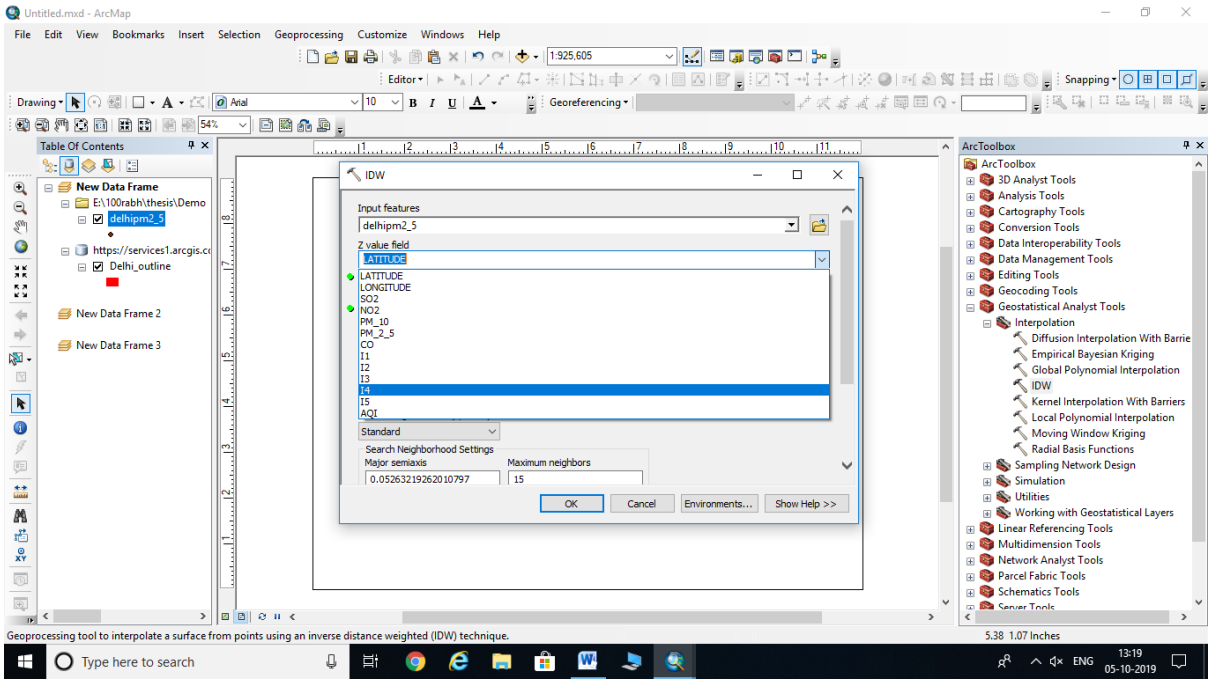

Figure 10 sub index selection in inverse distance weighing

Go to IDW for carrying interpolation computations select input feature which is needed and for Z value select corresponding sub index name example I4 shown in figure.

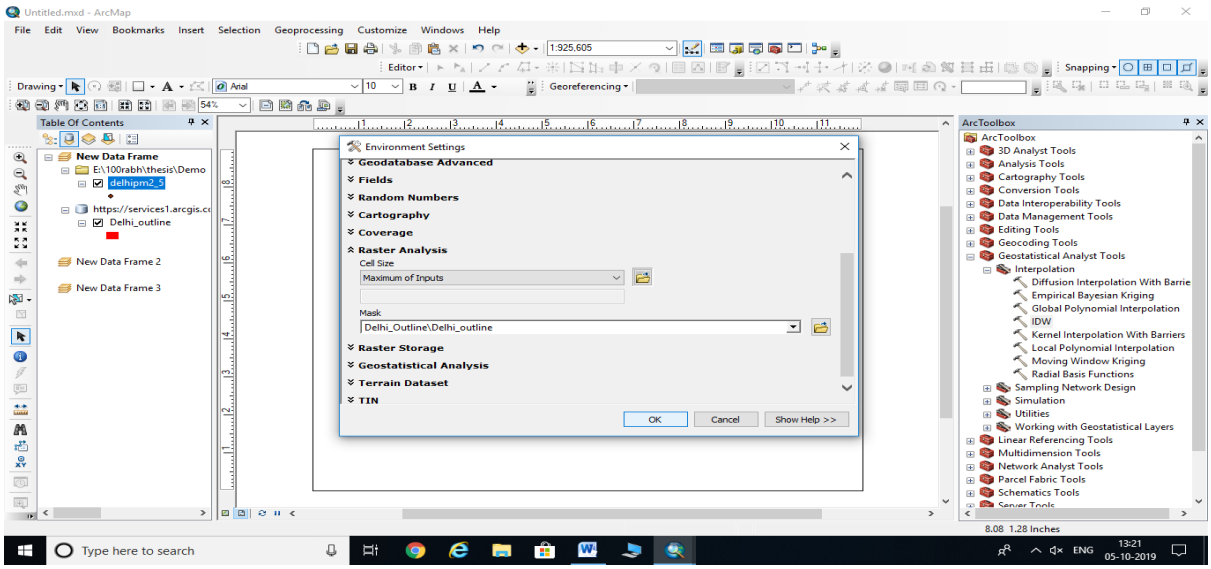

Figure 11 environment settings

To get output register rename file according to convenience and save as registered data sets type go to environment settings are depressed analysis and keep cell size as maximum of inputs and mass name as per the name chosen earlier carry out the return analysis and results

will be shown modify the settings to make results easy to understand as per the sub index suitable colour code is selected for better and improved visualisation and therefore interpretations could be done from the the results.

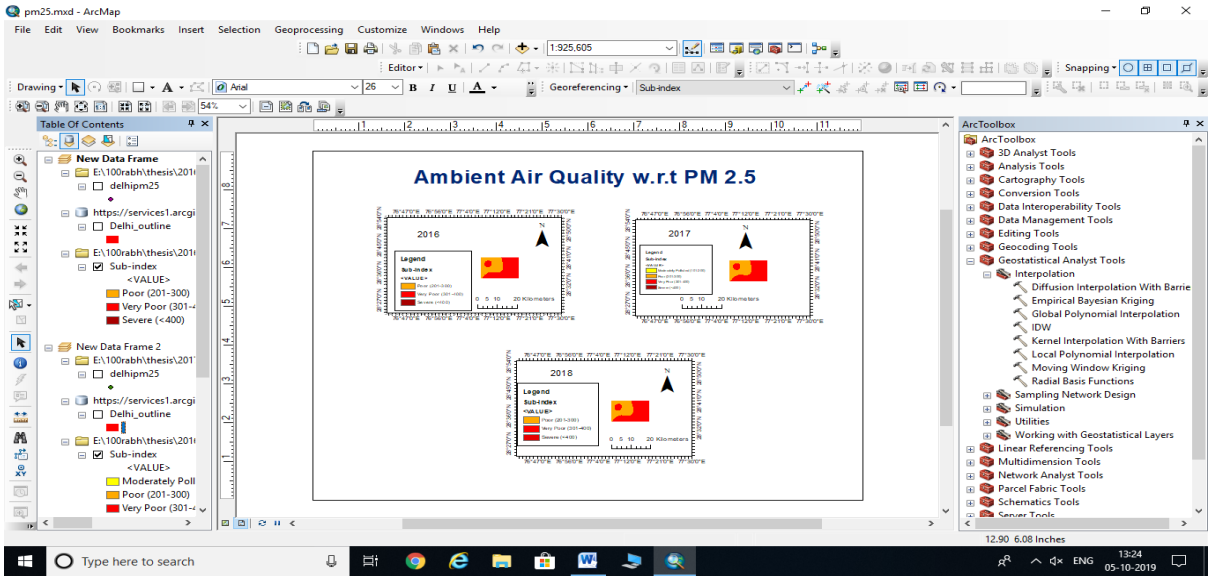

Figure 12 setting limits and obtain final results

Hence, by using inverse distance weighing interpolation is done and similar process is adopted to get results for other pollutants and subsequent years that's 2017,2018.

3.4 AMBIENT AIR QUALITY INDEX

Air quality monitoring Agency takes the help of air quality index in order to provide the information regarding the amount of pollution in the air to the public .Its acts as an evident which can pass away the effects on human health and environment . The term air quality index was first coined in USA in 1968. Other names of air quality index are air quality health index, air pollution index and pollution standard index .Monitoring sites provide AQI different locations forecasted by news channels at the specific time So that they are in easy reach for the general public. Air quality index monitoring in India - The ministry of environment, forest and climate change has launched National air quality index at New Delhi on September . It comes under the well known policy of India called "Swachh Bharat Abhiyan". Air quality index Provides its results on the basis of six categories Good, Satisfactory ,Moderately, Polluted, Poor ,Very poor and severe ambient air quality index is defined as an overall plan that change the weighed values of individual air pollutant

concentrations into a single number or set of numbers to display the quality of air based on effects on human health. The sub-index of individual pollutant is calculated based on break points for a particular NAMP station and maximum of sub-indices for a particular NAMP station give the overall Air quality index.

AQI Category	**PM_{10} 24-hr**	**$PM_{2.5}$ 24-hr**	**NO_2 24-hr**	**O_3 8-hr**	**CO 8-hr (mg/m^3)**	**SO_2 24-hr**	**NH_3 24-hr**	**Pb 24-hr**
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5-1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very Poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1-3.5
Severe (<400)	430+	250+	400+	748+*	34+	1600+	1800+	3.5+
*One hourly monitoring (for mathematical calculation only)								

Table 1 Breaking points for AQI

CHAPTER 4

RESULTS and DISCUSSION

4.1 SULPHUR DIOXIDE (SO2)

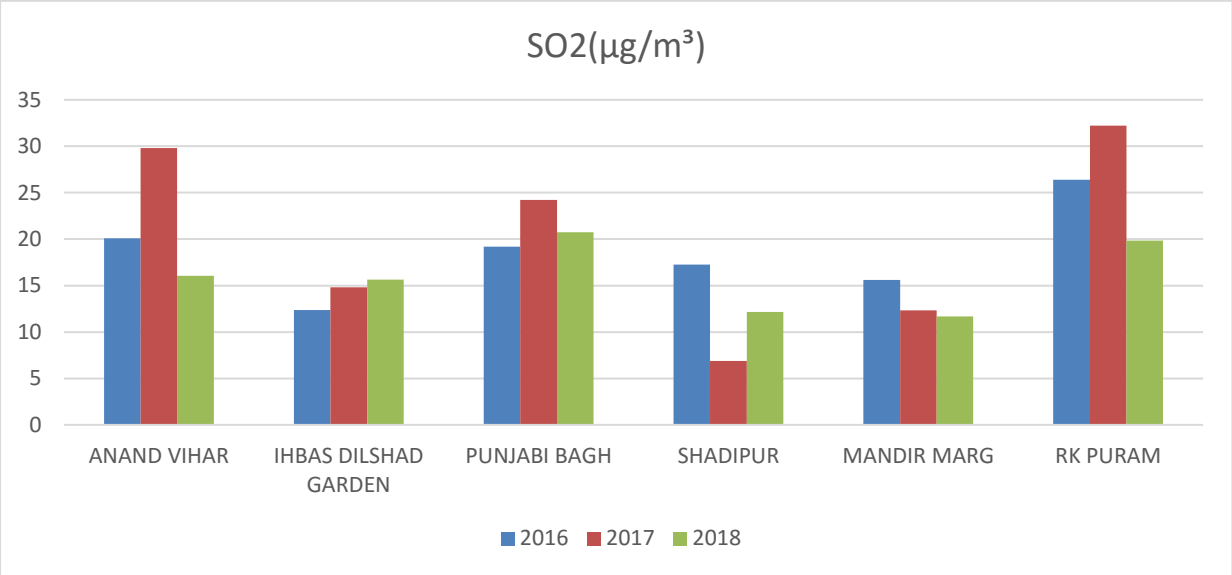

Figure 13 Sulphur dioxide values in 2016,2017,2018 , source CPCB

SUB INDEX		
I1 2016	I1 2017	I1 2018
25.1125	37.275	20.05
15.45	18.525	19.5375
23.975	30.2625	25.9375
21.5625	8.6125	15.1875
19.5125	15.4125	14.5875
32.99375	40.2625	24.8125

Table 2 sub index with respect to sulphur dioxide in 2016,2017,2018

According to National ambient air quality standards of India the permissible limit for Sulphur dioxide is 50 microgram per metre cube. Sulphur dioxide concentration in year 2016 2017 and 2018 has remained within the permissible limits. Ambient air quality with respect to Sulphur dioxide is calculated for 2016 2017 and 2018 from Sulphur dioxide data and it was found that all values are within the safe limit and Sulphur dioxide does not contribute to polluting the air quality index. In 2016 RK Puram has recorded maximum Sulphur dioxide concentration while in 2017 RK Puram has recorded maximum Sulphur dioxide concentration and in year 2018 Punjabi Bagh has recorded maximum Sulphur dioxide

concentration but 8000 respective values are the safe permissible norms given by the government.

From the interpolation results which we have obtained for ambient air quality with respect to Sulphur dioxide for year 2016 2017 and 2018 we can conclude that the values are in the category of good. Do there is some variation in numerical data but interpolation results shows no variation. Good category indicates that in last 3 years Sulphur dioxide is not a a pollutant which is considered to be as serious pollutant causing degradation of air quality index in Delhi.

Sulphur dioxide is a primary air pollutant. This gas causes irritation and when we inhale it affects our mucous membrane causing increased breathing rate and deficiency of oxygen in our body which could lead to bronchial spasms in the persons which are affected in that area asthma patients are worstly effected by this type of pollutant. Elder people and kids are are very easily affected it also leads to two generation of photochemical smog in some areas by causing oxidation of hydrocarbons.

Main source of Sulphur dioxide is refineries chemical processing plant and plants having melting operation facilities and burning of fossil fuels. Reduced level of Sulphur dioxide in Delhi indicates the absence of refineries smelting plants and chemical plants and also reduced burning of fossil fuels.

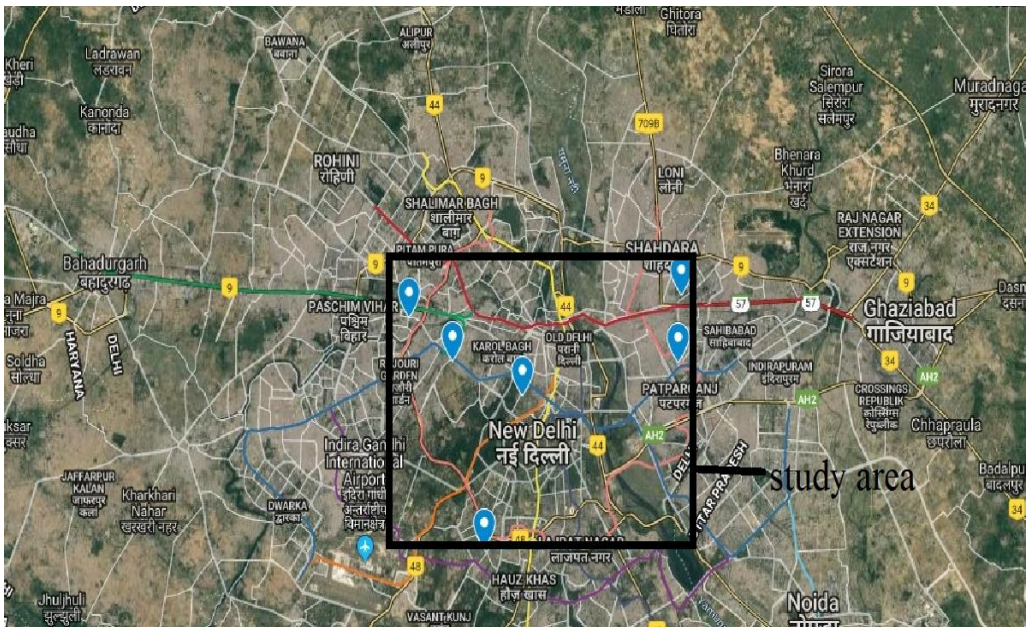

Figure 14 Study area for sulpur dioxide

Figure 15 Ambient air quality with respect to SO2

4.2 NITROGEN DIOXIDE (NO 2)

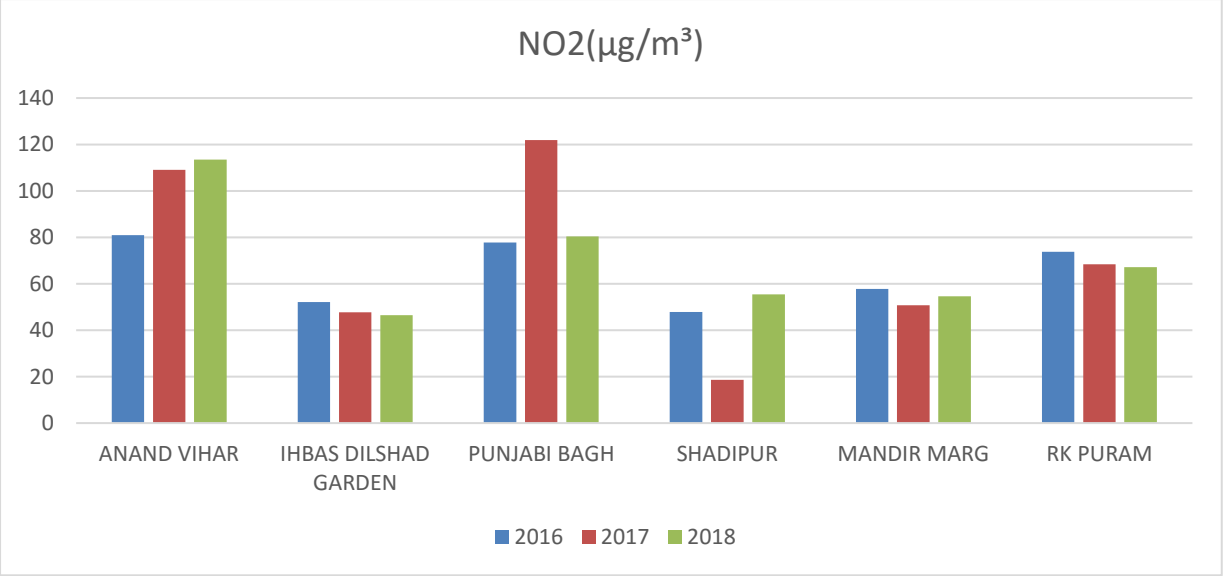

Figure 16 Nitrogen Dioxide values in 2016,2017,2018 , source CPCB

SUB INDEX		
I2 2016	I2 2017	I2 2018
100.94	129.11	133.44
65.0875	59.6375	58.15
97.275	141.96	100.36
59.9	23.2	69.2375
72.1875	63.4	68.275
92.225	85.575	83.9013

Table 3 sub index with respect to nitrogen dioxide in 2016,2017,2018

According to National ambient air quality standards of India the permissible limit for nitrogen dioxide is 40 microgram per metre cube. In year 2016 Anand Vihar has shown maximum NO2 concentration and Shadipur has shown lowest and NO2 concentration. In year 2017 Punjabi Bagh has shown maximum N O2 concentration while Shadipur has recorded lowest NO2 concentration. In year 2018 again Anand Vihar has shown highest NO2 concentration while this time Ihbas Dilshad garden has recorded lowest NO2 concentration.

From our interpretation results we have found that ambient air quality with respect to nitrogen dioxide in year 2016 is under satisfactory condition, only a trace area is moderately polluted. In 2017 certain area has even turn too good criteria from satisfactory but in 2018 that area again turned back to satisfactory category. In 2017 ambient air quality has decreased

to moderately polluted category from satisfactory category recorded in 2016 and in 2018 this area remained moderately polluted. A trace area in 2016 which was under satisfactory criteria turned to moderately polluted criteria in 2017 and it came back to satisfactory criteria in 2018 showing some improvement. So we can conclude that overall ambient air quality with respect to nitrogen dioxide in three consecutive years that is 2016 2017 and 2018 is well under satisfactory criteria and does not lead to an alarming situation considering nitrogen dioxide as pollutant.

Nitric oxide is formed from atmospheric nitrogen which reacts with oxygen at high temperatures generated during fuel combustion and this nitric oxide for the reacts with oxygen present in atmosphere and forms nitrogen dioxide which is a very harmful full compound from human health point of view. It leads to irritation in eye and nasal tracts respiratory problems and even deaths. Serious diseases like emphysema and pneumonia and also lung cancer can also be generated if prolonged and high concentration is consumed. It causes irritation in lungs bronchitis and lowers our resistance to respiratory diseases asthmatic patients are was affected and plays a major role in tropospheric ozone formation.

The main sources of nitrogenous oxides are exhaust coming from automobile, incineration plant processes, furnaces smoke and all those processes which involves high temperature as a result of fuel combustion.

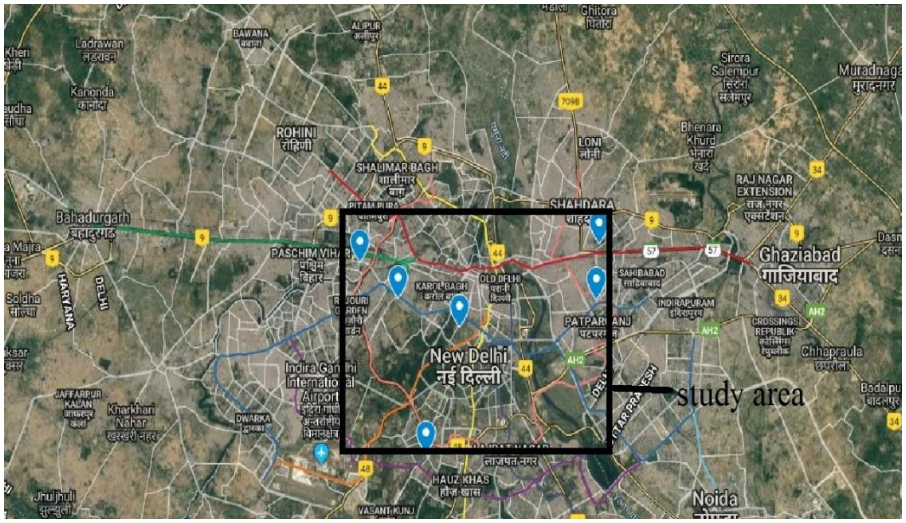

Figure 17 Study area for nitrogen dioxide

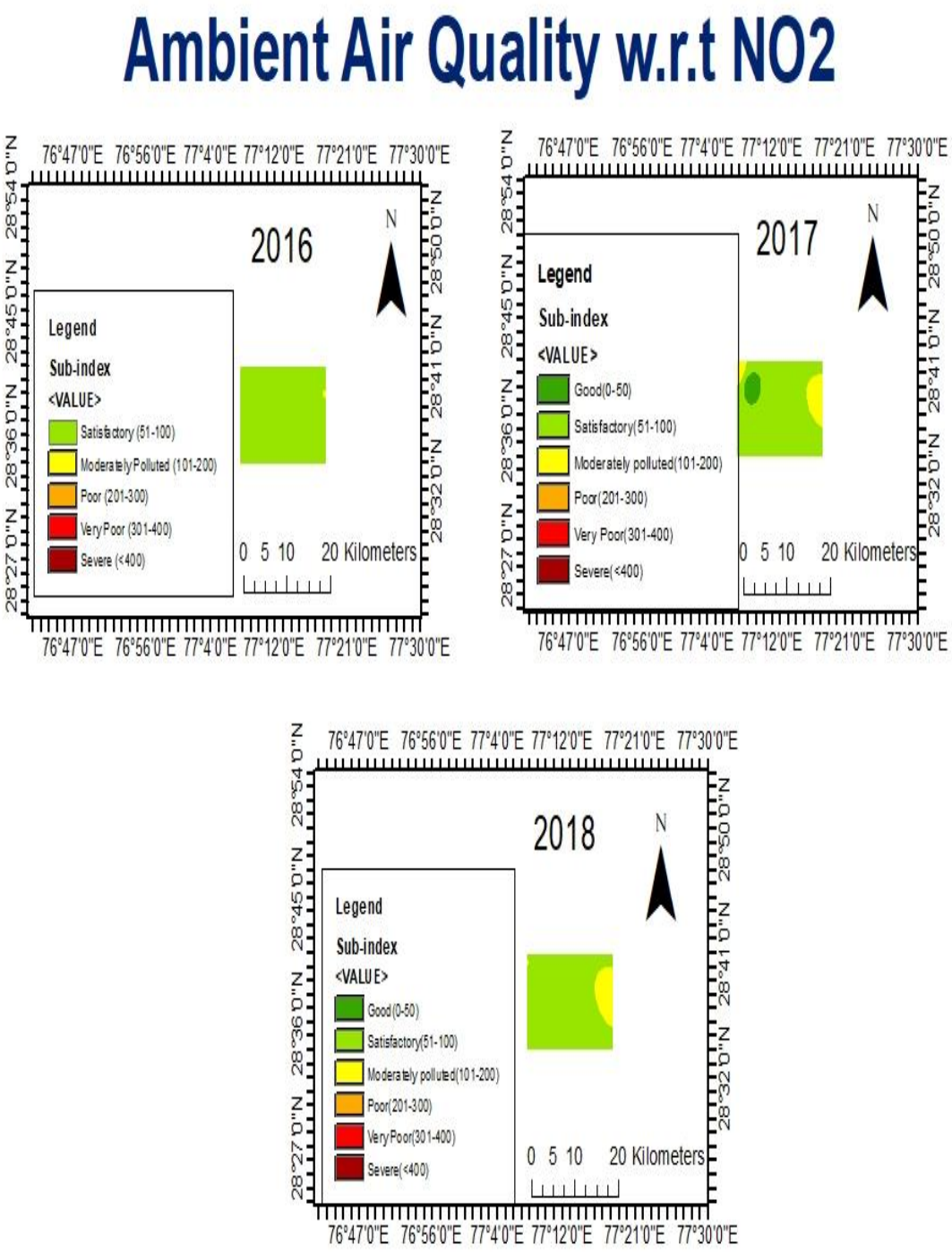

Figure 18 Ambient air quality with respect to NO2

4.3 PARTICULATE MATTER 10 (PM10)

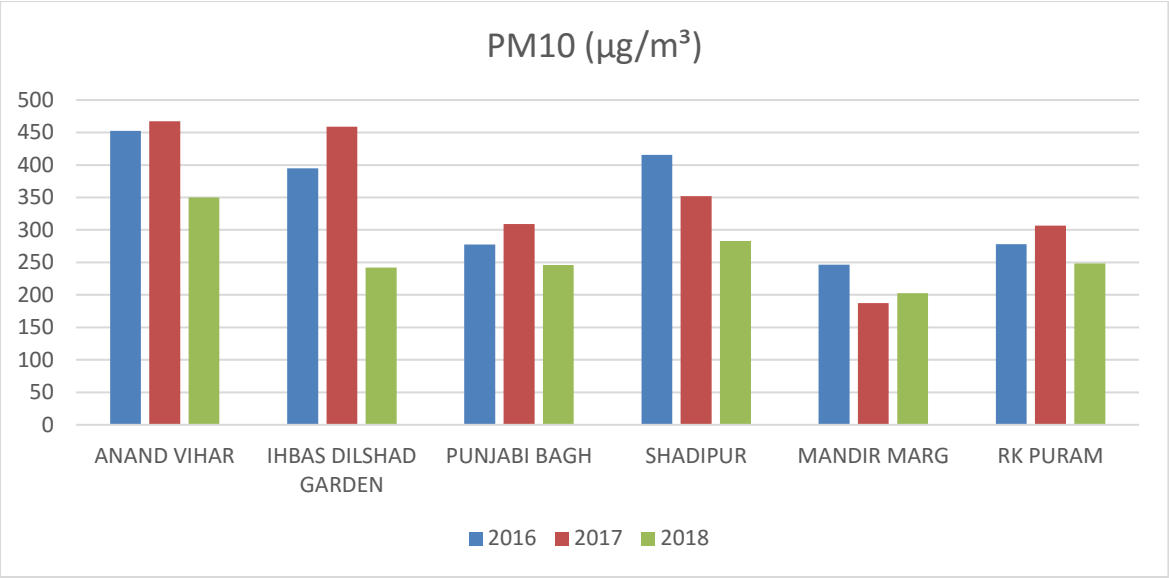

Figure 19 PM 10 in 2016,2017,2018 , source CPCB

SUB INDEX		
I3 2016	I3 2017	I3 2018
427.938	446.363	299.9
356.063	435.938	194.693
227.58	258.95	197.22
381.875	302.263	233.14
197.847	158.107	168.52
228.18	256.74	198.933

Table 4 sub index with respect to PM 10 in 2016,2017,2018

The permissible limit for PM 10 as per National ambient air quality index is 60 but we can see from our results that condition is very alarming in Delhi where Anand Vihar has highest pm10 measured rate and Mandir Marg at the lowest . Ambient air quality is obtained with respect to p.m. 10 in all three consecutive years that that is 2016 2017 2018 at all stations but same trend is seen that's Anand Vihar has highest pollution rate and Mandir Marg lowest.From our interpolations area which was moderately polluted in 2016 has increased in 2017 which has further increased in 2018.Region where air quality was under the category of very poor in 2016 has decreased in 2017 which has futher decreased in 2018 so we can say that the majority of the area is now under moderately polluted and poor category.Severely polluted area has increased in 2017 from 2016 but in 2018 this area has diminished to very

poor category.Although quality of air has improved from 2016 in 2018 but still very high compared to permissible limits.Particulate matter of size greater than 10 micron generally comprises of dust, smoke,fumes ,mist and fog which is obtained from burning of fuels that's in automobiles,garbages,Anandvihar is close to Sahibabad industrial area,Gazipur landfilling site and lot of traffic movement occurs here which overall has contributed towards high polluted recordings.Similar trend is for Ihbas Dilshad Garden station.While mandir Marg situated in central Delhi with considerable amount of green cover and absence of National highways has shown comparatively lower levels of pollution.High pollution levels are measured in winters where mixing of air doesn't occurs , parali burns in neighbouring cities worsens the condition in Delhi .Supreme court has also banned the use of crackers in 2018 for reducing pollution. Particulate matter has adverse effect on human health , it effects breathing and respiratory tract of human. Worsens existing respiratory and cardiovascular diseases ,bodies defence mechanism weakens against foreign materials, lungs tissues are damaged, premature births are observed and in adverse cases carcinogenic effects are also noted.Childrens and Old age people are most sensitive .Control measures could be using public transport,electric vehicles,greenfuels,adopting latest BS norms,parali burns should be banned, shutting down nearby thermal power and other air polluting plants, plantation programs at large scales as trees are important natural pollutant absorbing things.Sprinkling water in nearby areas of our home in winters, avoiding public places or high pollutant areas during morning and evening in winters, adopting appropriate masks while roaming outside. Indoor pollution could be minimised by using air purifiers and/ or indoor plants.

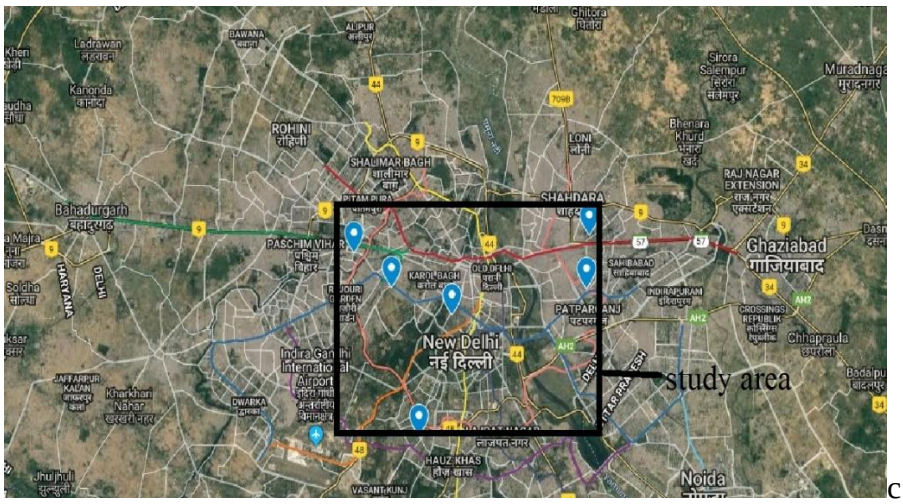

Figure 20 Study area for PM 10

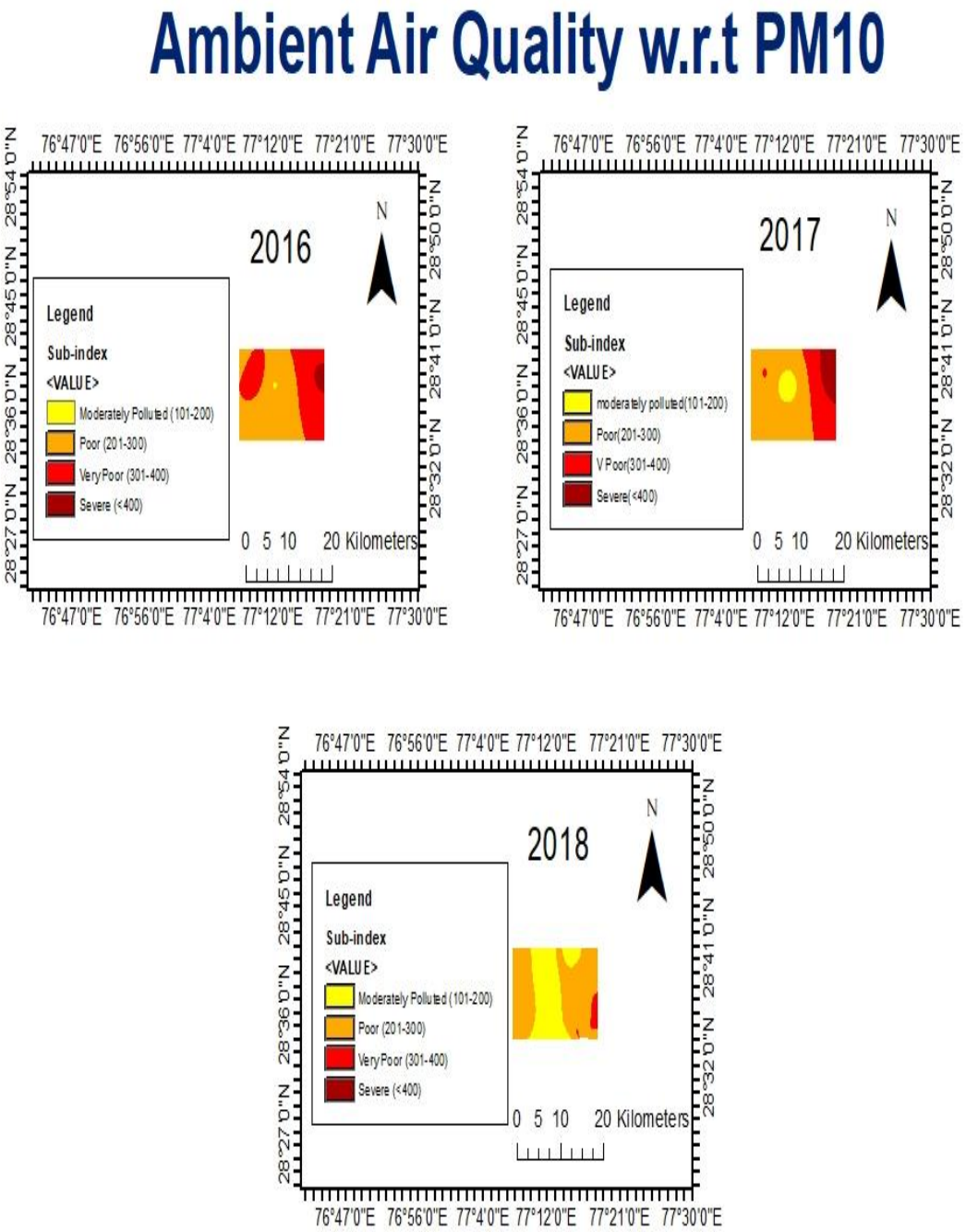

Figure 21 Ambient air quality with respect to PM 10

4.4 PARTICULATE MATTER (PM 2.5)

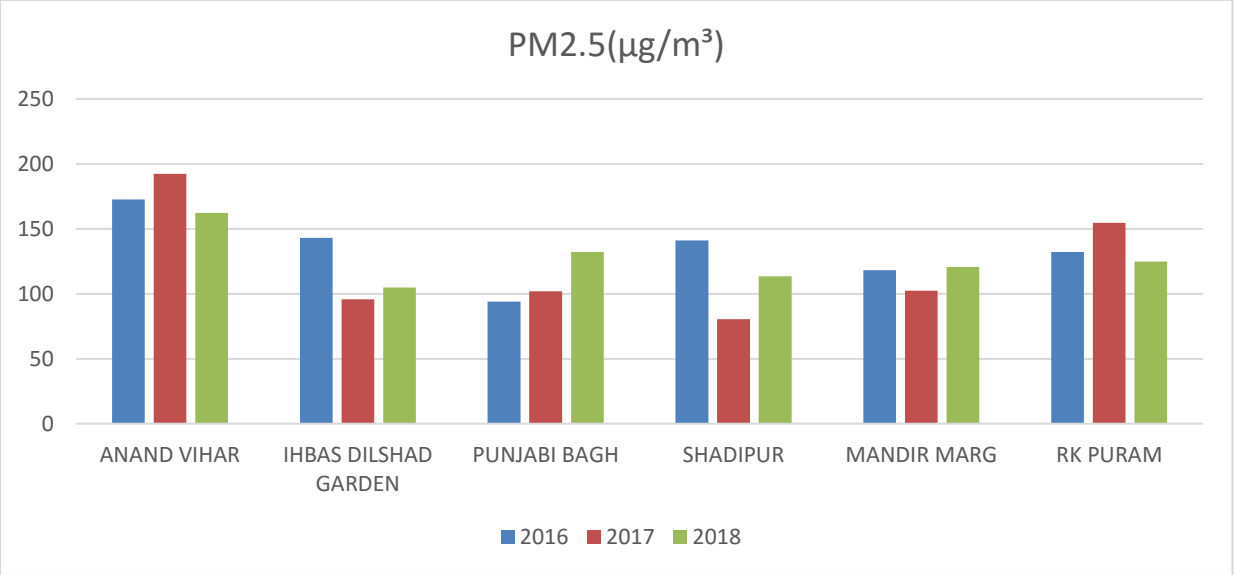

Figure 22 PM 2.5 values in 2016,2017,2018 , source CPCB

SUB INDEX		
I4 2016	I4 2017	I4 2018
340.415	355.662	332.492
317.677	218.8	249.433
213.7	239.6	309.339
316.154	168.167	278.413
293.833	241.1	300.477
309.369	326.677	303.715

Table 4 sub index with respect to PM2.5 in 2016,2017,2018

The permissible limit for PM 2.5 as per National ambient air quality index is 40 but we can see from our results that condition is not so good in Delhi where Anand Vihar has recorded highest pm 2.5 rate it and Punjabi Bagh has lowest pm 2.5 rate in 2016 followed by Shadipur in 2017 and again Shadipur in 2018.ambient air quality is obtained with respect to PM 2.5 in all three consecutive years that is 2016-2017-2018 at all stations but similar trend is seen at Anand Vihar which has highest measured rate and Shadipur and Punjabi Bagh has somewhat lowest monitored rate.From our interpolation results the area which was under very poor category in 2016 has shown slight improvement by shifting towards moderately polluted in 2017 but again in 2018 that area turn to be in poor category. Majority of the area in 2016 was under very poor category which has slightly improved and came under poor category in 2017 and few zones still remained under very poor category but in 2018 the zones having very

poor category has increased its area. There exists certain zones which remains unaffected that is is it resembles poor category in all three consecutive years.From our results we can say that 2017 is an improvement over 2016 3 from pm 2.5 point of view but again in 2018 pm 2.5 levels has risen up but as compared to 2016 it is still better. As compared to the permissible values measured pm 2.5 values is completely unfit for humans and condition is is not at all suitable particulates matter having the size less than 5 microns can penetrate to the lungs and gets deposited in our alveoli is the size of particulates decreases the chances of deposition in the lung increases. Particulates of size greater than 10 micron gets filtered up by hair present in our nostrils and also mucus traps it but final particles passes through it and reaches our pulmonary tract. For example cigarette smoking produces particles which are smaller than 1 micron and 25% of these particles gets deposited in our lungs. Sources of such pollutants could be smoke from burning of fuels garbage cigarette smoking dust storms etc. Anand vihar has shown higher level again just because enormous traffic movement occurs here and Sahibabad industrial area is near to it along with it there garbage burns also occurs.PM 2.5 reaches much deeper in our respiratory tract consisting of nasopharyngeal tracheobronchial and pulmonary tract. Our persisting respiratory diseases conversion to a larger extent. Our bodies resistance system against foreign substances can be easily altered with introduction of such minute particles which further damages tissues of our lungs ultimately carcinogenic effects could also be obtained. Pregnant ladies can conceive before the maturity of foetus.Control measures from pm 2.5 could be using non-polluting vehicles that is e vehicles, banning thermal power plants during winters as its smoke is a major pollutant , parali burns in neighbouring areas should be avoided, using specially designed masks which prevents pm 2.5 from entering, avoiding morning and evening walk during winters in open areas and areas near to landfill sites water splitting sprinkling could be done to minimise particulate levels in our neighbouring areas.

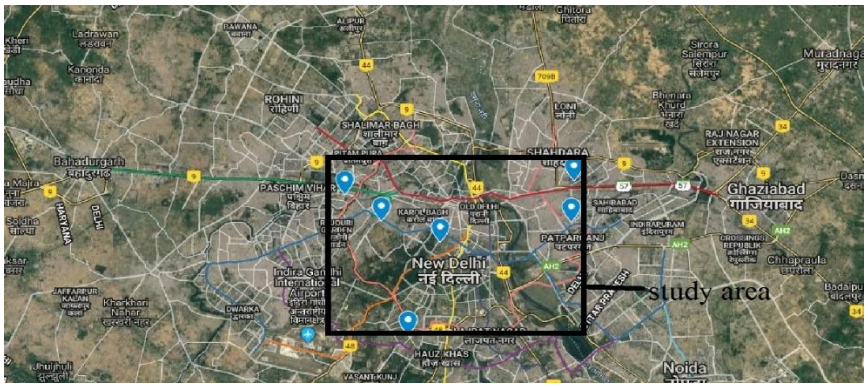

Figure 23 Study area for PM 2.5

Ambient Air Quality w.r.t PM 2.5

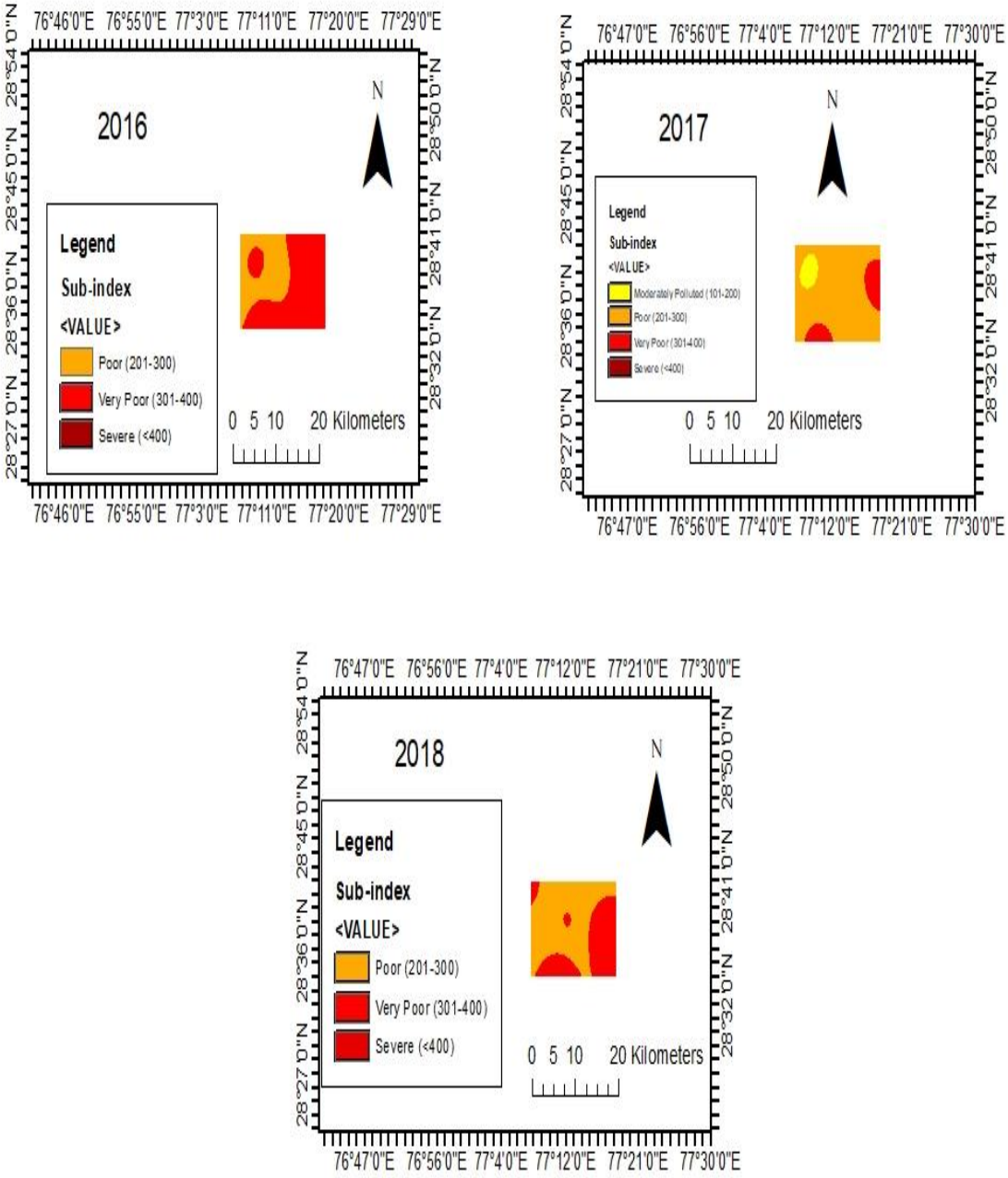

Figure 24 Ambient air quality with respect to PM 2.5

4.5 CARBON MONOXIDE (CO)

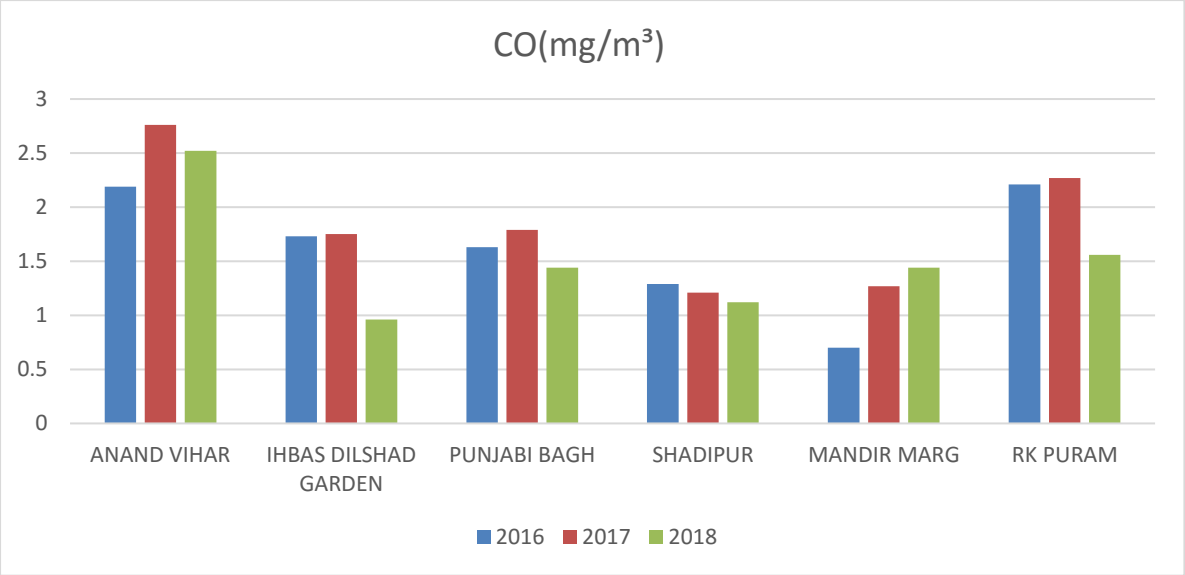

Figure 25 Carbon monoxide values in 2016,2017,2018 , source CPCB

SUB INDEX		
I5 2016	I5 2017	I52018
102.375	109.5	106.5
86.5	87.5	48
81.5	89.5	72
64.5	60.5	56
35	63.5	72
102.625	103.375	78

Table 5 sub index with respect to carbon monoxide in 2016,2017,2018

According to National ambient air quality standards of India the permissible limit for carbon monoxide is 2 milligram per metre cube for 8 hours. We can see that in year 2016 in RK Puram and Anand Vihar has recorded highest carbon monoxide levels while Mandir mark has recorded lowest carbon monoxide levels. In 2017 also similar trend is observed where Anand Vihar has shown maximum carbon monoxide levels and Mandir Marg and Shadipur lowest carbon monoxide levels but it's concentration has increased as compared to the values obtained in 2016. In 2018 Anand Vihar remained at top most position but the lowest value is recorded at Ihbas Dilshad garden.

From our interpolation results we can say a that ambient air quality with respect to carbon monoxide it is under satisfactory condition in all 3 years that is 2016 2017 and 2018.the area which was under good category in 2016 has turned into satisfactory category in 2017 and remained same as that in 2017 in 2018. The area which was moderately polluted in 2016 has increased upto certain limit in 2017 but in 2018 it again diminished. In the vicinity of heavy traffic National Highway industrial area nearby Anand Vihar continues to be e in the top position with respect to carbon monoxide emission.So we can say that CO is not considered as contributor to hazardous pollutant in ambient air quality in Delhi.

Carbon monoxide is a gas showing no colour no order or and toxic in nature which is produced when organic materials car burnt in completely like natural gas coal wood exhaust coming from vehicle is one of the largest source of carbon monoxide as the numbers of vehicles are are being increased day by day we can say that emission of carbon monoxide is also increasing. Poor maintenance of vehicles and having unhealthy in germs and lack of pollution control devices is releases more carbon monoxide. Carbon monoxide is very dangerous for humans as when it is inhaled carbon monoxide replaces oxygen from haemoglobin and forms carboxy haemoglobin. Our blood has 200 times more affinity for carbon monoxide as compared to oxygen. Increased carbon monoxide inhalation leads to impairment of oxygen carried by our blood and certain problems like nausea heart problems difficulty in breathing can also occur and sudden symptoms like headache dizziness low reaction time can be experienced.major threat of carbon monoxide is to those people who are suffering from cardiovascular diseases because it it reduces the amount of oxygen which is delivered to their organs and tissues. Visual perception and mental ability is affected and also it is helpful in formation of photochemical smog.

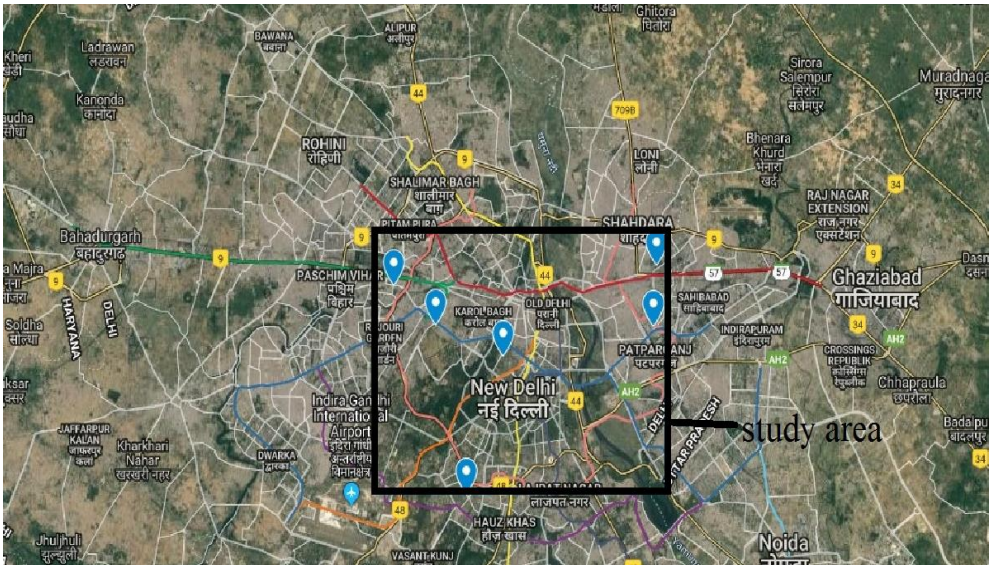

Figure 26 Study area for carbon monoxide

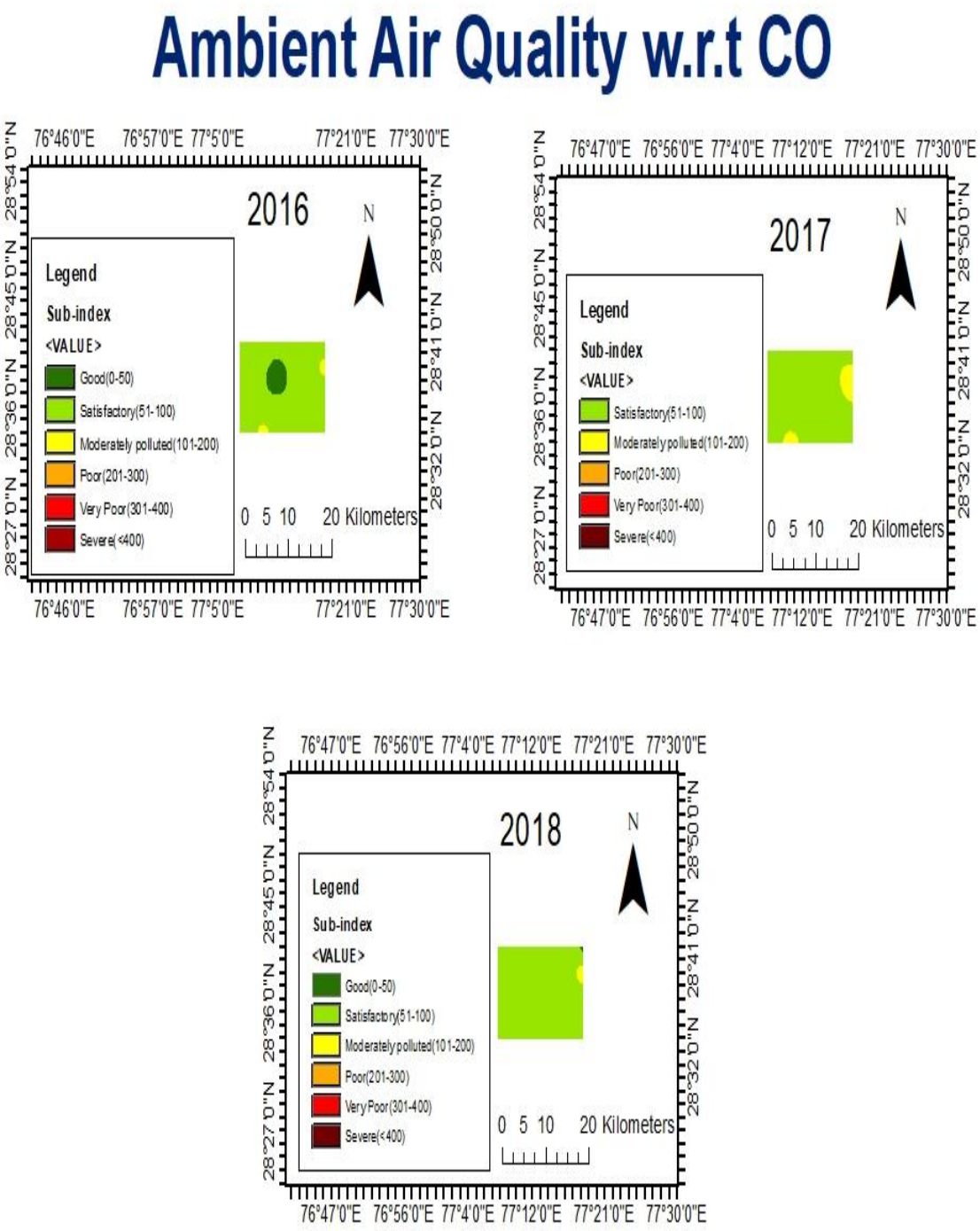

Figure 27 Ambient air quality with respect to carbon monoxide

4.6 AIR QUALITY INDEX (AQI)

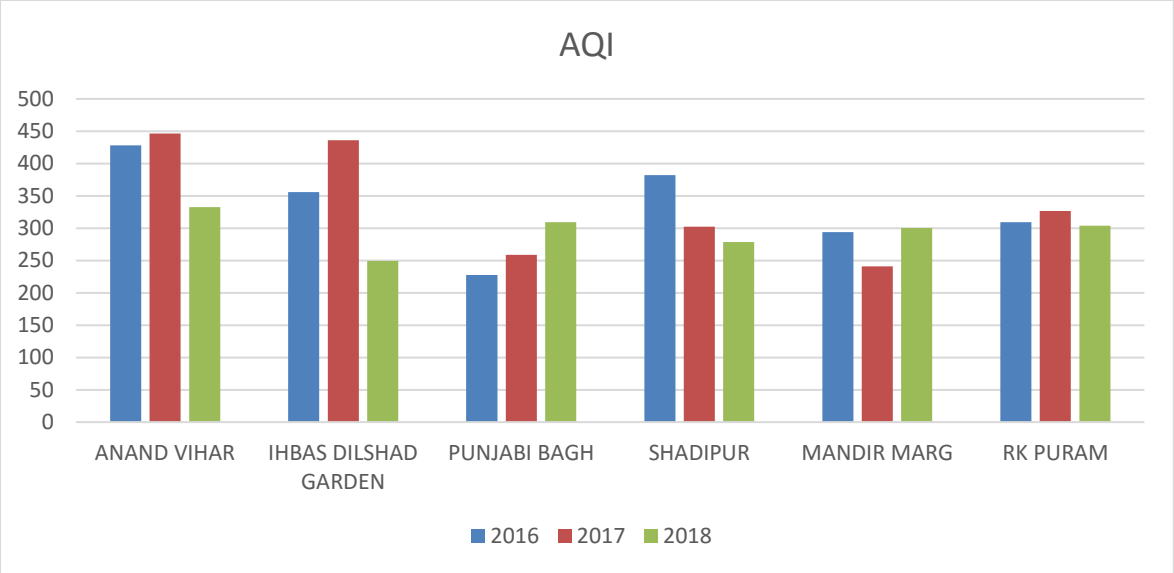

Figure 28 AQI values in 2016,2017,2018 , source CPCB

Air quality index is basically a number which is used by buy a agencies responsible for monitoring air quality e to inform public ok about the air quality in their area it informs how how much polluted the air is and forecasts also, we can further found how it will going to affect human health and environment.in our study we have find out air quality index on the basis of five pollutants that is Sulphur dioxide nitrogen dioxide carbon monoxide pm10 and in 2016 real quality index is found to be maximum at Anand Vihar and minimum in 2016 real quality index is found to be maximum at Anand Vihar and minimum at Punjabi Bagh while in year 2017 air quality index is again found maximum at Anand Vihar and lowest at Mandir Marg, in year 2018 Anand Vihar has shown the maximum air quality index value and Ihbas Dilshad garden has shown the lowest value.

On the basis of our interpolation results we have found out that the area which is under severe category in 2016 has increased in 2017 but has drastically vanished in 2018 coming under very poor category. In year 2016 majority of the area was under very poor category but in 2017 a change is observed that is a certain area has improved and changed its category to poor from very poor while in another area the condition is worsened, but in 2018 there is an improvement over air quality index as compared to 2017 values the area which was under severe category has vanished in 2018 and also the area which is under poor category has increased in 2018. In a trace area reverse phenomenon is observed that is it was under poor category in 2017 and 2016 but in 2018 it degraded to very poor category. All the quality has

improved in 2018 as compared to 2016 but air quality index is still in poor category which is not favourable for Delhi to be called as air pollution free city ,for AQI to fall in poor and very poor category particulate matter is a major contributor out of other pollutants we have considered AQI value up to 50 is expected to be in good category but we can see that our values are in poor and very poor category whose range is 201-300,301-400 respectively.

Such results have resulted in Delhi to be considered as the most polluted capital city in the world. Prolonged exposure to the air of Delhi could lead to respiratory problems to the people and effects could be even more to people having lung and heart diseases even healthy people are also causing deterioration to their respiratory track and serious health impacts can be expected in them in a long run.

Control measures needs to be strictly followed in such alarming conditions like People should use public transportation system, afforestation, using electric vehicles, shutting down thermal power plants, water sprinkling during winters, people should use appropriate masks while going outside in winter, artificial rain, avoiding parali burns in neighbouring areas, avoiding burns in landfills site in winters, shifting to clean energy, using clean fuels, and emissions norms to be made strict, by the government, carpooling, etc .

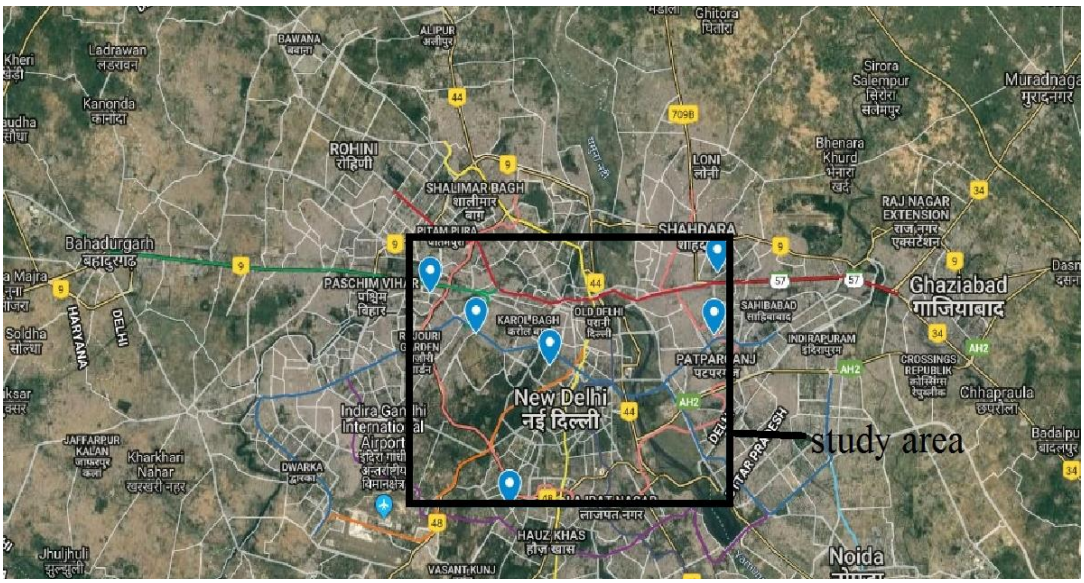

Figure 29 Study area for ambient air quality

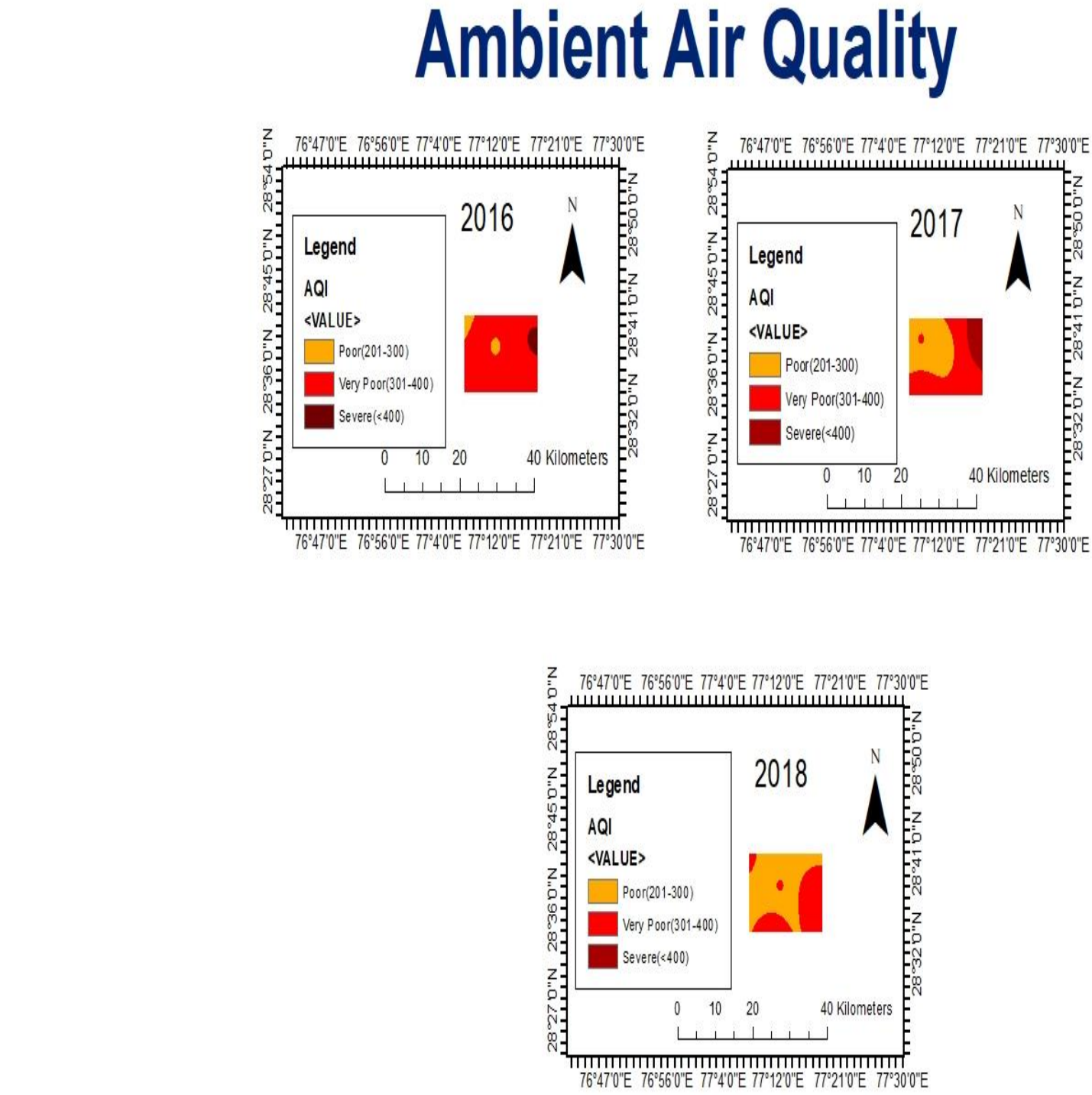

Figure 30 Air Quality Index

CHAPTER 5

CONCLUSIONS

On the basis of the interpolation method of analysis for ambient air quality with respect to pollutants that is PM10, PM2.5, NO2, SO2, CO in year 2016, 2017, 2018. AQI in Delhi lies poor (201-300) to very poor category (301-400). In 2016 major area was under very poor category but in 2018 it slightly improved and drifted in poor category. Though there is a change but health of people of Delhi will still be affected in a short and long age people, and pregnant ladies are target categories of such higher pollution range.

PM10 is a major pollutant which is mainly contributing to higher AQI, but we have found that area where pollution is under moderately polluted category has increased subsequently in 2017 followed by 2018. PM2.5 which is very dangerous minute pollutant is under poor to very poor category but in 2018 area under very poor category has reduced. Ambient air quality with respect to PM10 is well within satisfactory range (51-100), similar trend is observed with respect to NO2 where only some areas is moderately polluted. Ambient air quality with respect to SO2 has remained in good category in all three years that is 20016, 2017, 2018.For present and future reduction of AQI strict actions, necessary measures need to be adopted. People can safeguard themselves by using masks, e-vehicles, public transport, avoiding morning and evening walk in winters, air purifiers etc.

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Annexure 1

NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20	- Improved West and Gaeke
		24 hours**	80	80	-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual*	60	60	- Gravimetric - TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual*	40	40	- Gravimetric - TOEM
		24 hours**	60	60	- Beta attenuation
5	Ozone (O_3) µg/m^3	8 hours**	100	100	- UV photometric - Chemilminescence
		1 hour**	180	180	- Chemical Method
6	Lead (Pb) µg/m^3	Annual*	0.50	0.50	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) mg/m^3	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH_3) µg/m^3	Annual*	100	100	-Chemiluminescence
		24 hours**	400	400	-Indophenol blue method

Table 13 National Ambient Air Quality Standards (NAAQS CPCB)

Annexure 2

SUB INDEX CALCULATION formiulae in ms xl

calculating ambient air quality with respect to SO2

=IF(ISTEXT(F2),0,IF(F2<=40,F2*50/40,IF(AND(F2>40,F2<=80),50+(F2-40)*50/40,IF(AND(F2>80,F2<=380),100+(F2-80)*100/300,IF(AND(F2>380,F2<=800),200+(F2-380)*(100/420),IF(AND(F2>800,F2<=1600),300+(F2-800)*(100/800),IF(F2>1600,400+(F2-1600)*(100/800)))))))

calculating ambient air quality with respect to NO2 .=IF(ISTEXT(G2),0,IF(G2<=40,G2*50/40,IF(AND(G2>40,G2<=80),50+(G2-40)*50/40,IF(AND(G2>80,G2<=180),100+(G2-80)*100/100,IF(AND(G2>180,G2<=280),200+(G2-180)*(100/100),IF(AND(G2>280,G2<=400),300+(G2-280)*(100/120),IF(G2>400,400+(G2-400)*(100/120)))))))

calculating ambient air quality with respect to PM10 .=IF(ISTEXT(H2),0,IF(H2<=50,H2*50/50,IF(AND(H2>50,H2<=100),50+(H2-50)*50/50,IF(AND(H2>100,H2<=250),100+(H2-100)*100/150,IF(AND(H2>250,H2<=350),200+(H2-250)*(100/100),IF(AND(H2>350,H2<=430),300+(H2-350)*(100/80),IF(H2>430,400+(H2-430)*(100/80)))))))

calculating ambient air quality with respect to PM2.5

=IF(ISTEXT(I2),0,IF(I2<=30,I2*50/30,IF(AND(I2>30,I2<=60),50+(I2-30)*50/30,IF(AND(I2>60,I2<=90),100+(I2-60)*100/30,IF(AND(I2>90,I2<=120),200+(I2-90)*(100/30),IF(AND(I2>120,I2<=250),300+(I2-120)*(100/130),IF(I2>250,400+(I2-250)*(100/130)))))))

calculating ambient air quality with respect to CO .=IF(ISTEXT(B2),0,IF(B2<=1,B2*50/1,IF(AND(B2>1,B2<=2),50+(B2-1)*50/1,IF(AND(B2>2,B2<=10),100+(B2-2)*100/8,IF(AND(B2>10,B2<=17),200+(B2-10)*(100/7),IF(AND(B2>17,B2<=34),300+(B2-17)*(100/17),IF(B2>34,400+(B2-34)*(100/17)))))))

calculating ambient air quality with respect to AQI

AQI =Max(I1:I5)

Where F,G,H,I,B represents column name, 2 represents row number.For monitoring locations situated in different row number will be changed accordingly in Exce

Annexure 3

LOCATION	$SO_2(\mu g/m^3)$		
	2016	2017	2018
ANAND VIHAR	20.09	29.8	16
IHBAS DILSHAD GARDEN	12.36	14.8	15.6
PUNJABI BAGH	19.18	24.2	20.8
SHADIPUR	17.25	6.89	12.2
MANDIR MARG	15.61	12.3	11.7
RK PURAM	26.4	32.2	19.9

LOCATION	$NO_2(\mu g/m^3)$		
	2016	2017	2018
ANAND VIHAR	80.94	109	113
IHBAS DILSHAD GARDEN	52.07	47.7	46.5
PUNJABI BAGH	77.82	122	80.4
SHADIPUR	47.92	18.6	55.4
MANDIR MARG	57.75	50.7	54.6
RK PURAM	73.78	68.5	67.1

LOCATION	PM10 (µg/m³)		
	2016	2017	2018
ANAND VIHAR	452.35	467.09	349.9
IHBAS DILSHAD GARDEN	394.85	458.75	242.04
PUNJABI BAGH	277.58	308.95	245.83
SHADIPUR	415.5	351.81	283.14
MANDIR MARG	246.77	187.16	202.78
RK PURAM	278.18	306.74	248.4

LOCATION	PM2.5(µg/m³)		
	2016	2017	2018
ANAND VIHAR	172.54	192.36	162.24
IHBAS DILSHAD GARDEN	142.98	95.64	104.83
PUNJABI BAGH	94.11	101.88	132.14
SHADIPUR	141	80.45	113.524
MANDIR MARG	118.15	102.33	120.62
RK PURAM	132.18	154.68	124.83

LOCATION	CO(mg/m³)		
	2016	2017	2018
ANAND VIHAR	2.19	2.76	2.52
IHBAS DILSHAD GARDEN	1.73	1.75	0.96
PUNJABI BAGH	1.63	1.79	1.44
SHADIPUR	1.29	1.21	1.12
MANDIR MARG	0.7	1.27	1.44
RK PURAM	2.21	2.27	1.56

LOCATION	AQI		
	2016	2017	2018
ANAND VIHAR	427.938	446.363	332.492
IHBAS DILSHAD GARDEN	356.063	435.938	249.433
PUNJABI BAGH	227.58	258.95	309.338
SHADIPUR	381.875	302.263	278.413
MANDIR MARG	293.833	241.1	300.477
RK PURAM	309.369	326.677	303.715