DISSERTATION WORK

ON

"ASSESSING URBAN AIR QUALITY IN HALDIA MUNICIPALITY: A GEO – SPATIAL ANALYSIS"

M.sc Semester – IV, Practical Examination

Paper: GEO 496 Unit: GEO 496.2

SUBMITED BY

SUVAJIT BARMAN

Roll – PG /VUEGG19-IVS NO – 013

Registration No: 1011510 of 2018-2019

SUPERVISED BY

MRS. YOGIA DUTTA

Assistant Professor

Dept. of Geography

DECLARATION

I hereby declare that the project work entitled "ASSESSING URBAN AIR QUALITY IN HALDIA MUNICIPALITY: A GEO-SPATIAL ANALYSIS", PURBA MEDINIPUR, WEST BENGAL (2022-2023)' submitted to the Department of Geography, H.G.C. is a record of an original work done by me under the guidance of Mrs. Yogia Datta, Assistant Professor of Geography, Haldia Government College, and this project work is submitted in the partial fulfillment of the requirements for the award of the degree of Master of Science in Geography and Environment Management. The results embodied in this research have not been submitted to any other University or Institute for the award of any degree.

Mrs. Yogia Dutta

Assistant professor

Haldia Government College

Name of the student

Suvajit Barman

ABSTRACT

Air is a necessary element of every human being. A pure air is better than a polluted air for our health. In this case study, I have analyzed the air quality of Haldia, a newly born port city of Eastern India. An industrial city Haldia is not free from air pollution; that's why air quality of Haldia is not so good, especially in the industrial region. I have analyzed the AQI, I showed mainly 3 AQI pollutants, e.g., PM_{10}, NO_2& SO_2. All of these Pollutants and AQI concentration and sub-index has been shown using of spatial distribution map. When I relate industry with AQI of Haldia it has shown the positive relationship in between the two components. So, we can say that industrialization is one of the main reasons behind bad air quality of Haldia. Transport vehicle like truck, bus, four wheelers is also responsible for air pollution in Haldia. I think so, this research work has been able to fulfillment of its objectives.

Presentation, inspiration and motivation have always a key role in the success of any venture. First and foremost, praises and thanks to the God, the Almighty, for his/her showers of blessing throughout my research work to complete the research successfully.

I would like to express my deep and sincere gratitude to my research supervisor, Mrs. YogiaDatta, Assistant Professor of Geography, Haldia Government College for giving me the opportunity to do research and providing invaluable guidance throughout this research. He has taught me the methodology to carry out the research and to present the research works as clearly as possible. It was a great privilege and honor to work and study under his guidance. I am extremely grateful for what he has offered me. I would also like to thank him for his friendship, empathy and great sense of humor.

I would like to thank all the respective Professors of the Geography Department Haldia Government College.

Also, I am giving the true hearted thanks to my all friends of M.SC. 4th Semester for their extraordinary help, support and belief each and every purpose of my research work.

Last, but not the least, I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for my future.

SUVAJIT BARMAN

Date: Signature

ACKNOWLEDGEMENT

I express my sincere my deep regard and sincere gratitude to my research supervisor, Mrs. Yogia Dutta, Assistant Professor, Department of Geography. It was great privilege and honour to work and to study under his guidance. Under whose guidance and supervision the dissertation work"ASSESSING URBAN AIR QUALITY IN HALDIA MUNICIPALITY: A GEO-SPATIAL ANALYSIS", PURBA MEDINIPUR, WEST BENGAL (2022-2023)' has been complicate without his constant guidance and support this work could not be completed.

I would like to extend my sincere thanks and gratitude. Sarbeswar Halder, Assistant professor & HOD of department of Geography for his tremendous support and assistance in the completion of my present dissertation.

I would like to convey my sincere thanks and gratitude to all other respected professors of Geography department of Haldia Government College for giving me the invaluable guidance throughout this field study.

I extend my thanks and gratitude to Mr. Sukumar Adhikary and support staff of the Department for his constant help and co-operation as an when required.

Last but not the least, I really feel proud to extend my heart full thanks to all my class friends of M.sc 4th SEM for their constant support and co-operation towards the preparation of this report.

Date: Signature

CONTENT

LIST OF TABLE

LIST OF FIGURES

ABBREVIATIONS

- H.G.C. – Haldia Government College
- M.SC. – Master of Science
- Dr. - Doctor
- H.O.D – Head of the Department
- Etc. – and more
- E.g. - For example
- & - and
- N. – North
- S. – South
- E. – East
- W. -West
- Jan. – January
- Feb. – February
- Jun. – June
- Jul. - July
- Max. – Maximum
- Min. – Minimum
- No. - Number
- Avg. - Average
- Pm10 – Particulate Matter
- No2 – Nitrogen Dioxide
- So2 – Sulphur Dioxide
- Dec. – December
- CO – Carbon Monoxide
- O3 – Ozone
- CFC – Chlorofluorocarbon
- °C – Degree Celsius
- °F – Degree Fahrenheit
- AQI – Air Quality Index
- CFC - Chlorofluorocarbon
- NH3 – Ammonia
- Pb - Lead
- µg/m³ - Microgram Per Cubic Meter
- Sq. km. – Square kilometre
- m. - Meter
- Ft. – Feet or Foot
- in. - Inch
- mm. – Millimetre
- h. – Hour
- w/m2 – Watt per Meter Square
- MS - Microsoft
- ARC-GIS – Aeronautical Reconnaissance Coverage Geographic Information System
- WBPCB – West Bengal Pollution Control Boa

CHAPTER – 1

1.1 INTRODUCTION

Air is a core element for sustenance of life. The cleaner air is better for our health and wellbeing. However various sources, especially anthropogenic are posing a significant threat to air quality. Air quality index (AQI) is a numerical scale used for reporting day to day air quality with regard to human health and the environment. The daily results of the index are used to convey to the public an estimate of air pollution level. An increase in air quality index signifies increased air pollution and severe threats to human health. In most cases, AQI indicates how clean or polluted the air in our surrounding is, and the associated health risks it might present. The AQI centres on the health effects that may be experienced within a few days or hours after breathing polluted air. AQI calculations focus on major air pollutants, including particulate matter, ground-level ozone, sulphur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO). Particulate matter and ozone pollutants pose the highest risks to human health and the environment. For each of these air pollutant categories, different countries have their own established air quality indices in relation to other nationally set air quality standards for public health protection. India uses the National Air Quality Index (AQI), Canada uses the Air Quality Health Index, Singapore uses the Pollutants Standards Index and Malaysia uses the Air Pollution Index. On an hourly basis, the concentration of each pollutant in the air is measured and converted into a number running from zero upwards by using a standard index or scale. The calculated number for every pollutant is termed as a sub-index. The highest sub-index for any given hour is recorded as the AQI for that hour. In simple terms, AQI is like a yardstick that ranges from zero to five hundred (0-500). The index is a relative scale, meaning, the lower the index, the better the quality of air and the lesser the health concern, and vice versa. The concentration of each pollutant varies; therefore, AQI values are grouped into ranges assigned to standardized public health warnings and colour code. Air quality index is calculated by a linear function by determining the concentration of the pollutant. The equation below is used to compute AQI.

AQI-formula:

$$I = \frac{I_{high} - I_{low}}{C_{high} - C_{low}} * (C - C_{low}) + I_{low}$$

I : the (Air Quality) index
C : the pollutant concentration
C_{low}: the concentration breakpoint that is ≤ C
C_{high}: the concentration breakpoint that is ≥ C
I_{low}: the index breakpoint corresponding to C_{low}
I_{high}: the index breakpoint corresponding to C_{high}

$C_{low}, C_{high}, I_{low}, I_{high}$ are from the US EPA Pollutant Breakpoint

Fig. 1.1 AQI Formula

1.2 RESEARCH PROBLEM: Identification and formulation of a research problem is the first step of the research process. It is the most challenging and difficult phase of the research process. A research problem is a question that a researcher wants to answer or a problem that a researcher wants to solve. A research problem is an issue or a concern that an investigator/researcher presents and justifies in a research study. Selection of a research problem depends on several factors such as researcher's knowledge, skills, interest, expertise, motivation and creativity with respect to the subject chosen. In the case of my research problem a have select a small city area E.g., Haldia, and identify the problem of this area is how much the air quality changes as a industrial city. In this research problem I have justifies how the problem is created and how it will be solved or why the air quality is being poor in Haldia and how it will be recovered.

1.2 OBJECTIVES

1. To assess the condition of air pollution in Purba Medinipur district.
2. To understand the spatial variation of the distribution of air pollutants in Haldia in municipality area.
3. To represent peoples' perception regarding air pollution in the study area
4. To suggest a way forward.

1.3 DESCRIPTION OF THE STUDY AREA

❖ Geography of Haldia

The industrial town of Haldia is a symbol of development and growth. Situated in Purba Medinipur district in Indian State of West Bengal, it is located at between 22°03'43.93" to 22°09'03.61" north latitude and 88°07'53.15" to 83°09'03.61" east longitude. The total geographical area of Haldia town is 109 sq. km it has an average elevation of 5.8 meters. A fast-developing industrial town, it lies near the mouth of Hooghly River geographically located at around 50 kms southwest of Kolkata. A geographical delight, it enjoys the advantage of being an eco-friendly and serene spot. This rare feature of industrial development coupled with natural beauty makes Haldia stand out as a jewel in the crown of West Bengal. One of the other unique geographical advantages of Haldia is that it is surrounded by numerous beautiful tourist spots. Virgin beaches and beach resorts can be found aplenty within a distance of 200 kms from Haldia.

□ BACKGROUND OF THE STUDY AREA:

- **Physical Background:**

❖**Geology and Physiography:** Haldia is formed with Holocene sediments especially newer alluvium. Physio graphically Haldia is plain land of Ganga's lower river course. Its avg. elevation from the sea level is 5.8 m.

❖ Forest and vegetation

From 2001 (12.77 sq.km) to 2011 (19.65 sq.km) in ten years vegetation increases nearly 7 sq. km area in Haldia but between 2001 to 2021, it decreases 8 sq. km area; as a result, at present day only 11.28 sq.km area is under the vegetation cover.

❖ Rivers in Haldia

Haldia has been blessed with a location that is important strategically as well as for religious reasons. Bordering the industrial town and providing it unparalleled natural serenity is the Haldi River. This 24 Km long river is a tributary of the Hooghly River. Two rivers-Kansai and Keleghai combine together to form the Haldi River. Haldi River and Hooghly converge together at the beautiful industrial town of Haldia.

❖ Climate in Haldia

Haldia had a tropical Savana climate (Aw) with winter temperature ranges from 7°C to 22°C and summer temperature ranges from 24°C to 39°C. Although summers are hot and humid, Kalbaishakhi provide a relief to the people, with an average rainfall of 3,650 mm (144 in) and the rainy months are between May and September.

❖ LOCATION OF THE STUDY AREA

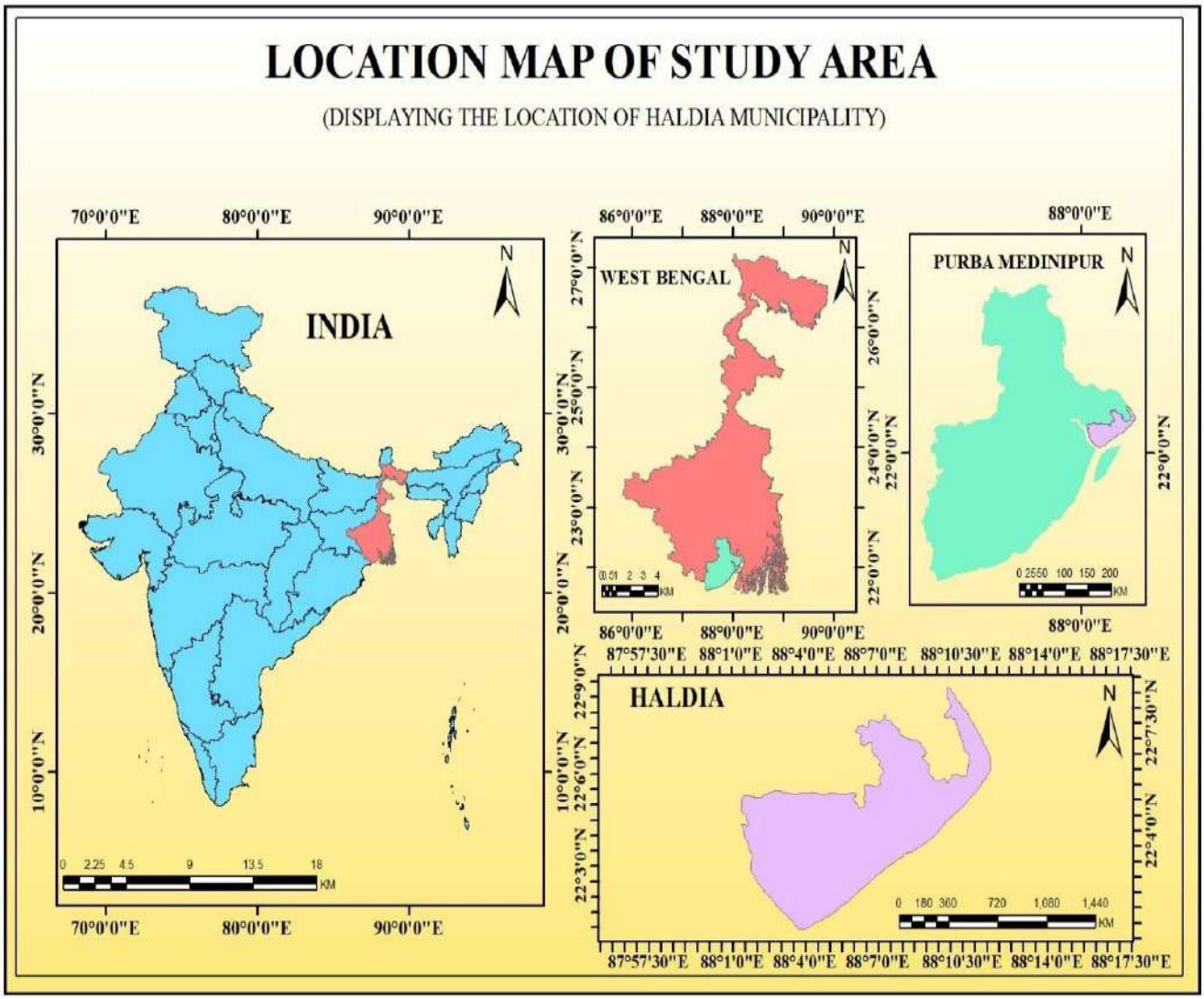


Figure: 1.2 Location map

LITERATURE REVIEW:

- Perli, B. (April, 2018), in his research paper "Ambient Air Quality Assessment in Major Petrochemical Industrial hubs in India" accesses how the petrochemical industry and its emission of gases effect the AQI and human health in Haldia (W.B), Manali (Tamilnadu), Navi Mumbai (Maharashtra), Mangalore (Tamilnadu),

- Ankleshwar(Gujrat). This research work was published in ISOR Journal of Engineering (ISORJEN) at 7th April, 2018. He used different methods for different air pollutants like, Gravimetric Method for PM_{10}; Modified West and Gaeke Method for SO_2; Modified Jacob &Hocchisser Method for NO_2. He has been shown the annual maximum & minimum variation of three pollutants and their trends in 2014, 2015 & 2016. From his research paper he has find out the PM_{10} value is decreasing and NO_2 and SO_2 value is increasing in the respective years. But the AQI Value is decreased more than 50 from 2014 to 2016.

- Roy, D., Chakraborty, S., Bhowmik, K., Mandal, S., Ghosh, P., Bhattacharya, A., Chowdhury, S., Bhattacharya, R. (2019) in their research paper "Air Pollution Status: A Case Study in West Bengal" compared the AQI of Haldia with Kolkata. The research work was published in Journal of Multidisciplinary Research (JISUJMR), which is under JIS University in 2019. They are used National Air Quality Index and its indices for their research purposes and analysed the air quality of Kolkata as a case study and compared its status in comparison with an industrial belt of Haldia in West Bengal. The outcomes of their research work are Kolkata is more polluted than Haldia with respect to NO_2 and $PM_{2.5}$ pollutants.

- Dutta, D. & Gupta, S. (2021) in their research paper "Rising Trend of Air Pollution and Its Decadal Consequences on Meteorology and Thermal Comfort Over Gangetic West Bengal, India" has shown the air pollution status is continuously increasing in the lower catchment area at an alarming rate. This research work is published in Spatial Modelling and Assessment of Environmental Contaminants, Environmental Challenges and Solutions, by Springer Nature Switzerland AG 2021. Outcomes of this research work indicate an increase of 0.8 °C to 1.2 °C air temperature with 1.5 to 1.8 W/m2 increase of sensible heat flux due to rising air pollution in the lower Gangetic plain of West Bengal. Vertical pressure–temperature profile as well as the boundary layer temperature and surface humidity are found to be affected by certain high pollution periods over the year.

❖ RESEARCH METHODOLOGY

FIELD WORK PROCESS:

Field work for studying air pollution involves direct observations, photography, field sketches, use of map satellite image etc.

Any field work involves three stages. They are:

1. **pre field work**
2. **post field work**
3. **On field work**

1) PRE- FIELD WORK:
   I. This involves proper planning, preparation and managements.
   II. Prior permission is to be obtained well in advanced to enter restricted areas.
   III. The problem, aim of the study and its objectives are to explained in details.
2) ON – FIELD WORK:
   I. When the students reach the local study area, the actual field work legging and information collected through.
   II. Observed the features and take notes.
   III. Prepare field sketches.

3) POST- FIELD WORK

1.4 LIMITATIONS

- The Lack of sufficient data.
- This is a very short time study.
- Absence of adequate laboratory for chemical analysis of environmental components.
- Lack of infrastructure facilities for monitoring of ambient air in the study area.
- Lack of detailed study on this topic previously.

CHAPTER – 2

CONDITION OF AIR POLLUTION IN PURBA MEDINIPUR

2.1 INTRODUCTION:

Special & seasonal variation of distribution of air pollutants on the basis of secondary data analysis. Haldia is an industrial area. So, it has several pollutants being added to the atmosphere from sources like plants, transport vehicles and many more. Data collected by pollution control board, are plotted here on the map to understand the spatial variety of the distribution of pollutants. A comparison has also been done between monsoon and post-monsoon variation in the distribution of pollutants.

TABLE NO – 2.1: AIR POLLUTION COLLECTION STATION IN PURBA MEDINIPUR

STATION	LATITUDE	LONGITUDE
BHABANIPUR	22.0609◦N	88.0711◦E
BHUNIARAICHAK	22.21005◦N	88.0181◦E
SUPER MARKET	22.066673◦N	88.06980◦E
TAKLUK	22.2858◦N	87.32148◦E
WBIIDC	22.43089◦N	87.32148◦E
EGRA	21.9001◦N	87.5370◦E

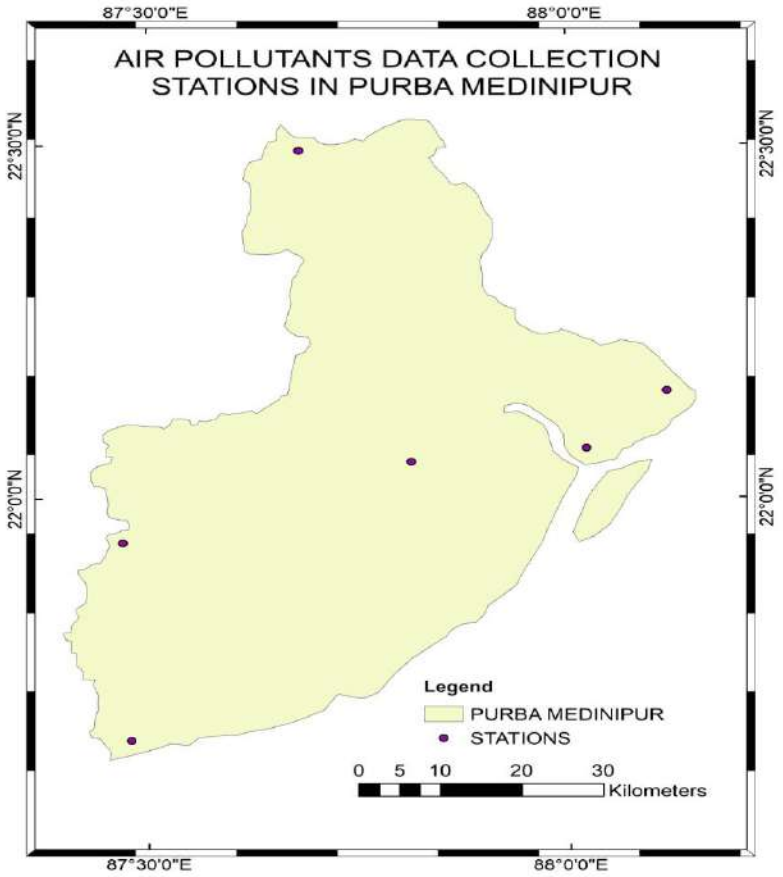


Fig – 2.1 Air pollution data collection station

SULPHUR DIOXIDE (SO2)

Sulphur die oxide is a colourless gas with a burnt order and the chemical formula so2. The gas is acidic and corrosive in nature and can react in the atmosphere with other compounds to form sulphuric acid and other oxides of sulphur.

Sources:

Emission from automobiles, Industries, combustion of fossil, fuel. Generation of electricity etc. are regions for the entry of the sulphur dioxide into the atmosphere.

Related effects:

Sulphur dioxide is a major cause of has production, acid, rain, damage to foliage, monument and building reacts and from particulate matter. In humans it causes breathing discomfort asthma, eyes, nose and throat irritation inflammation of year wish ways and heart disease.

Safe exposure level sulphur dioxide is used by the Indian govt. and US and EPA is a parameter calculation. The safe exposal level is 0-8 u /m3 24 hours and 0-75 ppb (1hours) according to the US-EPA respectively.

TABLE NO- 2.2: SO2 CALCULATION TABLE 2022 JANUARY & JULY

STATION NAME	MONTH	UG /M3	MONTH	UG /M3
BHABANIPUR	JANUARY	21.82	JULY	8.50
BHUNIA RAICHAK	JANUARY	21.62	JULY	8.82
SUPERMARKET	JANUARY	21.98	JULY	8.87
TAMLUK	JANUARY	19.77	JULY	8.73
WB II DC	JANUARY	20.77	JULY	8.55
EGRA	JANUARY	15.71	JULY	3.32

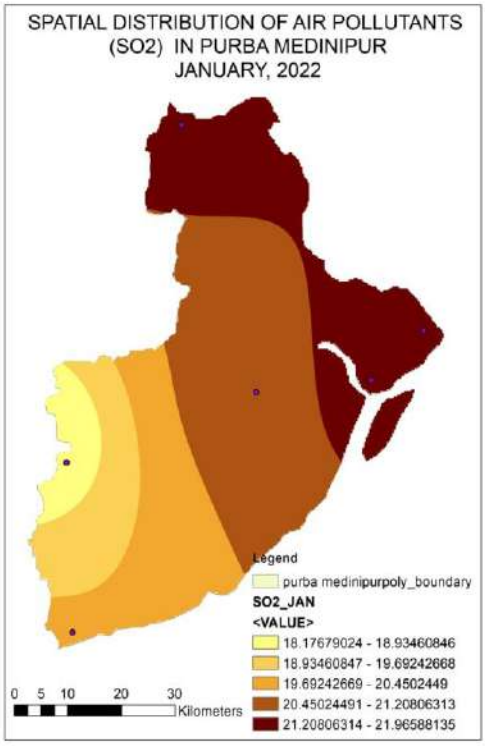


Fig – 2.1 Spatial distribution of SO2 in January

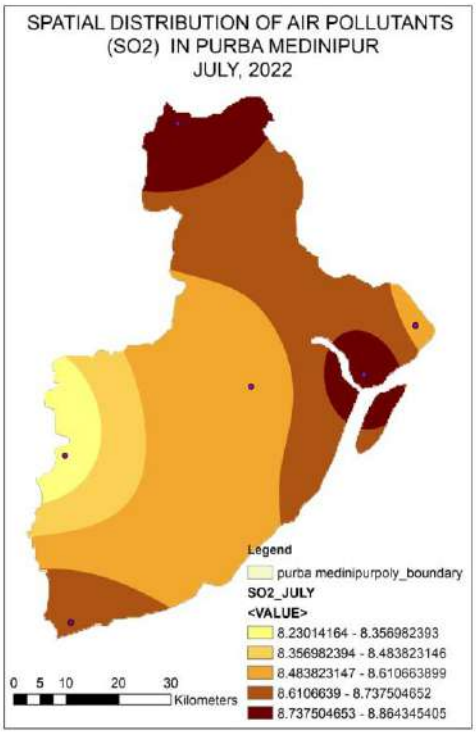


Fig – 2.1 Spatial distribution of SO2 in July

In above the map showing the spatial distribution of air pollutants area in the year of 2022 January to July. We saw the air pollutants parameters SO2 decreases in the month of July.

In January, 2022 show the highest polluted area due to so2 gasses are Supermarket, Tamluk, Bhabanipur in the Purba Medinipur districts. Moderate polluted areas are Bhuniaraichak and WBIIDC and the low polluted area are Egra in the district of Purba Medinipur.

In July 2022 shows the pollutant area decreases .in the month of January supermarket is highly pollutant but the month of July pollution is low .in the southern portion of Purba Medinipur like WBIIDC are increasing the pollution in the July.

NITROGEN DI OXIDE (NO2)

Nitro dioxide is a known highly reactive gas present in the atmosphere.

SOURCE

It is replaced in the environment from automobile emission, generation of electricity burning of fuel combustion of fossil fuel and different industrial process.

RELATED EFFECTS:

Nitrogen Di oxide poisoning is a much as hazardous as carbon mono oxide poisoning .it can cause serious damage to the heart, increase asthma attacks, reduced lung function , irritation of air wage . Smog formation are damage some environmental impacts of Nitrogen Di Oxide.

Safe exposure level : the Indian government and US EPA use Nitrogen Di Oxide as a parameter for calculating AQI .as per the Indian government , safe exposure is 0-80 ug /m3 (24) and as per US –EPA , it is 0-53 ppb

TABLE NO 2.3: NO2 CALCULATION TABLE 2022- JANUARY & JULY

STATION NAME	MONTH	NO2 UG/M3	MONTH	NO2 UG /M3
BHABANIPUR	JANUARY	40.72	JULY	32
BHUNIA RAICHAK	JANUARY	44.00	JULY	33.18
SUPERMARKET	JANUARY	40.22	JULY	33.15
TAMLUK	JANUARY	44.47	JULY	33.70
WBIIDC	JANUARY	56.28	JULY	33.17
EGRA	JANUARY	48.44	JULY	30.28

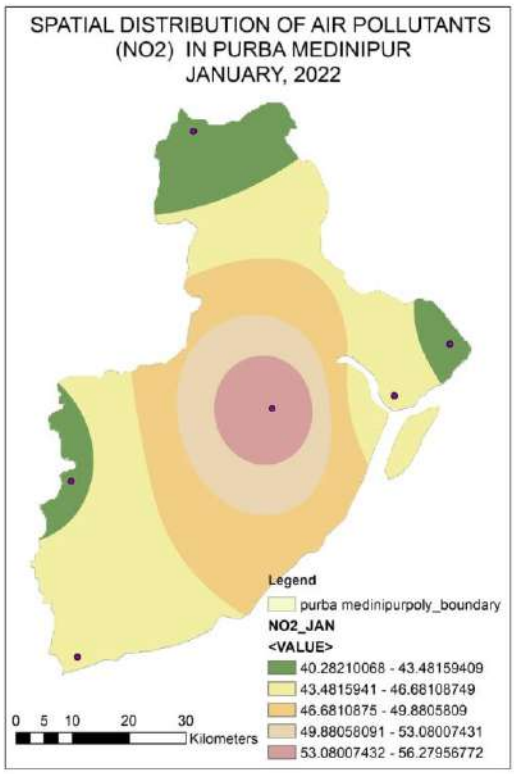


Fig – 2.3 Spatial distribution of NO2 in January

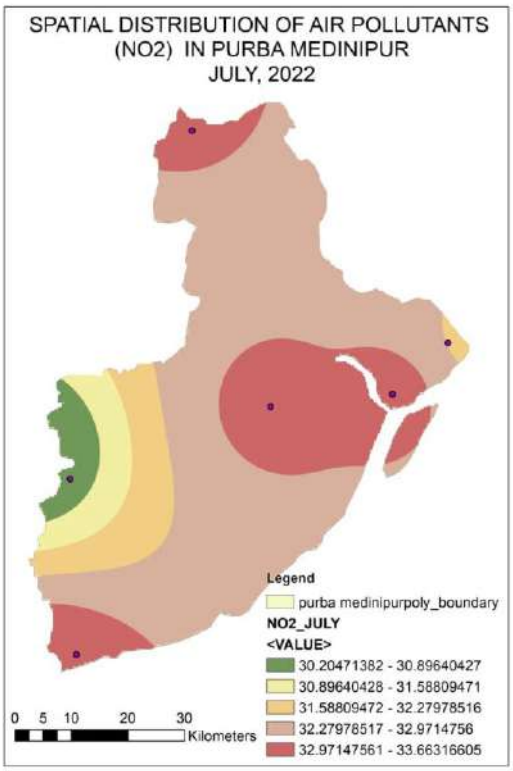


Fig – 2.4 Spatial distribution of NO2 in July

In above the map showing the special distribution of air pollution area in the year of 2022 January to July. We show the map air pollution parameters no2 decrease in the month of July. In January 2022, show the highest polluted area due to no2 gases Bhabanipur in the Purba Medinipur district. Moderate polluted area Agra, Tamluk, Bhuniaraichak, and WBIIDC, supermarket low polluted area in the district of Purba Medinipur. In the July show the highest polluted area due to the no2 gases are Tamluk, supermarket, Bhabanipur, WBIIDC, in the Purba Medinipur district. Bhuniaraichak moderate polluted area and low polluted area Egra in the district of Purba Medinipur .in month of July no2 gases increased in north, east and south of Purba Medinipur district and decreased of January the portion of north, East and Weast in the study area respectively.

Particulate Matter (PM10 & PM 2.5)

A mixture of particles with liquid droplets in the air forms particulate matter. PM 10 are particles that have a size of less than or equal to 10 microns whereas PM2.5 are ultra – fine particles having a size of than or equal to 2.5 microns.

Sources:

Particulate matter is released from constructions , smoking , cleanings , renovations , demolitions , constructions , natural hazard such as earthquakes , volcanic eruptions , and emissions from industries such as brick kilns , paper & pulp etc.

Related effects:

These particles, when inhaled, can penetrate deeper into the respiratory system and cause respiratory ailments such as I asthma, coughing, sneezing, irritation in the air nose, throat irritation, etc. Studies have also between PM exposure and diabetes.

Safe exposure limits:

The Indian govt. and the US EPA both use pm10 2.5 as one of the criteria for air quality index calculation. The safe exposure levels for pm10 (24 hours) are 0-100 ug/m3 and pm 2.5(24 hours) ug/m3 as per the Indian CPCB. As per US-EPA, safe levels of pm 10 are 0-54 ug/m3 and 2.5 is 0-12.0 ug/m3

TABLE NO. 2.4 - PM 10 CALCULATION TABLE JANUARY &JULY 2022

STATION NAME	MONTH	PM10 UG/M3	MONTH	PM10 UG/M3
BHABANIPUR	JANUARY	123.33	JULY	77
BHUNIARANICHAK	JANUARY	118.67	JULY	80.30
SUPERMERKET	JANUARY	124.33	JULY	85.67
TAMLUK	JANUARY	151.67	JULY	83.33
WBIIDC	JANUARY	129.00	JULY	76
EGRA	JANUARY	132.25	JULY	73.87

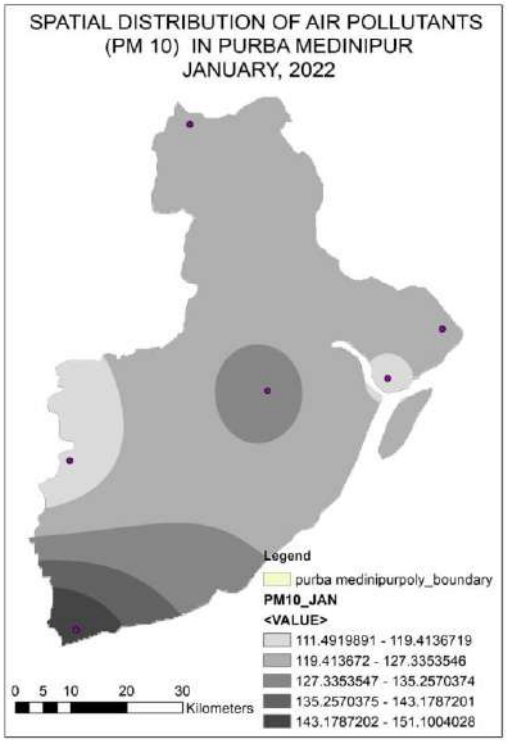


Fig – 2.5 Spatial distribution of PM10 in January

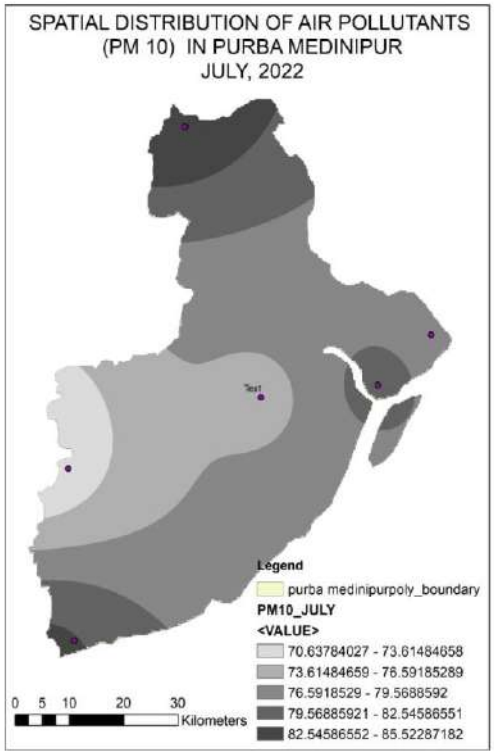


Fig – 2.6 spatial distribution of PM10 in July

AQI AIR POLLTION LEVEL:

EXCELLENT 0-19

The air quality is ideal for most individual enjoy your normal outdoor activity

FAIR 20-49

The air quality is generally acceptable for most individuals. However sensitive groups may experience minor moderate symptoms from long term exposer.

POOR 50-99

The air has reached a high level of pollution and is unhealthy for sensitive groups. Reduced time spend outside if you are filling symptom such as difficulty breathing or throat irritation.

UNHEALTHY 100-149

Health effect can be immediately felt by sensitive groups. Healthy individuals may experience difficulty breathing throat irritation with prolonged exposure. Limit outdoor activity.

VERY UNHEALTHY 150-249

Health effect will be immediately felt by sensitive groups and should be avoided outdoor activity .Healthy individuals are likely to experience difficulty breathing and throat irritation consider staying Indore and rescheduling outdoor.

DANGEROUS 250+

Any exposure to the air, even for a few minutes, can lead to serious health effects on everybody. Avoid outdoor activities.

IMPACT ON AIR POLLUTION:

- **Diseases:** Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma. Many people die every year due to the direct or indirect effects of air pollution.
- **Climate Change:** Climate change is a great concern in today's scenario. This problem has surfaced in the last few decades. Greenhouse gases are the major cause of climate change. Environmental changes have several destructive impacts such as the melting of glaciers, change in seasons, epidemics, etc.
- **Ozone Layer Depletion:** The ozone layer is a layer of concentrated ozone gas. It protects us from the sun's harmful ultraviolet rays. This very important layer is being destroyed by CFCs (chlorofluorocarbons), which are used in industries and everyday life (e.g., aerosol cans). The chlorine in these compounds destroys the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals. The hole in the ozone layer leaves humans and wildlife exposed to the harmful UV rays resulting in several skin diseases including cancer.
- **Global Warming:** Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global warming. This has resulted in the melting of glaciers and an increase in sea levels. Many areas are submerged underwater.
- **Acid Rain:** The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic and fall as acid rain which damages human, animal and plant life**.**
- **Effect on Animals:** The air pollutants suspend on the water bodies and affect the aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place. This renders them stray and has also led to the extinction of a large number of animal species.

MAJOR INDUSTRIES:

Table .present industry name and product

Name of the industry	**Product**
Indian oil corporation Ltd. Haldia	LPG motor , NasolineNaptha, Mto, Kerosene
Haldia Dock complex	Port services
Tata chemical Ltd. Haldia	Industrial phosphate and Acids
Exid industries ltd. Haldia	Containers, special type of Separatatars, etc.
Swal corporation ltd. Haldia	DimethanateFenithrothin, Ethion, Malathion.
Haldia petrochemicals ltd. Haldia	LIDPE, HDPE ,NAPTHA ,CRACKER ETC
Locpetronas ltd. Haldia	L.P.G
IOCL, Paradiphaldia oil pipeline	Petroleum storage and transportation
LOC Ltd. Haldia	Petroleum and acid product
Hindustan petroleum corporation ltd.	Petroleum and Auied product
Hindustan unilever limited	Detergents

❖ AIR QUALITY INDEX:

In addition to land water, air is the prime resource for sustenance of life. With the technological advancements, a vast amount of data on ambient air quality is generated and used to establish the quality of air in different areas. The large monitoring data result in encyclopaedic volumes of information that neither gives a clear picture to a decision maker nor to a common man who simply wants to know how well or bad the air is? One way to describe air quality is to report the concentrations of all pollutants with acceptable levels (standards). As the numbers of sampling stations and pollution parameters (and their sampling frequencies) increase, such descriptions of air quality tend to become confusing even for the scientific and technical community. As for the general public, they usually will not be satisfied with raw data, time series plots, statistical analyses, and other complex findings pertaining to air quality. The result is that people tend to lose interest and can neither appreciate the state of air quality nor the pollution mitigation efforts by regulatory agencies. Since awareness of daily levels of urban air pollution is important to those who suffer from illnesses caused by exposure to air pollution, the issue of air quality communication should be addressed in an effective manner. Further, the success of a nation to improve air quality depends on the support of its citizens who are well-informed about local and national air pollution problems and about the progress of mitigation efforts. To address the above concerns, the concept of an Air Quality Index (AQI) has been developed and used effectively in many developed countries for over last three decades (USEPA 1976, 2014; Ontario, 2013; Shenfield, 1970). An AQI is defined as an overall scheme that transforms weighted value of individual air pollution related parameters (SO2, CO, visibility, etc.) into a single number or set of number or set of numbers. There have not been significant efforts to develop and use AQI in India, primarily due to the fact that a modest air quality monitoring programme was started only in 1984 and public awareness about air pollution was almost non-existent.

TABLE NO 2.5: CALCULATION FOR AQI TABLE - JANUARY & JULY 2022

STATION NAME	MONTH	AQI	MONTH	AQI
BHABANIPUR	January	116	July	77
BHUNIARAICHAK	January	112	July	80
SUPERMARKET	January	137	July	86
TAMLUK	January	134	July	83
WBIIDC	January	119	July	76
EGRA	January	153	July	70

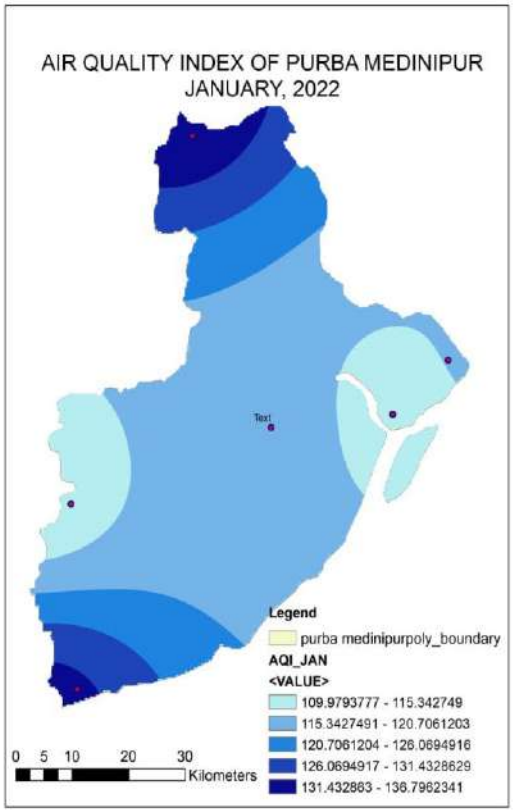


Fig – 2.7AQI Index January

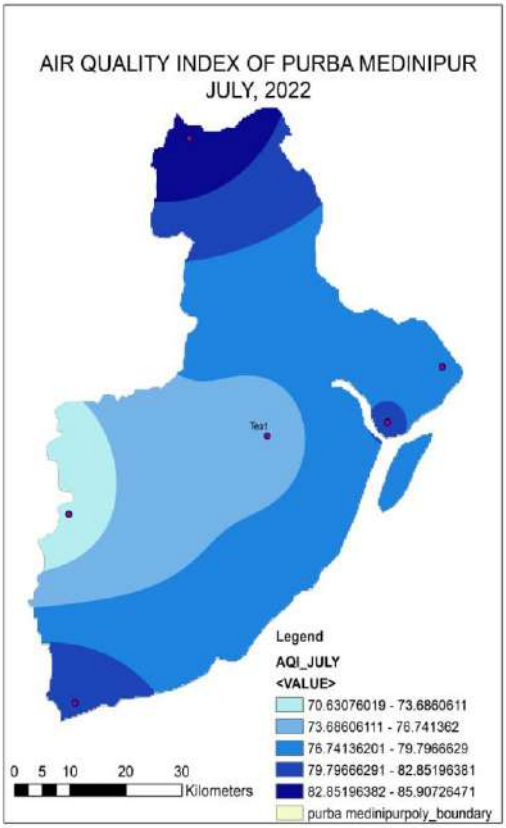


Fig – 2.8 AQI Index July

AQI BASICS OF OZONE AND PARTICLE POLLUTION

AQI Basics for Ozone and Particle pollution

Daily AQI Colour	Level of concern	Value of index	Description of air quality
Green	Good	0 – 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 – 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unhealthy sensitive to air pollution.
Orange	Unhealthy for sensitive groups	101 – 150	Member of sensitive groups may experience health effects .the general public is less likely to be effected.
Red	Unhealthy	151 – 200	Some member of the general public may experienced health effects; member of sensitive groups may experience more serious health effects.
Purple	Very unhealthy	201 - 300	Health alert: the risk of health

			effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

❖ MAJOR POLLUTANTS:

- Sulphur dioxide
- Nitrogen dioxide
- Carbon mono oxide
- PM10
- PM2.5

  Using the air quality index technical assistance document for the reporting of daily air quality index (AQI)

❖ Source of data:

- A data source is the location where data that is being used originate from. a data source maybe initial location where data is form of where physically information is the first organized, however even the most refined data may secure is a source , as long another process access and utilise it.

Here I am collecting data refers to secondary data refers to second hand information, like

- Google web sit
- Government publication
- Different books
- Journal articles
- Newspaper
- Blogs, etc.

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.

The above table is showing the AQI value ranges and the impact on health. On the basis of this table it can be said that in the month of July the AQI values in Purba Medinipur district is satisfactory. The range of AQI value is 70 – 85. It may cause some breathing discomfort. Haldia Petrochemical industries. So, the AQI value is slightly high in the North eastern part of the district. In the month of January the situation changes and the AQI values rise upto 137.

CHAPTER- 3:

Spatial distribution of air pollutants in Haldia Municipality on the basis of primary data analysis.

3.1Introduction: In this chapter the air quality condition of Haldia municipality has been studied. Data has been collected from five points of Haldia municipality and plotted through ArcGIS software.

TABLE NO 3.1: TABLE FOR FIELD SURVEY COLLECTED DATA

DATE	RELATIVE PLACE	LATITUDE (NORTH)	LONGITUDE (EAST)	TEMP (DEGREE C)	CO2 (ppm)	RH (%)
04-05-2023	Ranichak	22°03´17.3"	88°05´20.1”	31.4	180	75.5
06-05-2023	Dock	22°03´12.4”	88°05´20.4”	29.3	176	77.3
09-05-2023	Durgachak	22°04´30.5”	88°08´25.8”	33.9	177	72.3
13-05-2023	City centre	22°06´27”	88°08´33”	31.2	175	70.4
15-05-2023	Township	22°0´47”	88°02´50”	29.4	161	68.8

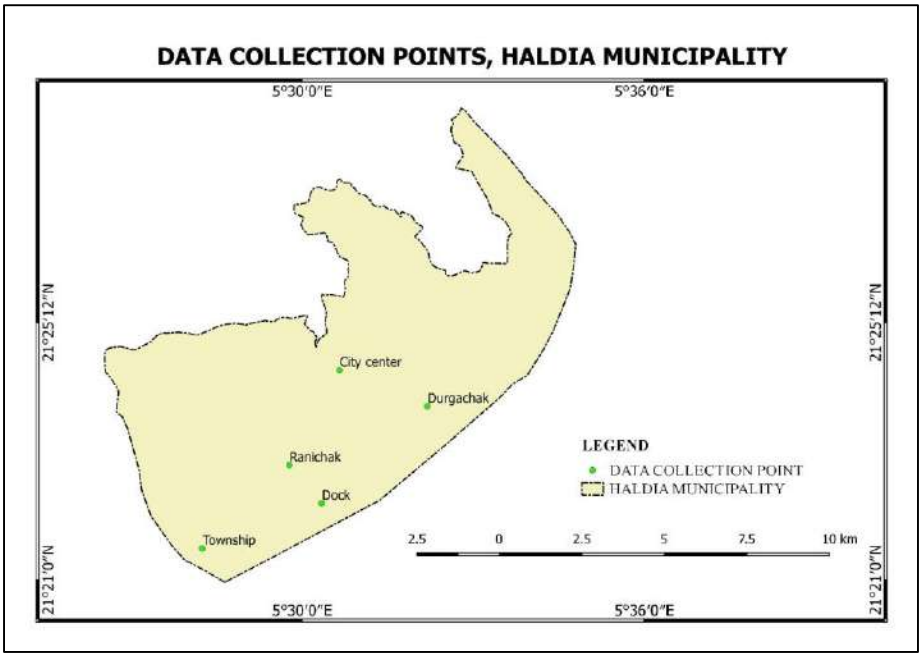


Fig 3.1 – Data collection point in Haldia

3.1 Spatial distribution of RH (RELATIVE HUMIDITY)

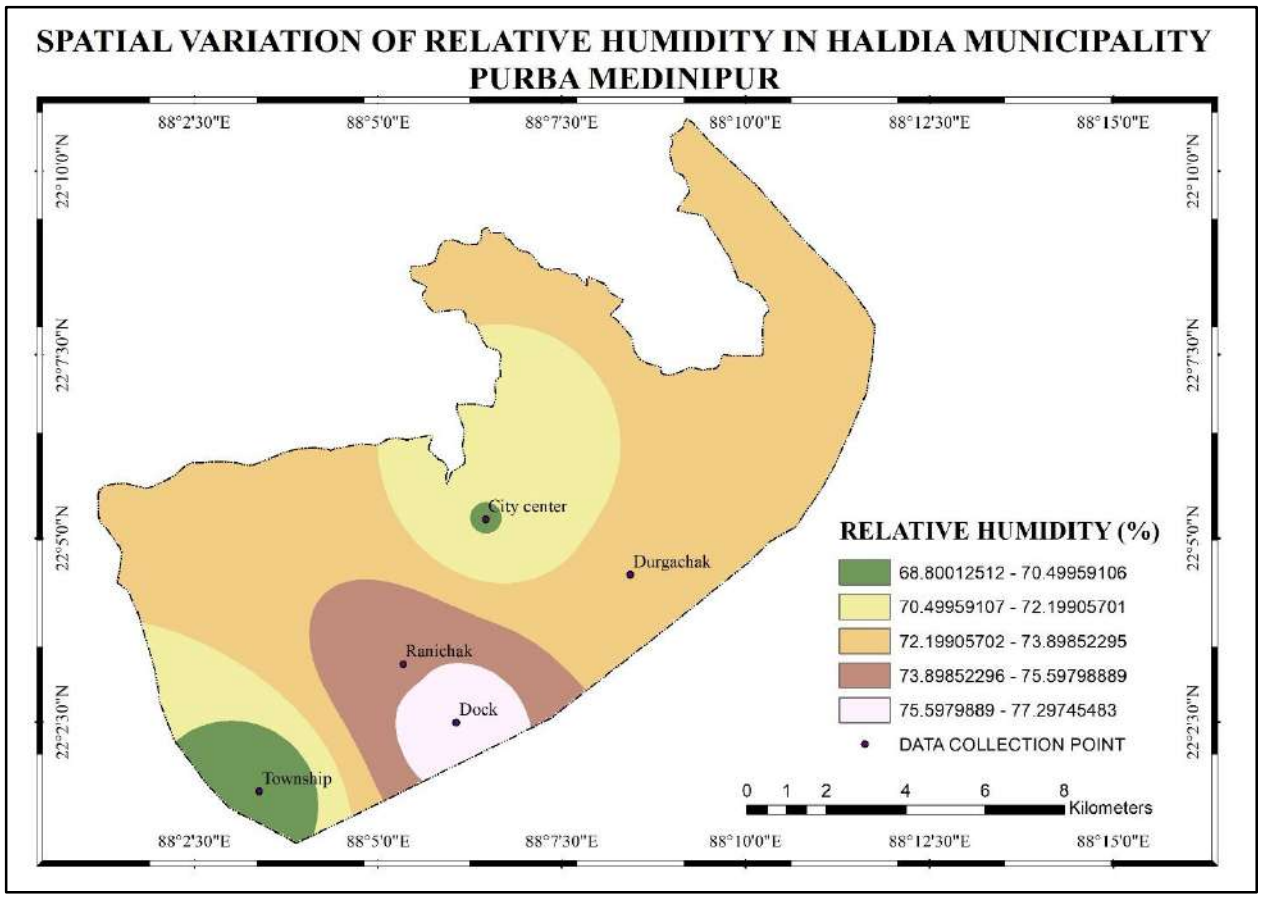


Fig – 3.2 spatial distribution of Relative Humidity

Above the map showing the spatial distribution of air pollutants area in the year of 2023. We show the air pollutants parameters of Relative humidity

We show the highest polluted area due to relative humidity are Ranichak and Dock in Haldia. Moderate Humidity area are Durgachak and City center. And the Low Humidity area are Township in Haldia.

3.2 Spatial distribution of CO2

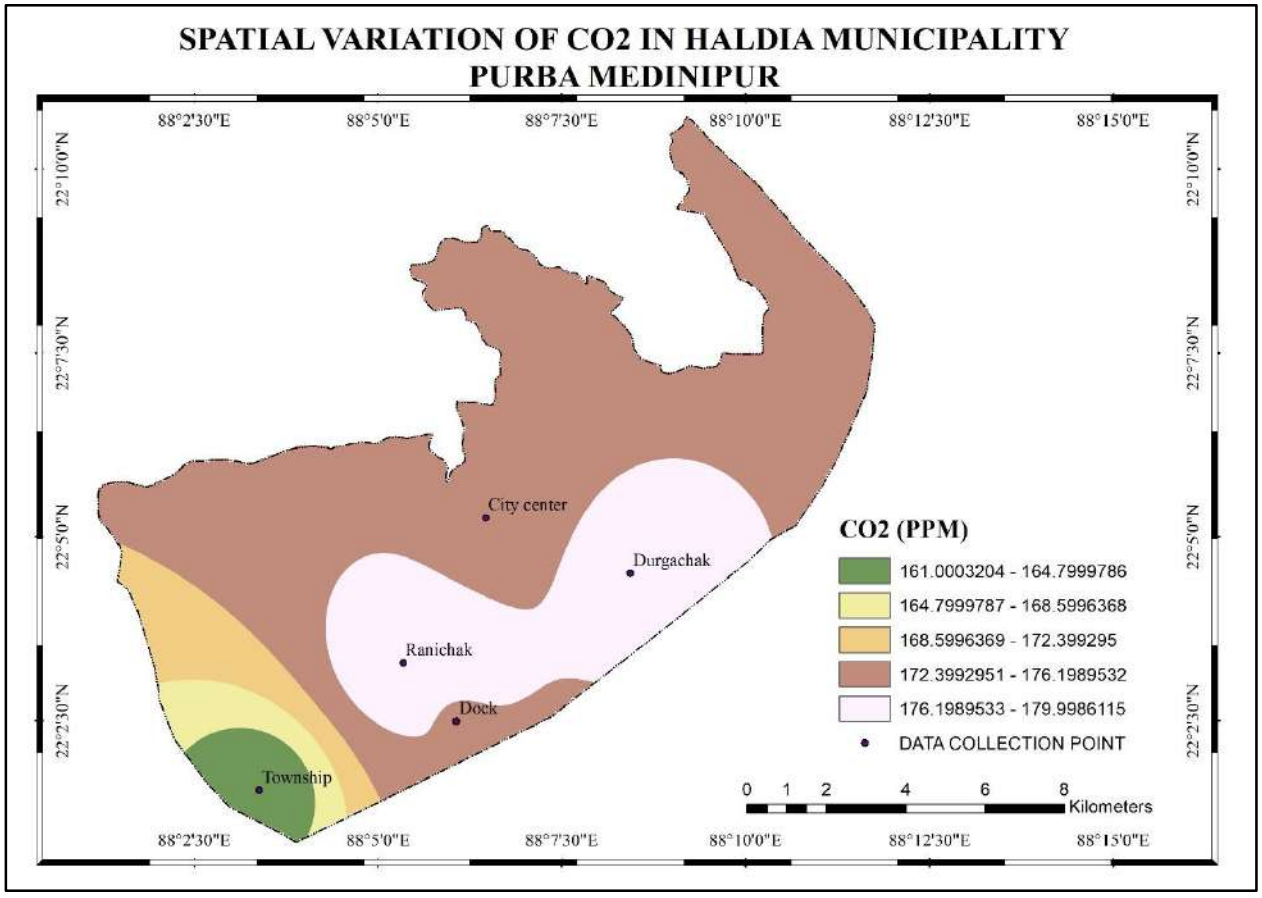


Fig 3.3 – Spatial distribution of CO2

Above the map showing the spatial distribution of air pollutants area is the year of 2023. We show the air pollutants parameters CO2.

We show the highest polluted area due to CO2 gasses are Ranichak, Durgachak in Haldia. Moderate polluted area are City center and Dock .and the lowest polluted area are Township in Haldia.

3.3 Spatial distribution of TEMPERATURE

The month of highest temperature is May during which the average temperature reaches up to 30.1◦C /86.1◦F. January is the coldest month, with temperatures averaging 19.8◦C/67.7◦F.

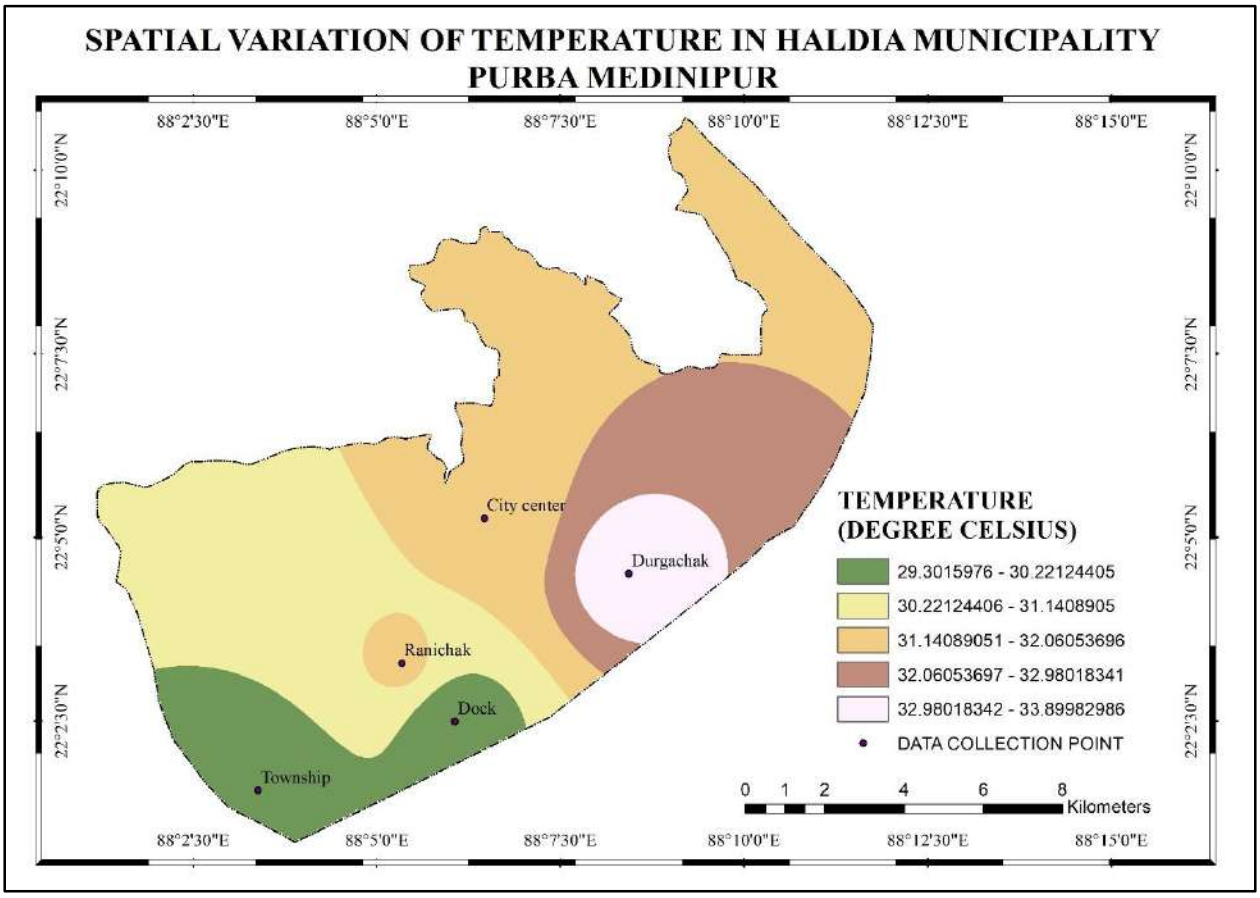


Fig – 3.4 spatial distribution of Temperature

Above the map showing the spatial distribution of air pollutants area is the year of 2023. We show the air pollutants parameters Temperature.

We show the highest polluted area due to Temperature are Durgachak in Haldia .Moderate polluted area are Ranichak and Citycenter. And the lowest polluted area are Dock and Township in Haldia.

CHAPTER -4: ANALYSIS OF STAKEHOLDERS PERCEPTION:

DEMOGRAPHIC STATUS OF HALDIA

4.1 POPULATION COMPOSITION:

Haldia block in west Bengal state, Haldia municipality population is 200,827 of which 104,841are males while 95986 are females as per report released by census of India 2011.

Population of haldia in 2023 is 276,000 literate people 158380 Out of total people of which 87334 are males while 71046 are females .average literacy rate of Haldia city is 88.54 percent of which male literacy rate is 93.26 % and female literacy rate is 83.35 %

Out of total population 61216 are engaged in work or business activity. Of this 54477 were males while 6739 were females in census survey.

TABLE NO 4.1 POPULATION COMPOSITION				
POPULATION	MALE	%	FEMALE	%
2,00,827	1,04,841		95,986	
SOURCE :CENSUS OF INDIA				

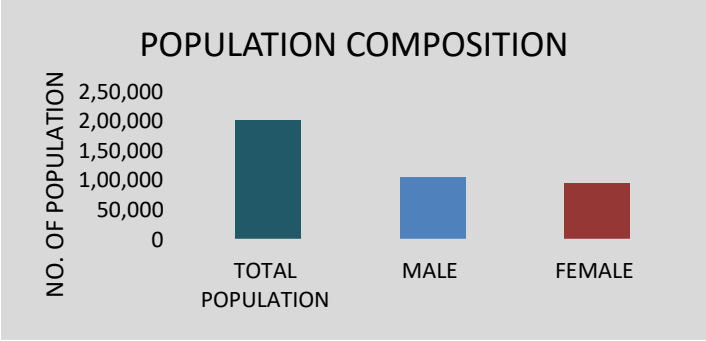
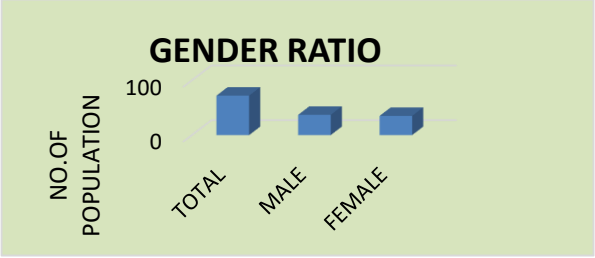


Fig – population composition

And my field survey collected data is given below:

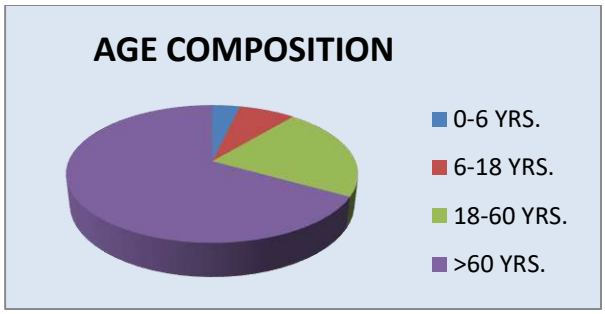
	GENDER	
TOTAL	MALE	FEMALE
72	37	35



4.2 AGE COMPOSITION:

The socio economic survey data on age, relevance that 10.93 of the population in the area is in the range of 0-6 years. 22.07 of the population in the area is in the range of 6 – 18 years about 65.02 of population is in the range of 18-60 yrs., last amount of population 1.98 belongs to old age group i.e., above 60 yrs.

AGE COMPOSITION	
AGE GROUP	POPULATION (%)
0-6 YRS.	10.93%
6-18 YRS.	22.07%
18-60 YRS.	65.02%
>60 YRS.	1.98
SOURCE :CENSUS OF INDIA 2011	



And my field survey collected data is given below:

	AGE		
TOTAL	**0- 18**	**18 - 45**	**45 - ABOVE**
72	16	35	21

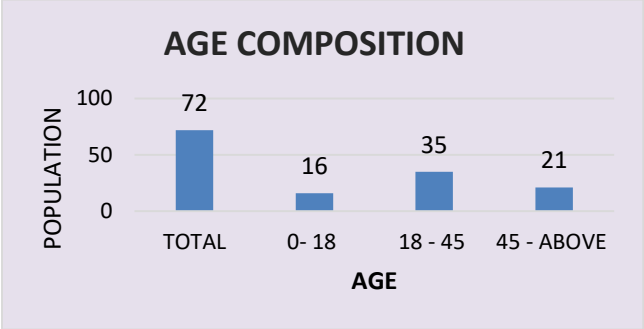


Fig - Age composition

4.3 SEX RATIO:

The sex ratio according to the census of India is about 916 per 950 male population .male population is more than female population.

TABLE NO .4.3 SEX RATIO	
GENDER	
MALE	950
FEMALE	916
TOTAL	1000
SOURCE :CENSUS OF INDIA,2011	

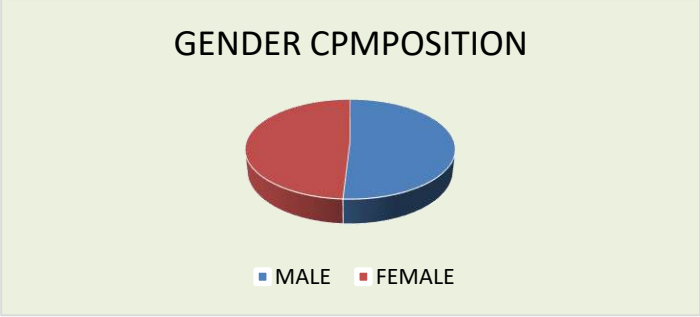


Fig 4.3 – Gender composition

4.4 RELIGIOUS COMPOSITIONS:

According to census of India 83.72%of the households in in the study area are Hindu religion .Another major religion is Islam with presence of about 15.74% christen households are found in small percentage of about 0.22% and others are 0.27

TABLE NO .4.4 RELIGIOUS COMPOSITION	
RELIGIONS	POPULATION (%)
Hindu	83.72%
Muslim	15.74%
Christen	0.17%
Other	0.27
SOURCE :CENSUS OF INDIA ,2011	

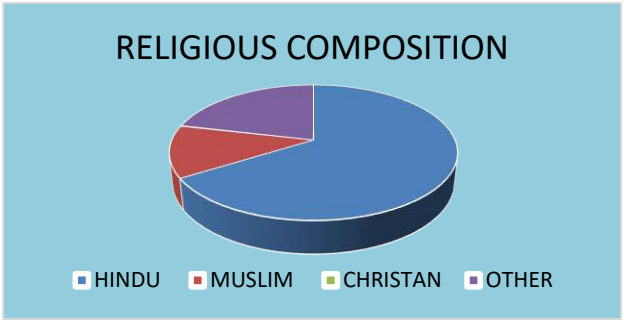


Fig – 4.4 Religious composition

4.5 LITERACY:

Literacy rate of about 88.54%out of which male and female literacy rate accounts about 93.26%are male and 83.85%are female respectively. According to census of India data. Disparity in education between male and female in this regard cab be observed from the following table:

TABLE NO. 4.5 LITERACY STATUS	
Literacy rate	Population in %
Male	93.26
Female	83.35
Total	88.54%
source: census of India ,2011	

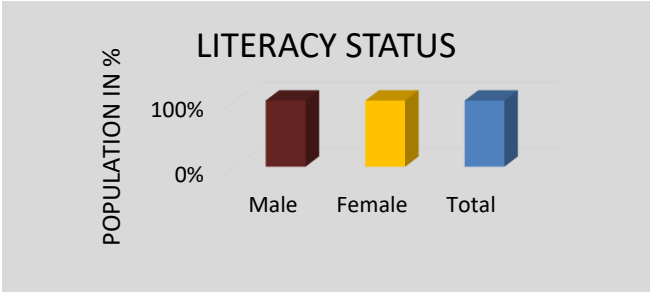


Fig – 4.5 Literacy status

4.6 Pollution problem in locality:

POLLUTION PROBLEM IN LOCALITY	
Suggestions	Agree people %
Strongly agree	35%
Agree	65%
Disagree	0
Total	100%

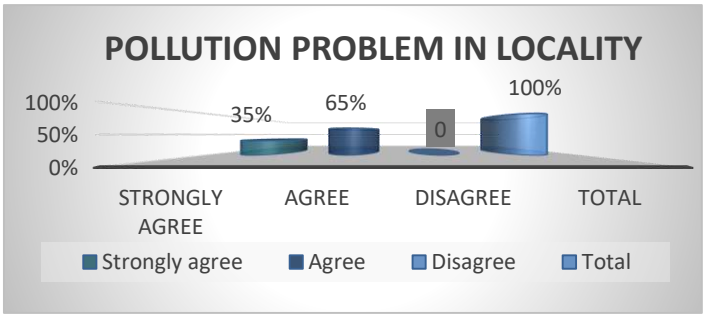


Fig – 4.6 Pollution problem in locality

4.7 Source point of air pollution:

SOURCE POINT OF AIR POLLUTION	
PLACES	PEOPLE PERCEPTION IN %
Restaurant	1%
Hotels	2%
Transport	32%
Real estate	3%
Personal service	6%
Industry	56%

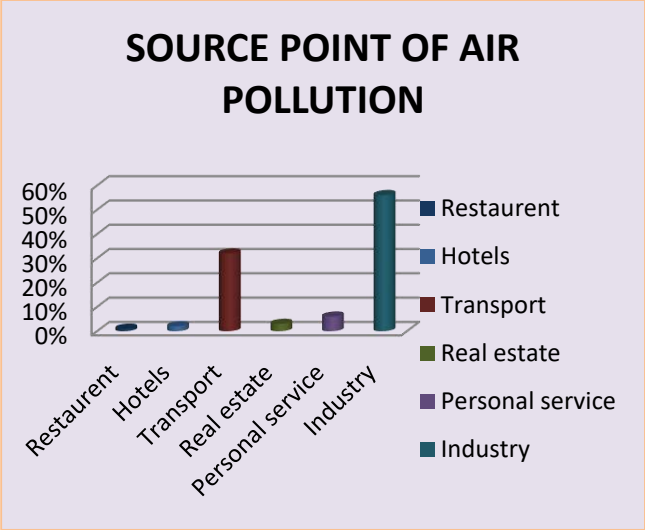


Fig – 4.7 Source point of air pollution

4.8 Suffered health problem people's perception:

Suffered health problem	
Problems	People %
Difficulty in breathing	22.50%
Skin problem	27.50%
Irritation of eyes /throat	21.67%
Asthma incidences	14.17%
Poor visibility	13%
Feeling depressed	2%

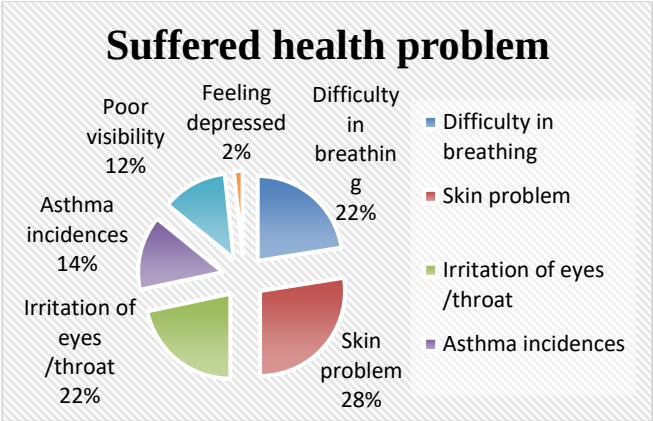


Fig – 4.8 Health problems

4.9 ACTIVELY INVOLVE IN CLEANING ENVIRONMENT:

ACTIVELY INVOLVE IN CLEANING ENVIRONMENT	
Suggestion	Agree people %
Strongly agree	30%
Agree	70%
Disagree	0%
Total	100%

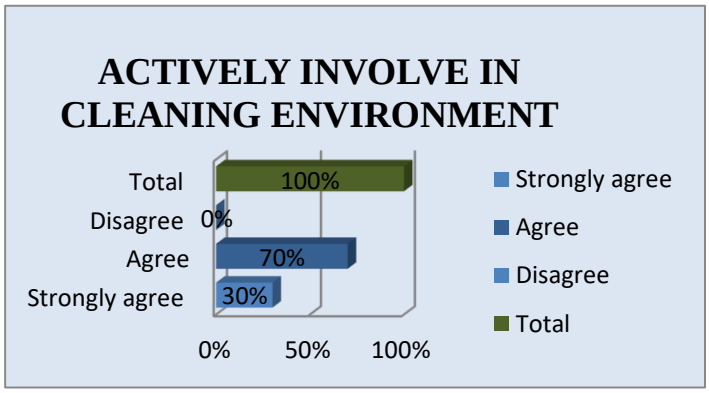


Fig – 4.9 Actively involved in cleaning environment

CHAPTER-5: SUGGESTION & CONCLUSION

❖ MAJOR FINDING

Considering some of the environmental issue, the study reveals the environmental impacts of the air pollution, particularly its fly ash, in project surrounding begin based on the opinion of NO2, SO2, PM10 It discloses that the cultivated land of major Pollutants has been acquired by the plant authority. Most of the families are aware of coal ash which pollutes the environments dangerously and well concerned about its removal from the Haldia Petro chemical plant & dock complex. A large numbers have boldly expressed their displace sled about coal ash which being discarded in their surrounding area. They are also much aware of its adverse environmental effects on the geological changes in their areas.

However, most of the NO2, SO2, PM10, CO2 have expressed their satisfaction with respects to some-infrastructural improvement but only a certain percentage of then have expressed their pleasure with different welfare activities undertaken by the project authority. The plant authority should strictly put into practice various legal provisions like compulsion for all action of fund as per CSR rule UD. Der companies Act, 2013 etc.

5.2 CONCLUSION

Without air no creatures are exhausted in this planet. Air is an extremely necessary element for all life. In the era of globalization air is a most anointed matter in the present world. All of the developed cities and megacities air quality is not up to the mark or not so good, as we want. The reason behind this case is mainly secondary activities; Haldia is not apart from that. Haldia is upcoming growing port city in India. But the main identity of this city is industrial city. Nearly more than 25 ongoing industries in there and some has been already proposed. The economy of Haldia is totally based on industry. The COVID-19 pandemic is helped Haldia to recovering its polluted and Unbreathable air as like the world. The air quality is many times better in May, June & July (2020) than December (2019), January and February (2020). In normal situation when all are sector was open then the air quality is bad but while all the sector is closed, the quality is improved itself automatically. So, the nature proved it that the human activities; mainly industrialization and traffic congestion is completely responsible for worst air quality in Haldia. Industrialization and traffic congestion (mainly truck) is a part of a developing city therefore, Haldia Development Authority need to improve the quality of technology & mechanism in industrial belt; expansion of highways; strictly follow the rules of pollution control board and a better management system.

5.3 RECOMMENDATIONS

The present research paper has been done especially on AQI of Haldia. All causes of bad air quality have some following suggestions –

➢ All of the industry should be following the proper guideline according to Pollution Control Board. It will be helped to increase the quality of air in Haldia.

➢ Emission of different greenhouse gases should be done in a proper height of atmosphere. As a result, the lower-level air is less effected from those gases.

➢ To stop the mixing of the coal dust to surface level atmosphere, local administration should be eyes on it and also companies and truck drivers. If the upper part of the truck is covering with a solid polyethene, it will be better to stop the dust mixing in the air.

➢ The emission of gasses from the traffic congestion should be removed by constructing two or four lane roadways and increasing the transport network.

➢ The management of all industry should be conscious about the air quality of this region.

➢ The citizens of this Municipality should be concern about the burning fossil fuel, as a result air pollutant will be less released in the ground level atmosphere.

➢ Municipality should be planting more and more trees in empty barren land area in Haldia through a social forestry programmed.

❖REFERENCES

[1] Agarwal S. Effect of indoor air pollution from biomass and solid fuel combustion on prevalence of self-reported asthma among adult men and women in India: findings from a nationwide large scale cross-sectional survey. J Asthma 2012;49(9):989.

[2] Allen MR, Frame DJ, Huntingford C, Jones CD, Lowe JA, Meinshausen M, Meinshausen N (2009): Warming caused by cumulative carbon emissions towards the trillionth tonne. Nature 458. https://doi.org/10.1038/nature08019

[3] Armstrong DV (1994): Heat stress interaction with shade and cooling. J Dairy Sci 77(7):2044–2050. https://doi.org/10.3168/jds.S0022.0302(94)77149-6

[4] Badarinath KVS, Kharol SK, Sharma AR (2009): Long-range transport of aerosols from agricultural crop residue burning in indo-Gangetic Plains – a study using LIDAR, ground measurements and satellite data. J Atmos Sol Terr Phys 71(1):112–120. https://doi.org/10.1016/j.jastp.2008.09.035

[5] Bajani S, Das D (2020): Sustainable planning interventions in tropical climate for urban heat island mitigation - case study of Kolkata. In: Ghosh M (ed) Perception, design and ecology of the built environment. Springer, Cham. https://doi.org/10.1007/978-3-030-25879-5_10

[6] Ballester F, Fuentes Leonarte V, Tenías Jm.: Sources of indoor air pollution and respiratory health in preschool children. J Environ Public Health 2009:19. [Doi 727516: 1–727516].

[7] Barck C, Lundahl J, Hallden G, Bylin G.: Brief exposures to NO2 augments-the allergic inflammation in asthmatics. Environ Res 2005:58–66.

[8] Bell Ml, Davis Dl, Gouveia N, Vector Hba, Cifuentes La.: The Avoidable Health Effects Of Air Pollution In Three Latin American Cities: Santiago, Sao Paula, Andmexico City. Environ Res 2006;100:431–40.

[9] Bhargava A, Bunkar N, Aglawe A, Pandey K, Tiwari R, Chaudhury K, Goryacheva IY, Mishra PK (2018): Epigenetic biomarkers for risk assessment of particulate matter associated lung cancer. Curr Drug Targets 19(10):1127–1147. https://doi.org/10.2174/1389450118666170911114342

[10] Bhattacharya R, Pal S, Biswas G, Karmakar S, Saha G (2013): Seasonal distribution of comfortability: a regional based study over Kalyani, West Bengal India. Int J Innov Res Sci Technol 2:2856–2862

[11] Boucher O et al. (2013): Clouds and aerosols. Climate change 2013: the physical science basis; contribution of working group 1 to the fifth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge, pp 571–657

[12] Brown T, Holmes P, Harrison Ptc.: Review: The Applicability of Epidemiological Methods to The Assessment of The Risks To Human Health of Indoor Air Pollution: An Overview. Indoor Built Environ 2010;19:311–26.

[13] Chapman EG, Gustafson WI, Easter RC, Barnard JC, Ghan SJ, Pekour MS, Fast JD (2008): Coupling aerosol-cloud-radiative processes in the WRF-Chem model: investigating the radiative impact of elevated point sources. Atmos Chem Phys 9:945–964

[14] Chapman HL (2017): Performance test of the Pasquill stability classification scheme. Thesis and Dissertations 1453, University of Wisconsin Milwaukee. UWM Digital Commons

[15] Choudhury D, Das K, Das A (2019): Assessment of land use land cover changes and its impact on variations of land surface temperature in Asansol-Durgapur development region. Egy J Remote Sensing Space Sci 22(2019):203–218. https://doi.org/10.1016/j.ejrs.2018.05.004

[16] Cohen AJ. 1995(2003): Air pollution and lung cancer: what more do we need to know? Thorax 58:1010–1012. https://doi.org/10.1136/thorax.58.12.1010

[17] Das S, Dey S, Dash SK, Basil G (2013): Examining mineral dust transport over the Indian subcontinent using the regional climate model, RegCM4.1. Atmos Res 134(2013):64–76. https://doi.org/10.1016/j.atmosres.2013.07.019

[18] David J.: Fungi As Contaminant In Indoor Air. Atmos Environ 1992;26:2163–72. Indian Institute Of Toxicology And Research (Iitr), Lucknow. Assessment Of Ambient Air Quality Of Lucknow City During Pre-Monsoon. 2012 — A Report; 2012.

[19] Dear RJd, Akimoto T, Arens EA et al (2013): Progress in thermal comfort research over the last twenty years. Indoor Air 23(6):442–461. https://doi.org/10.1111/ina.12046

[20] Dutta A, Jash T (2014): Studies on energy consumption pattern in mechanized van rickshaws in West Bengal and the problem associated with these vehicles. Energy Procedia 54 (2014):111–115. https://doi.org/10.1016/j.egypro.2014.07.253

[21] Dutta D, Gupta S, Kistawal CM (2018): Linking LULC change with urban heat islands over 25 years: a case study of the urban-industrial city Durgapur, Eastern India. J Spat Sci. https:// doi.org/10.1080/14498596.2018.1537198

[22] Ehret U, Zehe E, Wulfmeyer V, Warrach-Sagi K, Liebert J (2012): Should we apply bias correction to global and regional climate model data? Hydrol Earth Syst Sci Discuss 9:5355–5387. https:// doi.org/10.5194/hessd-9-5355-2012.

[23] Emmons LK, Walters S, Hess PG (2010): Description and evaluation of the model for ozone and related chemical tracers, version 4 (MOZART 4). Geosci Model Dev 3:43–67. https://doi.org/ 10.5194/gmd-3-43-2010

[24] Forkel R, Brunner D, Baklanov A et al (2016): A multi model case study on aerosol feedbacks in online coupled chemistry meteorology models within the COST action ES1004 EuMetChem. Air Pollut Model Appl XXIV. https://doi.org/10.1007/978-3-319-24478-5_

[25] Fosu BO, Wang S-YS, Wang S-H, Gillies RR, Zhao L (2017): Greenhouse gases stabilizing winter atmosphere in the Indo-Gangetic plains may increase aerosol loading. Atmos Sci Lett 18:168–174. https://doi.org/10.1002/asl.739

[26] Ghosh S, Tripathi SN (2014): Chemical characterization of summertime dust events in Kanpur: insight into the sources and level of mixing with anthropogenic emissions. Aerosol Air Qual Res 14:879–891

[27] Ghude SD, Chate DM, Jena C, Beig G, Kumar R, Barth MC, Pfister GG, Fadnavis S, Pithani P (2016): Premature mortality in India due to PM25 and ozone exposure. Geophys Res Lett 43:4650–4658. https://doi.org/10.1002//2016GL068949.

[28] Hu X-M, Klein PM, Xue M (2013): Evaluation of the updated YSU planetary boundary layer scheme within WRF for wind resource and air quality assessments. J Geophys Res Atmos 118 (10):490–505

[29] Jethva H, Torres O, Field RD, Lyapustin A, Gautam R, Kayetha V (2019): Connecting crop productivity, residue fires, and air quality over Northern India. Sci Rep 2019(9):16594. https://doi.org/10.1038/s41598-019-52799-x

[30] Kaplan C.: Indoor Air Pollution From Unprocessed Solid Fuels In Developing Countries. Environ Health 2000;25:221–42.

[31] Kar J, Deeter MN, Fishman J et al (2010): Wintertime pollution over the Eastern IndoGangetic Plains as observed from MOPITT, CALIPSO and tropospheric ozone residual data. Atmos Chem Phys 10(2010):12273–12283. https://doi.org/10.5194/acp-10-12273-2010

[32] Khan A, Chatterjee S (2016): Numerical simulation of urban heat island intensity under urbansuburban surface and reference site in Kolkata, India. Model Earth Syst Environ 2:71. https:// doi.org/10.1007/s40808-016-0119-5

[33] Khan Ah, Ansari Fa, Patel Dk, Siddiqui H, Sharma S, Ashquin M, Et Al.: Indoor Exposure To Respirable Particulate Matter And Particulate-Phase Pahs In Rural Homes In North India. Environ Monit Assess 2010;170(1–4):491–7.

[34] Kim Ys.: A Literature Review On Indoor Air Quality In Korea. J Korean Public Health Assoc 1992;18:147–65.

[35] Kong X, Forkel R, Sokhi RS (2015): Analysis of meteorology-chemistry interactions during air pollution episodes using online coupled models within AQMEII phase-2. Atmos Environ 115 (2015):527–540. https://doi.org/10.1016/j.atmosenv.2014.09.020

[36] Kumar M, Parmar KS, Kumar DB, Mhawish A, Broday DM, Mall RK, Banerjee T (2018): Long term aerosol climatology over Indo-Gangetic plain: trend, prediction and potential source fields. Atmos Environ. https://doi.org/10.1016/j.atmosenv.2018.02.027

[37] Luan T, Guo X, Zhang T (2019): Below cloud aerosol scavenging by different intensity rains in Beijing city. J Meteorol Res 33:126–137

[38] Makar PA, Gong W, Milbrandt J, et al. (2014, August): A study of feedbacks between weather and air pollution using GEM-MACH (and several other models!). WWSOC Presentation 18

[39] Michael M, Yadav A, Tripathi SN et al (2013): Simulation of trace gases and aerosols over the Indian domain: evaluation of the WRF-CHEM model. Atmos Chem Phys 13:12287– 12336. https://doi.org/10.5194/acpd-13-12287-2013

[40] Misra P, Srivastava R, Krishnan A, Sreenivaas V, Pandav CS.: Indoor Air PollutionRelated Acute Lower Respiratory Infections And Low Birth Weight: A Systematic Review. J Trop Pediatr 2012;58(6):457–66.

❖ Articles

[1]Action plan for abatement of pollution in respect of Panipat town (online), available from:www.cpcb.nic.in

[2] Action plan for industrial cluster-navimumbai,(online), available from: www.cpcb.nic.in

[3] Area wide environmental quality management plan for Haldia, 2004.

❖ Web Page

[1] Www.India.Com/Health/Report(2010).

[2] Www.Rediff.Com/Business/Report/Manglore.Refinery,(2014).

[3] Www.Diajiworld.Com/New/News.Disp.Aspin-Id-271147(2014).

[4] Www.Ifc.Org/Ifcext/Enviro.Nst/Content/Environmental Guidelines (2010).

[5] Www.Coastaldigest.Com/Index(2015).

[6] Www.Indianexpress/Article/Cities/Mumbai (2010).

[7] Http://Worldpopulationreview.Com/Countries/India-Population.