GORAKHPUR CITY CLEAN AIR ACTION PLAN

DECEMBER, 2020

UTTAR PRADESH POLLUTION CONTROL BOARD
TC-12V, VIBHUTI KHAND, GOMTI NAGAR, LUCKNOW,
UTTAR PRADESH 226010

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I. INTRODUCTION

A vast country and an emerging economy like India, faces enormous challenges with its burgeoning population and widespread poverty, in meeting its various other significant commitments associated with poverty, and eradication of hunger under the SDGs. India has been going through a phase of accelerated industrial activities for the past three decades. The associated growth in terms of industrialization and urbanization has led to a manifold increase in pollution issues, more specifically air pollution issues. In recent years, medium and small towns and cities have also witnessed an increase in pollution, thus getting fast reflected in the non-attainment cities of India. Air pollution has increasingly become a serious concern, predominantly because of its health impacts. The reported perplexing statistics in various international reports, correlating air pollution with health impacts without the use of indigenous dose-response functions, further complicates the issue by possibly creating an ambiguous public perception.

With the recent focus on pollution in tier II cities, the MoEF&CC and CPCB has identified the non-attainment cities mostly in Indo-Gangetic Plains based on ambient air quality data for the period 2011 – 2015 and WHO report 2014/2018. However, many of tier II cities in India, including state capital, have similar problems of outdoor air pollution. Gorakhpur has been identified as a NAC in the month Nov, 2020 with the objective to evolve an action plan having action points with specific timelines based upon scientific inputs time-bound actions and its effective implementation in order to bring down the pollution levels.

II. GOAL

The goal of the Action Plan is to meet the prescribed annual average ambient air quality standards at all locations in Gorakhpur City within a stipulated timeframe (long-term).

III. TARGET

The global experiences clearly highlight the fact that internationally, the actions had been city specific rather than country oriented and, accordingly, the statistics indicates 35%–40% $PM_{2.5}$ reduction in five years for cities, such as Beijing and Seoul, whereas cities, such as Santiago and Mexico City have shown 73% and 61% reduction in 22 to 25 years with regard to $PM_{2.5}$ and PM_{10} concentrations, respectively. Recently, a new Lancet study by Peking University School of Public Health on the impact of China's 'Air Pollution Prevention and Control Action Plan (2013–2017) has found that an annual average concentration of $PM_{2.5}$ decreased by 33.3% and PM_{10} levels reduced by 27.8% in the 74 key cities in China where the plan was implemented in the last five years. Sulphur dioxide reduced by 54.1% and CO by 28.2% in five years, but no significant improvements were seen in NO_2 or O_3 concentrations. TERI and ARAI report dated August, 2018, analyzed various interventions and estimated their possible impacts

over $PM_{2.5}$ and PM_{10} concentrations in Delhi and NCR. An alternative scenario has been developed considering the interventions which can provide maximum air quality benefits. Taking into account the available international experiences and national studies, the tentative national level target of 20%–30% reduction of $PM_{2.5}$ and PM_{10} concentration by 2024 is proposed under the NCAP. This is keeping 2017 as the base year for the comparison of concentration. Recent rise in development activities of the city resulted in the rise of particulate matter (PM) and consequently listed Gorakhpur city in non-attainment cities list. The targets for Gorakhpur City are kept similar to the targets envisaged under NCAP as described above with a modified timeline by 2025 as interventions will be starting in 2020. The yearly targets will be decided so that the emphasis in first two years will be largely upon taking up the actions for the institutional strengthening and development of infrastructure in consultation with CPCB & MoEF&CC.

IV. TIME FRAME

Considering 2020-21 as base year, this action plan is prepared for a term of next five years (mid-term action plan) to begin which is further extendable up to 20-25 years in long-term after mid-term review of the outcomes.

V. OBJECTIVES

1. To ensure stringent implementation of mitigation measures for prevention, control and abatement of air pollution
2. To carry out scientific studies for apportionment of sources of air pollution, identification of gaps, identification of the hot spots and prioritization of actions for increasing the effectiveness of mitigations
3. To augment and evolve effective and proficient ambient air quality monitoring network across the city for ensuring a comprehensive and reliable database.
4. To augment public awareness and capacity-building measures encompassing data dissemination and public outreach programmes for inclusive public participation and for ensuring trained manpower and infrastructure on air pollution.
5. To evaluate the impact of mitigation measures periodically in order to ensure the effectiveness and realignment of the mitigation strategies

VI. OVERVIEW OF GORAKHPUR CITY

Gorakhpur lies in a terai (low land region) of Himalaya and Indo-Gangetic plains. Covering an area of 3483.8 sq. km Gorakhpur district stretches between Latitude 26°13′N and 27°29′N and Longitude 83°05′E and 83°56′E. River Rapti flows through Gorakhpur supplying it with rich alluvium plain. At present, it is one of the fast-accelerating cities in sense of population and economic growth in the Middle Ganga plain. The average altitude

of the city from the mean sea level is about 102 m (302 feet). Being located in the Middle Ganga Plain, the average annual rainfall of Gorakhpur city is 1118.37 mm

Gorakhpur city is also the headquarters of Gorakhpur Division. Gorakhpur division comprises four districts, Gorakhpur, Deoria, Mahrajganj, and Kushinagar. Gorakhpur was a part of the famous kingdom of Koshal, one of sixteen Mahajanpadas in 6th Century B.C. Gorakhpur also became an important center of activity during the first war of independence.

Being headquarter of north-eastern railway, Gorakhpur is well connected to the rail network of the country. The city is also well connected by road and air transport network from other areas of the country.

The terracotta work of Gorakhpur is a centuries-old traditional art form that got a geographical indication (GI) tag in April 2020. The natural red color of terracotta does not fade for years which gives it a peculiarity.

Gorakhpur is also the Head Quarter of the Indian Air Force and is known for Cobra Squadron.

VII. STATUS OF AIR QUALITY & ITS TREND IN GORAKHPUR

The non-attainment status of a city is implicative of a consistently high level of air pollutants above the national ambient air quality standards. Exponential growth in construction and demolition activities, increase in the number of vehicles, roadside encroachments, and expansion of industries in Gorakhpur city resulted in poor regional air quality problems characterized by inhalable particulate matter (PM_{10}) and fine particles ($PM_{2.5}$). Long-term exposure to particulate matter gives rise to chronic lung and heart disease in humans. High pollutant level in the air also deteriorates the ecological and aesthetic balance of the city. This action plan is developed to control the pollutant level and improve air quality in Gorakhpur.

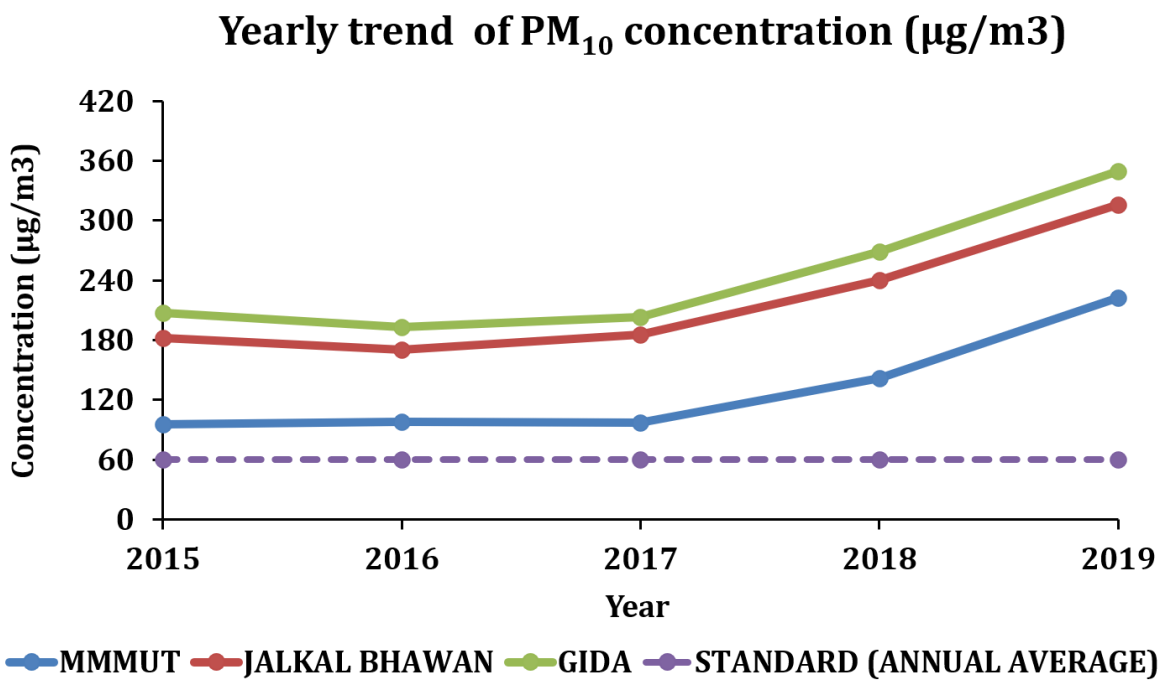


Figure 1: Yearly trend of PM_{10} concentration (µg/m³) in Gorakhpur city

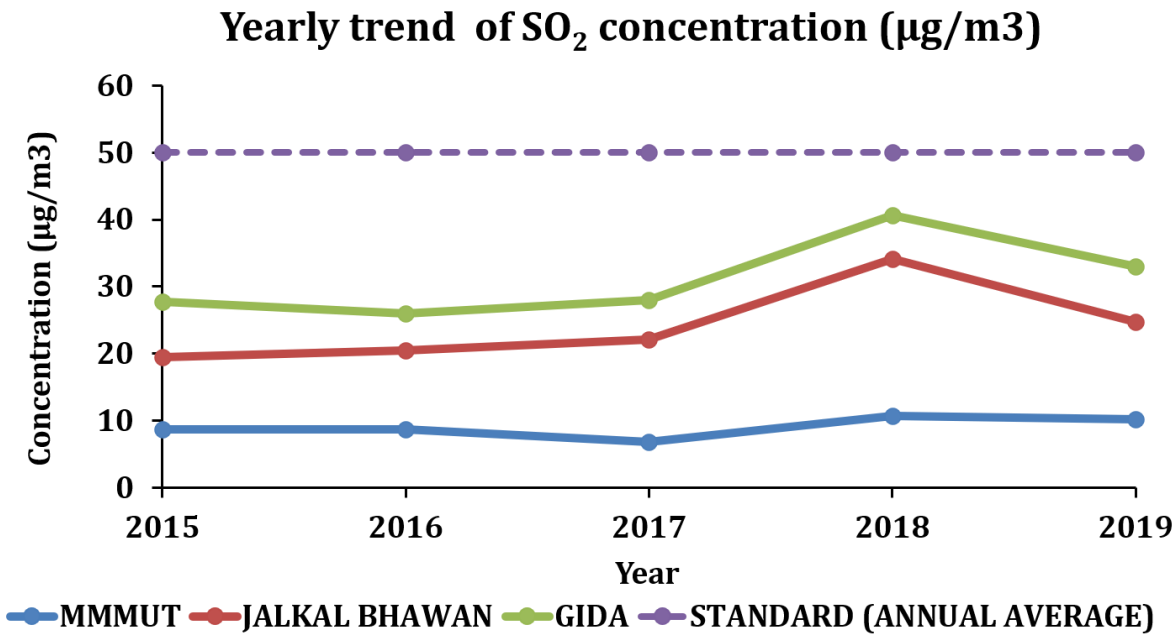


Figure 2 : Yearly trend of SO_2 concentration (µg/m³) in Gorakhpur city

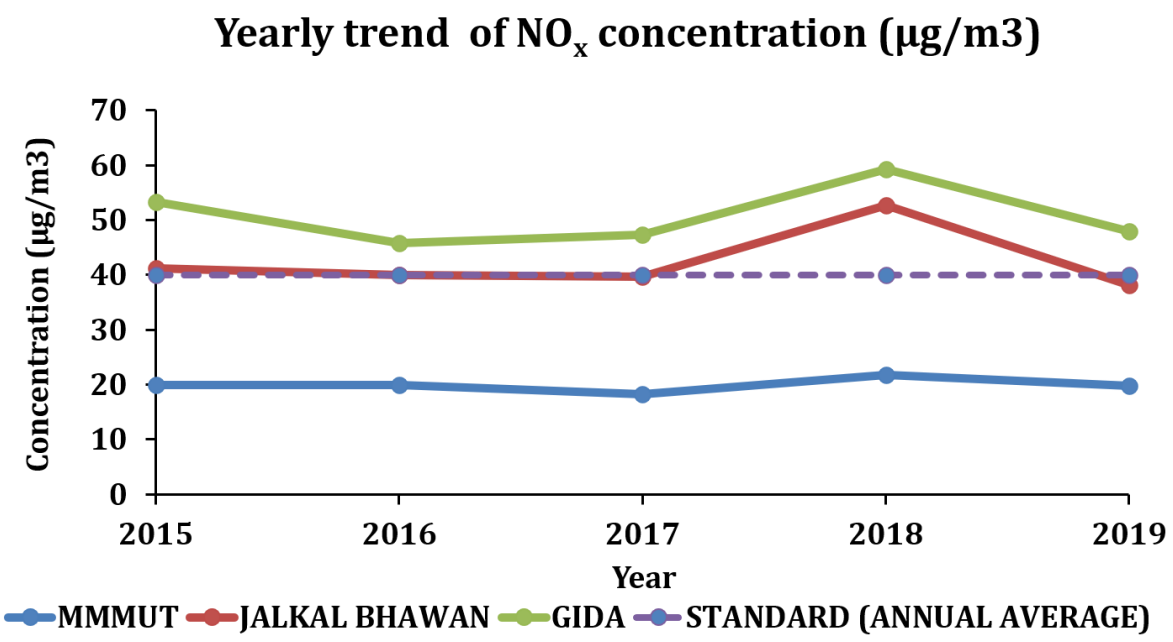


Figure 3: Yearly trend of NO_x concentration (µg/m³) in Gorakhpur city

While a predominant pollutant (i.e., PM_{10}& $PM_{2.5}$), is taken as a reason for non-attainment. It is important to note that air is spiked with numerous pollutants of which 12 are regulated under NAAQS and a good action plan will be able to tackle all kinds of pollutants.

Air Quality Index is a tool for effective communication of air quality status to people in terms, which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour as shown below.

Table 1 : Categories of Air Quality Index along with the expected impact

Good (0 – 50)	Minimal Impact
Satisfactory (51–100)	Minor breathing discomfort to sensitive people
Moderate (101–200)	Breathing discomfort to the people with lung, heart disease, children and older adults
Poor (201–300)	Breathing discomfort to people on prolonged exposure
Very Poor (301–400)	Respiratory illness to the people on prolonged exposure
Severe (>401)	Respiratory effects even on healthy people

Air Quality Index for the last 5 years has been calculated for the three manual monitoring stations based on three parameters PM_{10}, SO_2, and NO_2. While it is imperative to note that the AQI of Gorakhpur city has changed from a moderate category to poor since the winters of 2018. The main causes of this decline in the air quality of Gorakhpur are recent escalation in construction and industrial pursuit accompanied by poor or no control measures. Also increase in the number of vehicles, traffic congestion due to inadequate road width and increase in roadside encroachments hampering the free flow of traffic, increase in the influx of non-destined traffic has increased the PM_{10}, SO_2 & NO_2 levels. The spike in the SO_2 & NO_2 levels in 2018 may be attributed to local factors also. COVID-19 pandemic and the subsequent lockdown have some positive impact on the environment across the world. Similarly, the AQI of Gorakhpur also improved. There is 77%, 80%, and 78% decline in AQI of residential, commercial, and industrial areas respectively in the month of April 2020 with respect to the previous year due to pandemic-lockdown. AQI in the residential area of Gorakhpur is in the satisfactory category till October 2020. AQI in a commercial and residential area is moderate in the post-lockdown period.

Without effective measures, the AQI is set to move into the poor category and hence an effective clean air action plan addressing all the major air pollution-related issues is essential.

Table 2: Air Quality Index trend at MMMTU monitoring station (Residential)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2015	63.0	121.0	63.0	114.0	109.0	99.0	62.0	104.0	97.0	90.0	94.0	106.0
2016	112.0	118.0	122.0	118.0	118.0	122.0	55.0	56.0	62.0	67.0	67.0	108.0
2017	109.0	112.0	107.0	108.0	107.0	108.0	90.0	55.0	68.0	78.0	92.0	112.0
2018	117.0	117.0	118.0	117.0	117.0	116.0	104.0	89.0	110.0	115.0	177.0	243.0
2019	273.0	246.0	249.0	240.0	225.0	152.0	135.0	135.0	133.0	145.0	161.0	163.0
2020	146.0	145.0	249.0	55.0	55.0	55.0	60.0	73.0	82.0	92.00		

Table 3: Air Quality Index trend at Jalkal bhawan monitoring station (Commercial)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2015	125.0	195.0	125.0	179.0	174.0	166.0	118.0	167.0	152.0	146.0	150.0	162.0
2016	166.0	178.0	183.0	180.0	183.0	184.0	87.0	97.0	107.0	110.0	111.0	172.0
2017	176.0	175.0	175.0	178.0	178.0	179.0	155.0	73.0	92.0	111.0	207.0	175.0
2018	177.0	181.0	180.0	179.0	178.0	179.0	172.0	167.0	179.0	185.0	270.0	366.0
2019	392.0	280.0	285.0	280.0	280.0	249.0	214.0	227.0	224.0	235.0	267.0	277.0
2020	234.0	231.0	285.0	55.0	78.0	90.0	104.0	109.0	122.0	138.00		

Table 4: Air Quality Index trend at GIDA monitoring station (Industrial)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2015	146.0	191.0	146.0	202.0	195.0	182.0	145.0	186.0	162.0	159.0	163.0	184.0
2016	189.0	192.0	190.0	196.0	195.0	194.0	115.0	119.0	122.0	123.0	121.0	185.0
2017	186.0	186.0	185.0	187.0	188.0	187.0	168.0	106.0	113.0	123.0	217.0	187.0
2018	192.0	193.0	194.0	191.0	191.0	188.0	182.0	174.0	187.0	265.0	356.0	402.0
2019	409.0	289.0	296.0	293.0	302.0	275.0	239.0	272.0	271.0	291.0	344.0	358.0
2020	282.0	193.0	296.0	65.0	121.0	145.0	160.0	106.0	115.0	125.0		

VIII. GAPS IN DATABASE AUGMENTATION

A. Air Quality Monitoring Network

In view of the Hon'ble NGT order regarding the air quality monitoring stations, the proposed action plan has recommended a plan for further strengthening of the monitoring grid. The NGT has directed that the scope of monitoring should be expanded to include all twelve notified parameters as per Notification NoB-29016/20/90/PCI-L dated 18 November 2009 of CPCB. It is further said that continuous Ambient Air Quality Monitoring Stations (AAQMS) should be preferred to manual monitoring stations. And, all such ambient air quality monitoring stations shall be connected to the central server of CPCB for reporting analysis of results in a form of Air Quality Bulletin for the general public at regular intervals at least on weekly basis and ambient air quality on continuous e-portal. MoEF&CC will provide requisite funds for the purpose.

A robust air quality monitoring network (AQMN) is one of the main ways to surveil air pollution. One of the purposes of a systematic monitoring network is to document the consequences of air pollution control measures. AQMN provide detailed information to citizens about what they are breathing, identify hotspots, and help assess immediate solutions.

The air quality of Gorakhpur city is monitored by 3 manual monitoring stations which are operated by Madan Mohan Malaviya University of Technology (MMMUT), Gorakhpur. There are monitoring stations in residential, commercial, and industrial areas.

Table 5: Details of existing air quality monitoring stations

S.No.	Name of the station	Latitude	Longitude	Category of station	Type of Station	Parameters Monitored
1	Station Code-728, M.M.M. University of Technology, Gorakhpur	26°43'53.1"	83°25'57.5"	Residential	Manual	PM_{10}, SO_2, NO_2
2	Station Code-729, India Glycol LTD., GIDA, Gorakhpur	26°44'52.8"	83°13'28.1"	Industrial	Manual	PM_{10}, SO_2, NO_2
3	Station Code-730, Jal Kal Building, Golghar, Gorakhpur	26°45'2.2"	83°22'12.3"	Commercial	Manual	PM_{10}, SO_2, NO_2

Figure 4: Regional Office, Gorakhpur, UPPCB

The status of existing air quality monitoring stations along with the gaps in the monitoring network is provided in the table below.

Table 6: Status of existing air quality monitoring network

Category of station	Manual monitoring station			CAAQMS		
	Minimum no. of stations required	Existing no. of stations	Gap	Minimum no. of stations required	Existing no. of station	Gap
Background	1	0	1	0	0	0
Residential	1	1	0	1	0	1
Commercial	1	1	0	1	0	1
Traffic dominant	0	0	0	1	0	1
Industrial	0	1	0	0	0	0
Total	**3**	**3**	**1**	**3**	**0**	**3**

The state further plans to expand the monitoring network as per the CPCB guidelines based on the city's population so that it can contribute to developing a robust nationwide ambient air quality monitoring network.

At present, the process for procurement of one CAAQMS is underway and 1 CAAQMS will be procured and installed by February 2021. Up-gradation of existing 03 manual monitoring stations as per the directions of Hon'ble NGT is also being initiated and at the first stage monitoring for PM 2.5 shall be started at the earliest. The funding arrangements for the installation of 02 CAAQMSs and 01 Background Monitoring Station are also being explored and it will be initiated soon.

Figure 5: Manual Air Quality Monitoring Station at Jalkal Building (left), (b) GIDA (right), in Gorakhpur city

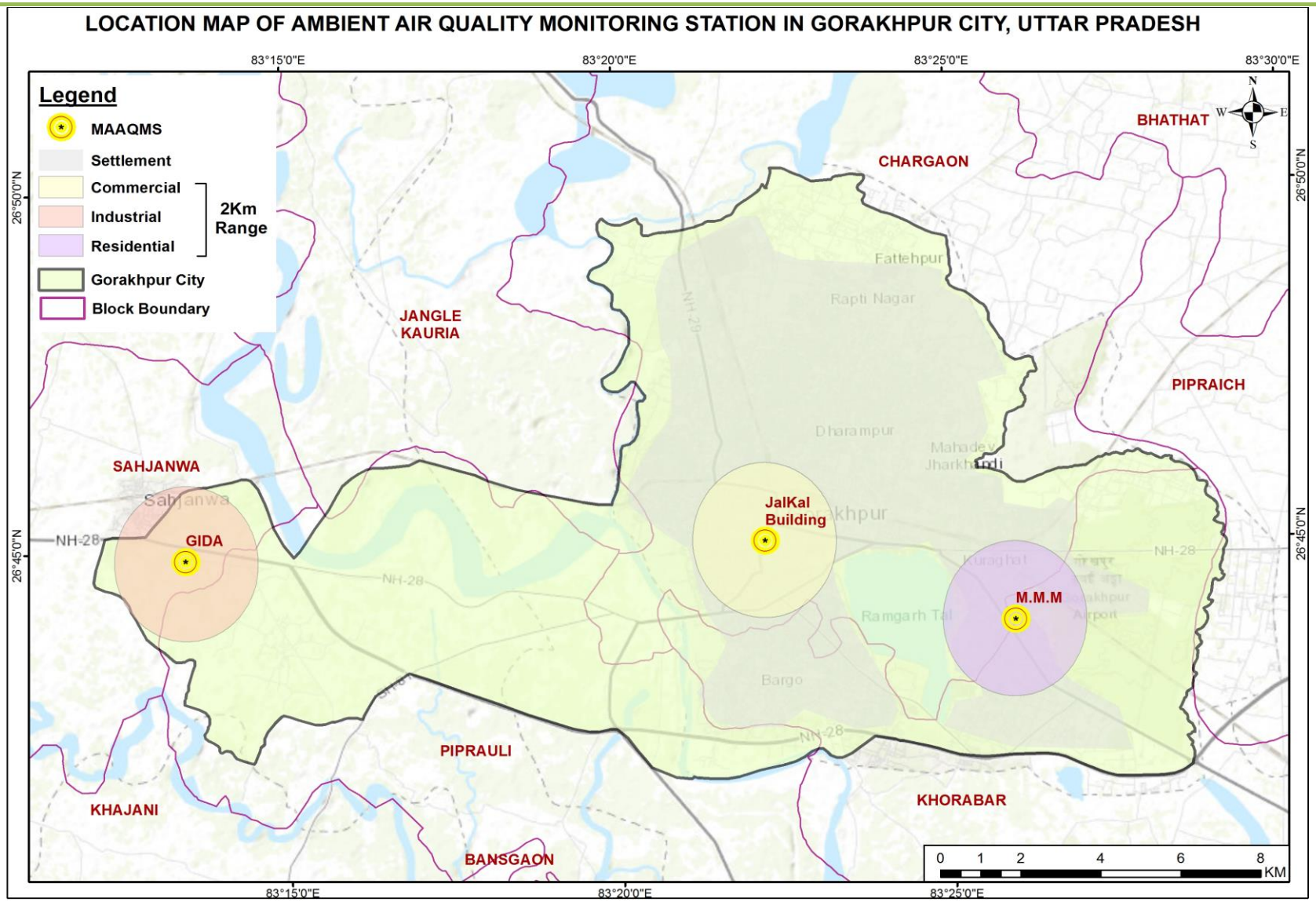


Figure 6: Location Map of AAQMS

B. Source Apportionment & Carrying Capacity Studies

It is necessary to understand the contribution of different sources of pollution to the ambient air quality for the planning of source-specific focused interventions for meeting the targets of improvement in the air quality in a time-bound manner. The Comprehensive Source Apportionment Study (CSAS) for Gorakhpur City is not available which is identified as a gap in the database augmentation.

The comprehensive source apportionment & carrying capacity studies will be conducted in due course of time through organizations of repute having ample experience in carrying out such studies and the action points will be prioritized and reviewed on the apportionment of various sources in the City.

However, to start with, UPPCB has made emission estimation from various sources with an objective of initiation of the implementation of the Action Plan based on the secondary data available.

C. Gaps in data related to Monitoring of Air Pollution Sources

Governments, multilateral organizations, and the private sector are increasingly motivated to take action as a result of a growing understanding of the negative health and environmental impacts associated with high levels of air pollution. Unfortunately, there is a critical lack of air quality data in most Non-Attainment Cities (NACs). The implementing agencies can take action without making substantial investments in air measurement systems. However, any robust air quality management system should include a measurement component to address city-specific air pollution reduction objectives and document trends over time. A quality data of the monitoring of various pollution sources with well-defined periodicity is a must for preparation of an Action Plan and also to monitor the impact of various actions for improvement of air quality in the city. This is also very important for decision-makers at various stages in the air quality management process.

A successful, sustainable monitoring strategy requires equipment and critical human and institutional systems to sustain equipment and ensure that data quality remains high and that any data collected can be analyzed and communicated to decision-makers in support of desired objectives.

Ambient air quality monitoring is being done by UPPCB through manual monitoring stations operated by outsourced Technical Institutions. Presently, the regional office of Gorakhpur is not having state of art air quality analysis lab, and also the equipment which is needed for air quality monitoring of point and line sources are not available. The human resource and their capacity for data collection, analysis, and data interpretation are also not available. The stack monitoring of the industries is limited to the analysis reports of accredited labs made available by the industries which have issues of reliability of sample and their analysis also. This plan envisages the establishment of an Air Quality Monitoring Lab along with the staff & researchers for periodic monitoring of point and line sources of air pollution in the city along with data

analysis/interpretation. The issue of management of air pollution in developing countries and countries with economies in transition is hampered by a lack of expertise, technology, and adequate related information. Regarding developing countries and countries with transition-economy as India, technological and expertise limitations are considered as major hindrances in achieving our obligations under various international conventions and in meeting the national commitments concerning prevention, control, and abatement of pollution; and protection of the environment. Accordingly, technology transfer and information sharing are the way forward for any collaboration on the environment. Technology transfer does not just relate to equipment or 'hardware', but also total systems and their component, including know-how, goods and services, equipment, and organizational and managerial procedures. Accordingly, multilateral and bilateral cooperation on air pollution, including related demonstration/pilot projects, including a prototype development for the best available technologies and best environmental practices for pollution prevention, minimization, and mitigation strategies and for the control and abatement of pollution, specifically air pollution, are needed. The experience from around the world demonstrates that abatement of air pollution can only be done through a multipronged strategy involving interventions on various aspects at various levels including Institutional, Policy, and Technical.

Broadly the best practices can be divided into two categories: Those of overall air quality management and the others that target some specific source sectors. UPPCB has also adopted some of these best practices for the betterment of air quality.

One such practice that is being implemented across the state by UPPCB is the self-disclosure audit sheet by the infrastructure projects which are one of the main sources of dust generation.

In addition to this, the state has adopted a unique technique called Miyawaki's method for urban afforestation and increasing the overall green cover by planting native plant species in a very short period and thus mitigating the air pollution in long run.

UPPCB has already entered into a tripartite agreement with the Ministry of Environment Forests & Climate Change (MoEF&CC) and Indian Institute of Technology Kanpur for getting technical assistance on various aspects related to air quality management in 15 non-attainment cities identified under the National Clean Air Programme. The same agreement may be extended for the city of Gorakhpur as well. In addition to this, UPPCB intends to take a decentralized approach through which local research and educational institutions, which are well accustomed to the local conditions, can be engaged as knowledge partners.

This plan envisages International scientific and technical cooperation in the area of air pollution that will be established as per national priorities and socio-economic development strategies and goals. Modalities of such cooperation may include joint research and technology development, field studies, pilot-scale plants, and field

demonstration projects with the active involvement of local academia, local research institutions, and industries on either side.

IX. INSTITUTIONAL STRENGTHENING

To execute the city action plan in the best possible manner, it is necessary that institutional strengthening is done at the local level.

A. Public Awareness and Education

Awareness and education initiatives towards prevention, control, and mitigation of air pollution combined with specific information sharing on health advisories and dealing with air pollution exigency is an essential component, which provides communities with the knowledge and tools to take action and help improve their local air quality. Problem areas can easily be identified and monitored using citizen science methods, empowering communities, and reducing the risks of exposure to air pollution. Studies show that simple measures such as walking just a few yards away from the curbsides of a busy road could reduce exposure by 30%. Idling your car engine uses more fuel and is worse for your engine than restarting. The most important initial step is awareness. Engaging children at an early age is the best way to ensure we build a foundation to ensure clean air for future generations. With air quality now ingrained in public health frameworks and local authority jurisdiction, an ever-increasing number of industries are required to take action and all institutions have a responsibility to reduce their air quality footprint. The public can become more involved in reducing local air pollution impacts in their communities. Extensive awareness and outreach programs for various stakeholder groups need to be taken up for the non-attainment cities. Building public awareness will be vital in supporting the implementation of the City Action Plan. This will be achieved through national portals, media engagement, civil society involvement, curricula reform, and recognition/ awards, etc.

City-specific awareness programs targeting key stakeholders need to be formulated and taken up for implementation. This could include (1) Awareness generation in public for the prevention of adverse effects of air pollution. (2) Sensitization of the media for the right interpretation of international reports and data as well as for disseminating information on measures being taken by the government for the abatement of air pollution to be undertaken.

Information Education & Communication activities shall be undertaken for the dissemination of air pollution-related information for the awareness of the general public through various social media platforms of departments engaged in the city action plan (e.g., UPPCB, Gorakhpur Nagar Nigam, Gorakhpur Development Authority, etc.). It is also planned to engage educational institutions (schools, colleges, etc.) through workshops, seminars, competitions, etc.

Besides the above, UPPCB will take up Clean Air Hackathons with the objective of involving various stakeholders and students for crowdsourcing of ideas/technologies for control of air pollution. This kind of activity-based awareness program will not only generate awareness but also provide innovative ideas/concepts to mitigate air pollution. The Hackathons will be online and will provide sufficient time for the participants to develop ideas and find their application.

B. Training and Capacity Building

One of the major issues, which is a hurdle for effective implementation of air pollution management plans have been observed to be a lack of capacity on air quality issues due to limited manpower and infrastructure in the UPPCB and ULBs, lack of formal training for various associated stakeholders, a limited number of trained individuals in air quality management, limited publications designed to provide information on local air quality issues, limited collaboration between government, universities, and other research institutions, lack of a forum for sharing of published local research work on air quality, etc. One of the key issues in the implementation of an action plan is the lack of capacity of in-house capability and adequately trained manpower. If this is not set right, all other improvements in infrastructure and processes, etc. would not yield expected results. Key areas to focus on are:

a) ULB – waste management, plantation schemes, maintenance of roads, dust suppression measure, development of green infrastructure, etc.

b) UPPCB – Internal training on the handling of machinery and equipment for sampling and analysis

c) Industries – best practices for boiler and furnace operation, retrofitting of DG sets, up-gradation of machinery with cleaner technologies, usage of clean fuel

d) Construction projects: control measure for fugitive dust, segregation, handling, and disposal of C&D waste.

An orientation workshop was carried out by UPPCB in collaboration with its knowledge network partner, IIT Kanpur, with an objective of mutual sharing of the best practices and relevant knowledge with the other states in the country and also with the International Organizations namely UNEP, World Bank and Global NGOs under National Clean Air Programme on 14-15 Oct 2019. Besides this, UPPCB has also organized the training and capacity building workshops of the officers of the implementation departments/agencies for implementation of GRAP and various measures for control of air pollution.

Through this action plan, it is envisaged that extensive capacity-building programs for manpower and infrastructure augmentation in the UPPCB & other line departments/agencies will be formulated and intensive training, comprising national and international best practices and technological options, of all the associated stakeholders will be organized in the plan period. It is also envisaged that online

training modules on the subjects of Solid Waste Management, Plastic Waste Management, C & D Waste Management and Operation and maintenance of Air Pollution Control Systems installed in industries and other sources shall be carried out to improve the overall capacity of the human resource for enhancement of Clean Air Actions in the City.

UPPCB intends to introduce the "**Paryavaran Prahari**" program under the principles of green skill development in which individuals will be trained for disseminating the role of a common citizen for control of pollution and implementation of the action plan. The individuals may also be trained for augmenting their participation/services for monitoring of pollution sources where they may act as skilled personnel. The various aspects on which training shall be provided include sampling and analysis, operation of machinery and equipment related to air quality management and monitoring, etc. All such trained individuals will form a panel through which the trained personnel may be engaged by the concerned department on a pro-rata basis from time to time as per requirement and type of skills.

C. Setting Up City level Knowledge/Monitoring Centre

An Air quality monitoring system will be established in the regional office of UPPCB which will be part of the Environment Pollution Control Centre. The scope of this center will be more inclusive and it will also act as a knowledge Centre. The Air information/monitoring Centre shall comprise of members from UPPCB regional office, Gorakhpur Nagar Nigam, local technical institutions, and other non-profitable organization. Madan Mohan Malviya University of Technology (MMMTU), Gorakhpur, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur, and Gorakhpur Environment Action group (GEAG) shall be considered and their capacities shall also be utilized for handholding the technical studies related to various pre and mid-term & post plan impact assessment in terms of air quality for assessment of the efficacy of actions.

D. Monitoring Mechanism

The State has formulated a comprehensive monitoring mechanism with a well-defined monitoring protocol. The Monitoring mechanism developed by the State is a three-tier mechanism in which regular monitoring shall be done at the District and the State level. The monitoring at State is being undertaken at the level of dedicated Air Quality Monitoring Committee (AQMC) under the Chairmanship of Principal Secretary, Environment, Forest & Climate Change and subsequently by the Chief Secretary, Government of Uttar Pradesh. The structure of Monitoring is as detailed below: -

a) *At State Level:*

The State has developed a monitoring mechanism taking into consideration the requirement of statutes and Action Plans. The detail of AQMC constituted by the State of Uttar Pradesh is as follows:

Table 7: Air Quality Monitoring Committee

S.No.	Name of Committee	Chairperson	Work area
1.	Air Quality Monitoring Committee	Additional Chief Secretary/ Principal Secretary Environment, Forest & Climate Change	Effective Air Pollution Control in the State and maintenance of Ambient Air Quality

b) *District and Commissioner Level-*

A District Level Committee under the Chairmanship of respective District Magistrates has been constituted by O.M. No. 13/2019/NGT-257/55-Parya-2-2019-44(Writ)/2016 dated 14-06-2019 for monthly monitoring of all the Environmental issues and compliance of Environmental Laws including implementation of GRAP and City Action Plan. The District Level Committee has 28 Officers of all the concerned District Level Departments. District Forest Officer is the convener of the Committee.

c) *The monitoring protocol shall be as below-*

The State has developed a dedicated-UP Environment Compliance Portal www.upecp.in for monitoring of various issues related to environmental compliances. The purpose of the portal is to have mechanisms for focused dialogue and facilitate smooth coordination on issues related to air pollution. The access to the portal is given to Chief Secretary, State Level Monitoring Committees, and the District Level Committee. Portal has been provided with a dedicated Template for Online Filing of the Compliance Status to be reviewed at State Level by the State Level Committees. The issues requiring State Level intervention shall be flagged before the Chief Secretary, Uttar Pradesh.

d) *Schedule of Monitoring:*

The monitoring is to be done as per the following schedule-

Table 8: Schedule of Monitoring

Level of Monitoring	Schedule of Monitoring
District Level Committee under District Magistrates	1st week of every month
District Level Committee under Commissioner	2nd week of every month
State Level Committees	3rd week of every month
Chief Secretary Level	4th week of every month

In addition to the above, the District Environment Committee of Gorakhpur shall be monitoring all the updates regarding the city action plan as a part of the State 3-tier monitoring system.

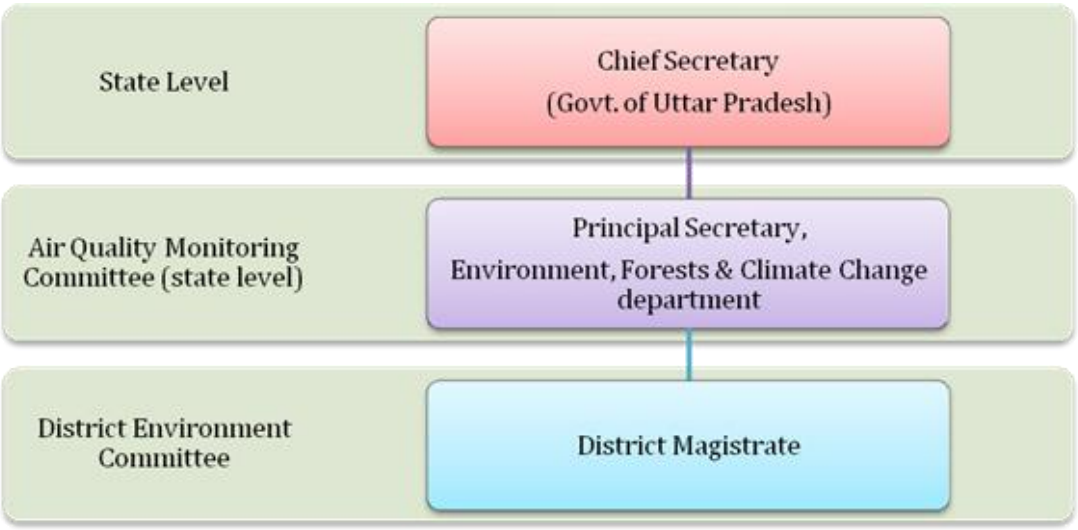


Figure 7: 3-tier monitoring system

X. STATUS GAPS AND STRATEGIES OF AIR POLLUTION MITIGATION MEASURES FOR VARIOUS SOURCES

A. Gorakhpur City Emission Inventory

An emission inventory is the reckoning of all air pollution emissions and associated data from sources within a specified geographical area and over a specific interval of time. The development of the EI database is very crucial for air quality management. It helps in planning air quality goals and tracking the progress of control initiatives towards pollution mitigation. Besides, the result from EIs can be used to study other sectors related to human health, economic loss from air pollution, etc.

a) *Emission Estimation and Factors*

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the mass of pollutant per unit mass of raw material, volume, distance traveled, or duration of the activity (e.g., grams of particulate emitted per kilogram of coal burnt). Such factors facilitate the estimation of emissions from various sources of air pollution. In most cases, these factors are simply averaging of all available data of acceptable quality and are generally assumed to be representative of long-term averages for all facilities in the source category.

The general equation for emissions estimation is:

$$E = A*EF*(1-ER/100) \quad (1)$$

where:

E = Emissions rate;

A = Activity rate;

EF = Emission factor, and

ER = Overall emission reduction efficiency, %

This emission inventory is based on available indicative data which faces a lot of data gaps. This is a first-time emission inventory is developed for Gorakhpur. It is prepared in-house at UPPCB according to the bottom-up approach with aim of starting planned efforts for control of air pollution and is subjected to further improvement with aid of reputed institutes. In constructing this emission inventory total fuel use, total population, total activity data, etc. are used as indicators of emission. In the action plan period, a comprehensive source apportionment study and dispersion modeling will be done.

The figure below depicts the various sources identified for calculating the emission load, which are primarily classified into a point, area, and line sources.

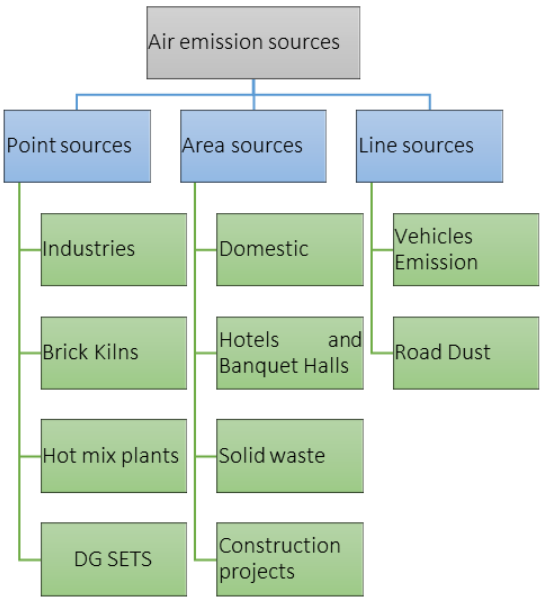


Figure 8: Emission Sources in Gorakhpur

Emission load of the based on the secondary data available and information available with UPPCB. The detail of the emission load for all the sources has been cumulated and is discussed as follows: -

B. Cumulative *Emission Inventory*

The overall baseline emission inventory for all the sources is presented in **Table-9** and Figure-9. The pollutant wise contribution is shown in **Figures-10, 11, 12, and 13.**

Table 9: Cumulative Inventory of Gorakhpur city

S.No.	Source	Emission PM10 (kg/day)	Emission PM2.5 (kg/day)	Emission SO2 (kg/day)	Emission NOx (kg/day)	Emission CO (kg/day)
1	Brick Kilns	2757.71	303.84	2965.15	2559.57	237.48
2	Industry	3984.11	2390.46	5955.49	5142.13	42975.66
3	Construction	26585.87	10634.35	0.00	0.00	0.00
4	DG Sets	71.86	64.68	70.10	1062.93	229.53
5	Domestic	1507.21	1083.90	175.61	489.22	8878.12
6	Hotels (Cooking)	7.18	3.80	4.65	28.64	155.05
7	Banquet Hall (Cooking)	2.27	1.46	1.19	1.06	2.84
8	Hot-Mix plants	1184.00	1065.60	32.56	44.40	148.00
9	MSW	42.10	16.84	2.63	157.89	221.04
10	Vehicular Exhaust	164.45	148.01	0.44	1889.61	3722.89
11	Road Dust	33070.00	8490.00	0.00	0.00	0.00
Total Emission (kg/day)		**69376.77**	**24202.94**	**9207.82**	**11375.44**	**56570.61**
Total Emission (tonne/day)		**69.38**	**24.20**	**9.21**	**11.38**	**56.57**

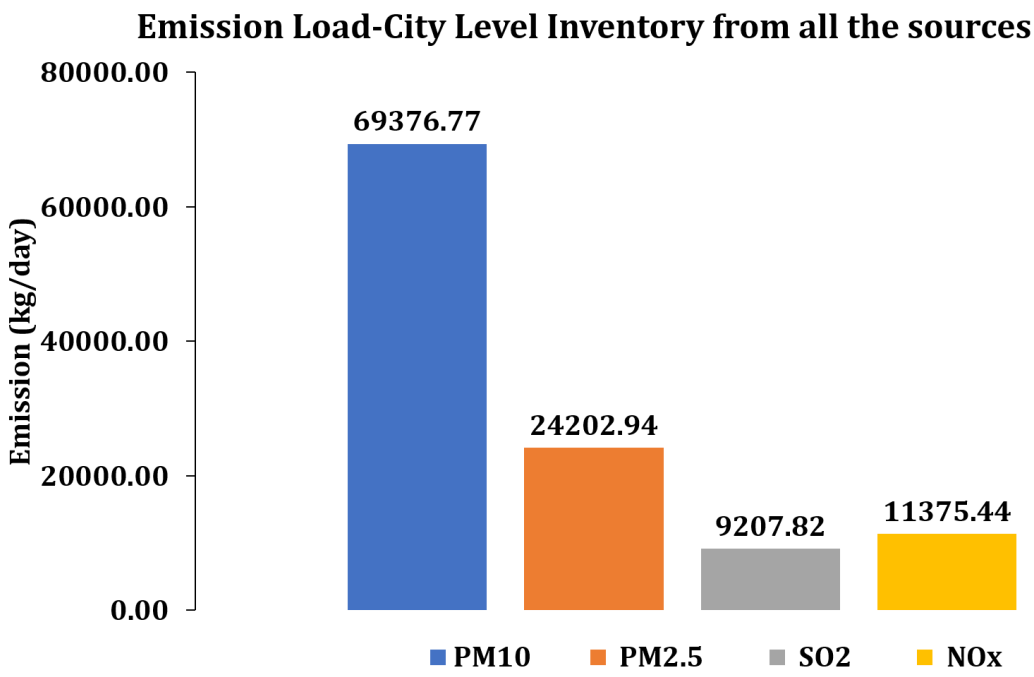


Figure 9: Cumulative emission load for Gorakhpur

The total emission load for PM_{10} is estimated to be 69376.77 kg/day. The top contributors to PM_{10} emissions are Road Dust (48%), Construction (38%), Industries (6%), Brick Kiln (4%) and hot mix plant (2%) based on annual emissions. Seasonal and daily emissions could be highly variable. The estimated emission suggests that road dust contributes majorly in particulate matter emission in ambient air of Gorakhpur city. $PM_{2.5}$ emission load in the city is estimated to be 24202.94 kg/day. The top contributors to $PM_{2.5}$ emissions are Construction and Road Dust with 44% and 35% share respectively, of each in total PM2.5 emission. Industry (10%) is second major contributor. Seasonal and daily emissions could be highly variable. SO2 emission load is estimated to be 9207.82 kg/day. Industry accounts for 77% percent of the total emission. Brick Kilns contributes to 21%. NOx emissions load is estimated to be 11375.44 kg/day. Nearly 54% of emissions are attributed to Industries followed by Brick Kilns (26%). NOx apart from being a pollutant itself is an important component in the formation of secondary particles (nitrates) and ozone.

Estimated Carbon Monoxide (CO) emission is about 56570.61 kg/day. Nearly 76% emission of CO is from Industrial sector, followed by Domestic cooking emission (15.7%). The high emission load of CO is due to the large use of petroleum product and biomass-based fuel. Incomplete combustion is also a cause for high CO emission.

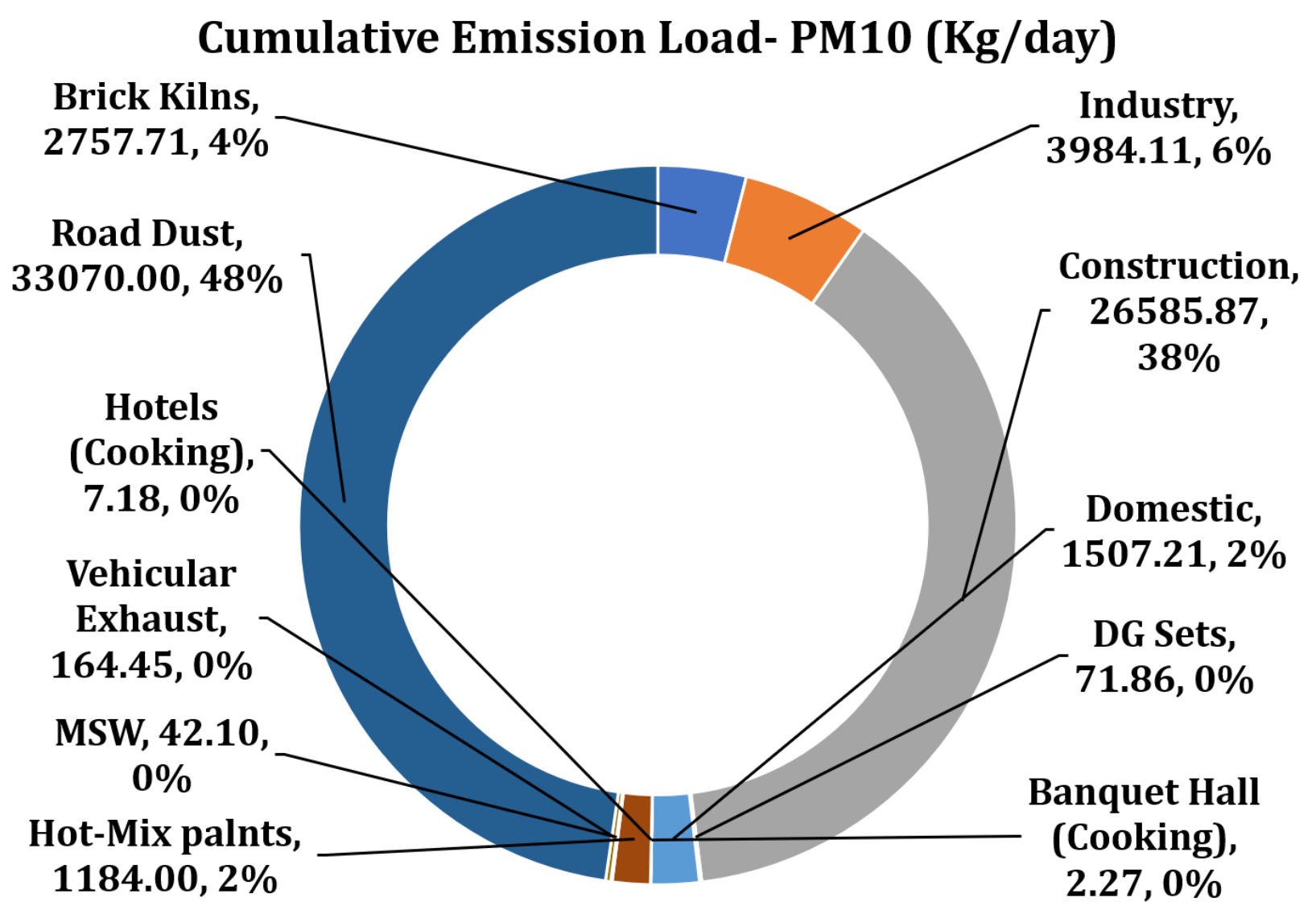


Figure 10: PM_{10} Emission Load of Different Sources in Gorakhpur

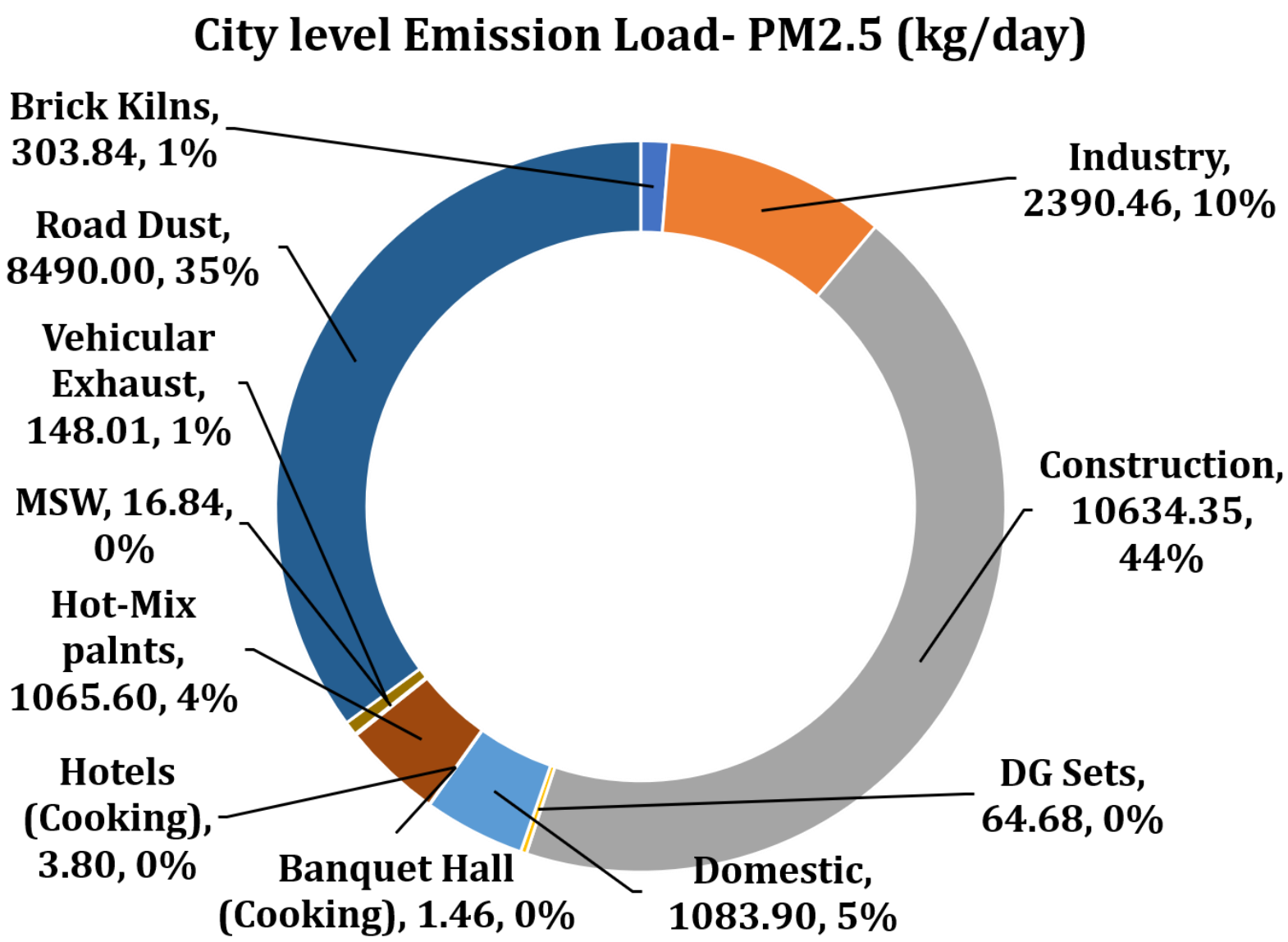


Figure 11: $PM_{2.5}$ Emission Load of Different Sources in Gorakhpur

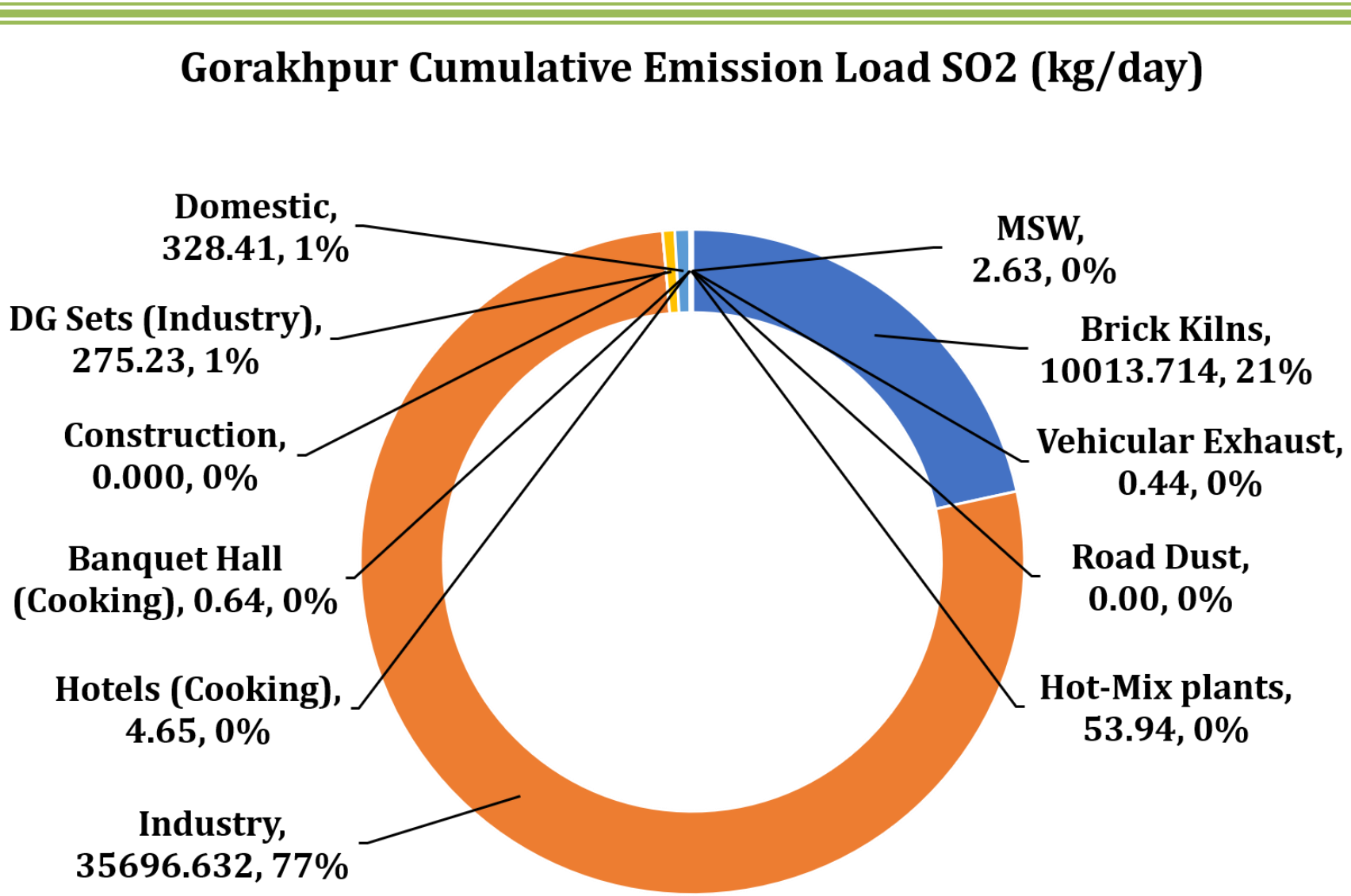


Figure 12: SO_2 Emission Load of Different Sources in Gorakhpur

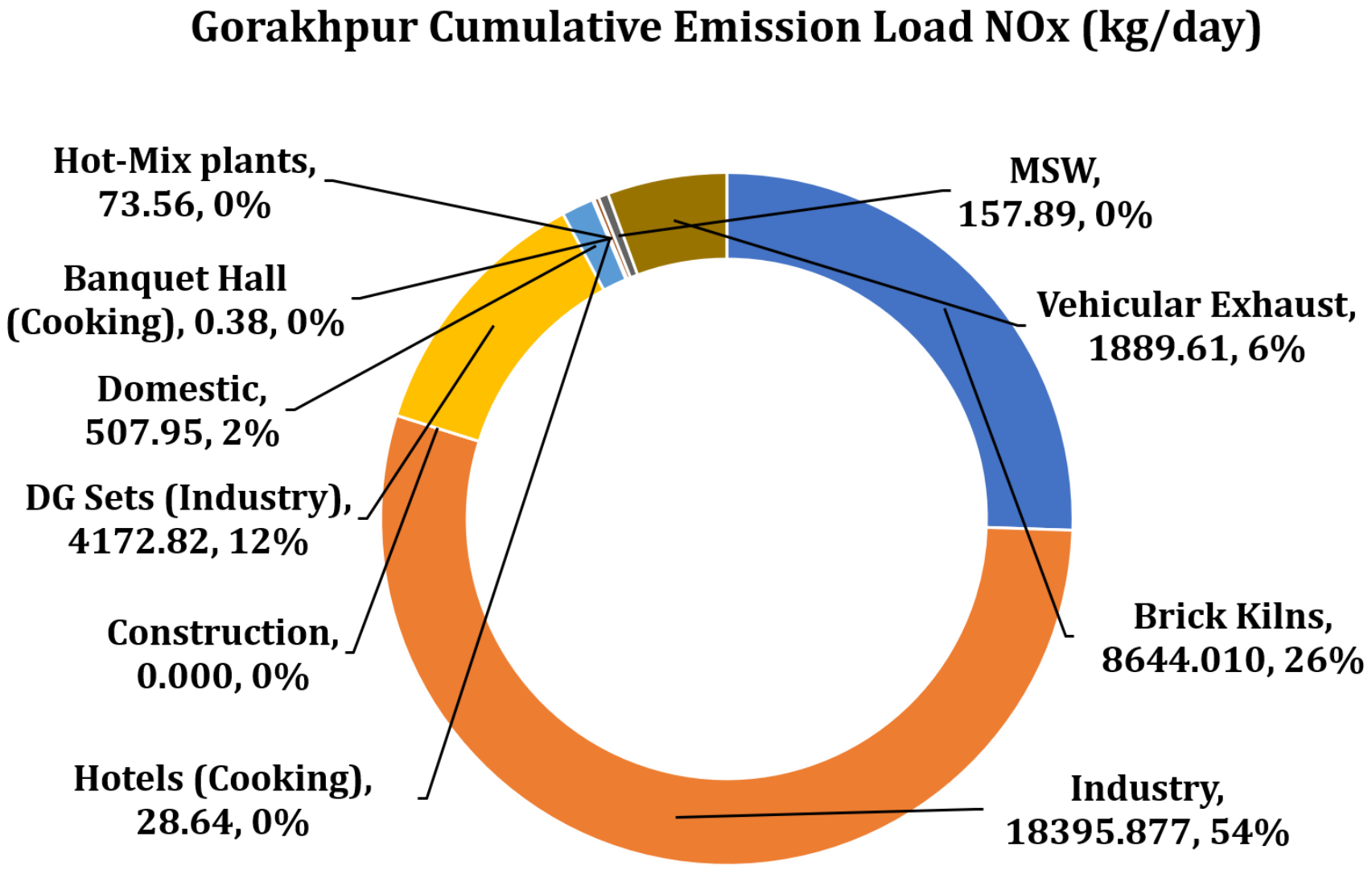


Figure 13: NOx Emission Load of Different Sources in Gorakhpur

C. Industrial Pollution

Industries are a major stationary source of air pollution emitting PM_{10}.

a) *Industrial profile of Gorakhpur*

Air pollution due to anthropogenic sources is a matter of concern in the whole world. The urban areas may be viewed as dense sources of enormous anthropogenic emissions of pollutants which can alter the atmospheric composition, chemistry, and life cycles in its downwind regimes, extending over several hundred kilometers. Moreover, a worldwide epidemiological study on the effect of air pollution has revealed that gaseous pollutants and particulate matter have enough potential to cause severe health effects like respiratory, cardiovascular diseases, and cardiopulmonary mortality. The modernization and Industrialization of developing countries have led to the increased use of fossil fuels and their derivatives.

A city that has stood in all its cultural glory over time, Gorakhpur has a variety of industries that provide the livelihood of its residents. Its industries have been growing as well as evolving, and much of the city's cultural relevance can be seen in the types of industries that define this city.

Types of Industries in Gorakhpur can be largely split up into Food products, Cotton textiles, Beverages, Tobacco and Tobacco products, Wool, silk and synthetic fiber textiles, Terracotta products, Jute, hemp and mesta textiles, Hosiery and garments, Leather products, Wood products, Paper Products, and printing, Chemical and chemical products, Transport equipment and parts, Rubber and plastic products, Metal products, Non-metallic mineral products, Basic metal industries, Machinery, and parts, excepts electrical, Electrical machinery and apparatus, Repairing and servicing industries, etc. Gorakhpur has many small-scale industries such as wheat flour, oils, biscuits, flour, dal, tobacco, furniture, soap, bricks, metalware, and sports goods. Since 1956, the production of goods and further investment in small scale industries in this region has gone up. Most of the small-scale industries are agriculture-based or chemical-based, further on diversifying into other manufacturing units. There are very few medium and large-scale industries in the City.

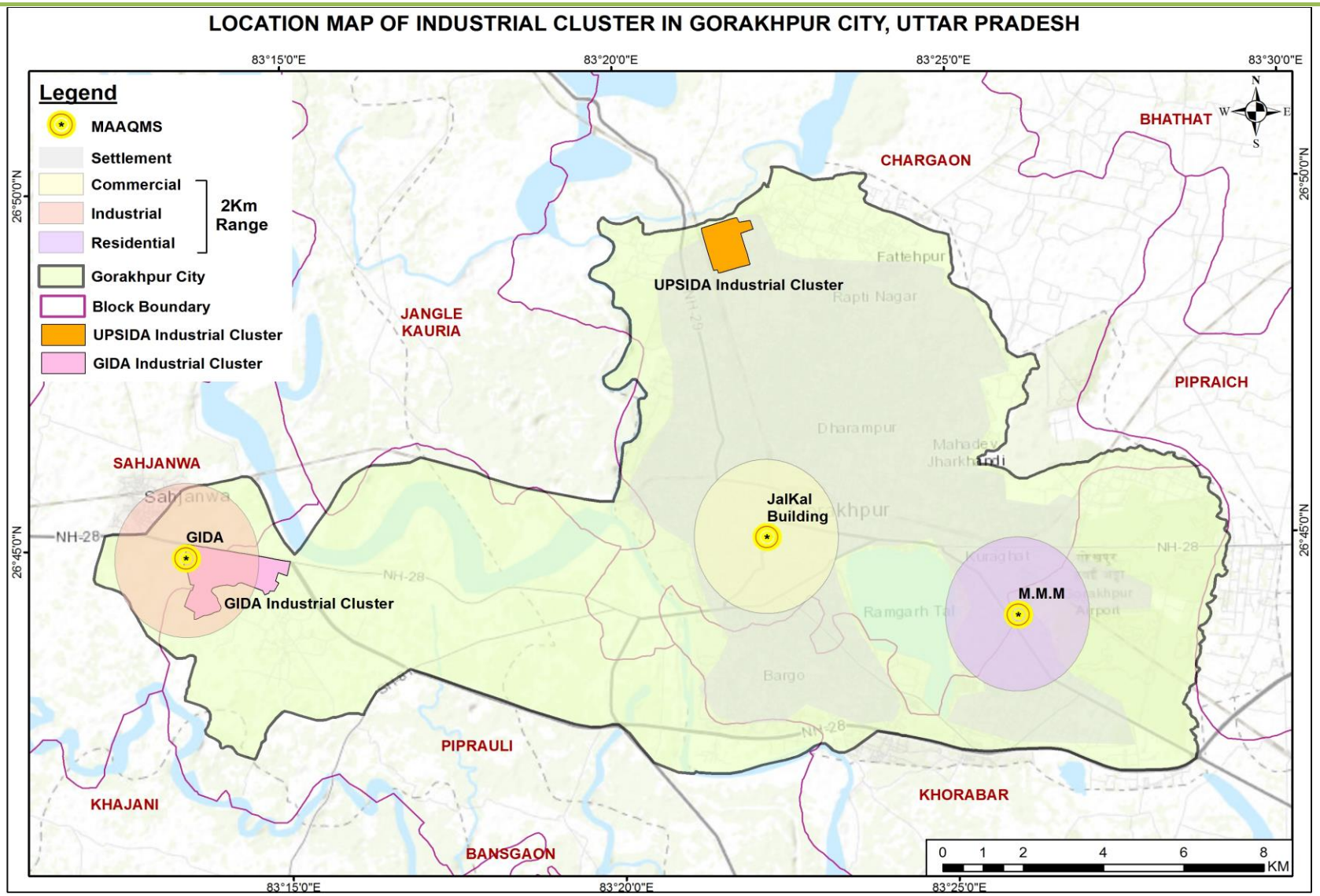


Figure 14: ***Industrial Cluster of Gorakhpur city***

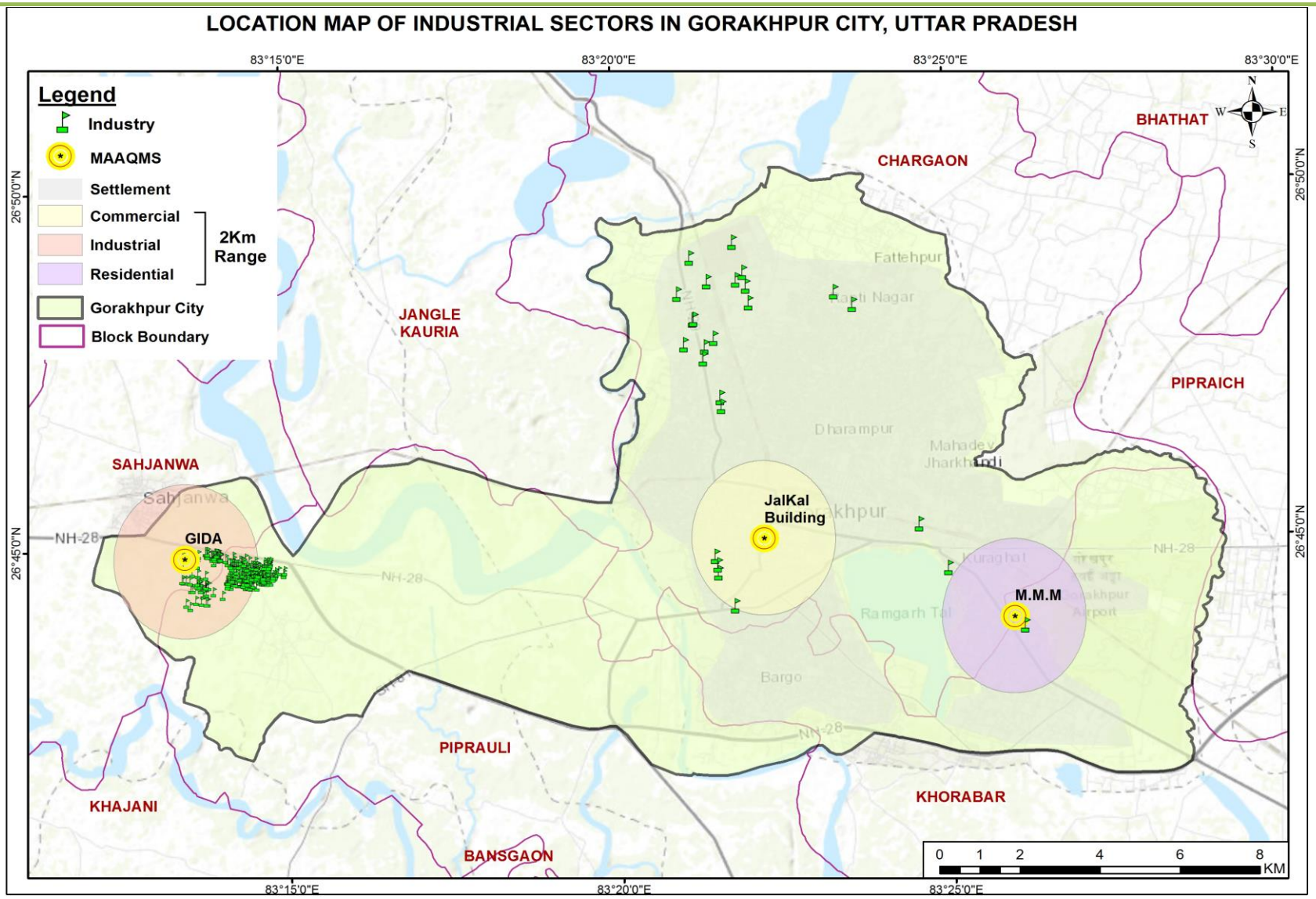


Figure 15: GIS Industrial profile of Gorakhpur

b) Industrial sectors in Gorakhpur

Gorakhpur is a hub for a variety of industries. All these industries in Gorakhpur have been classified into sectors details of which are tabulated below and their percent contribution is depicted in the pie-chart:

Table 10: Categorization of industries

S.No	Industrial sector	Number of Industries
1.	Chemical	8
2.	Aluminum	7
3.	Fertilizer	3
4.	Plastic	51
5.	Paper	18
6.	Wood	9
7.	Iron Steel	8
8.	Food Processing	44
9.	Others	104
	Total	**252**

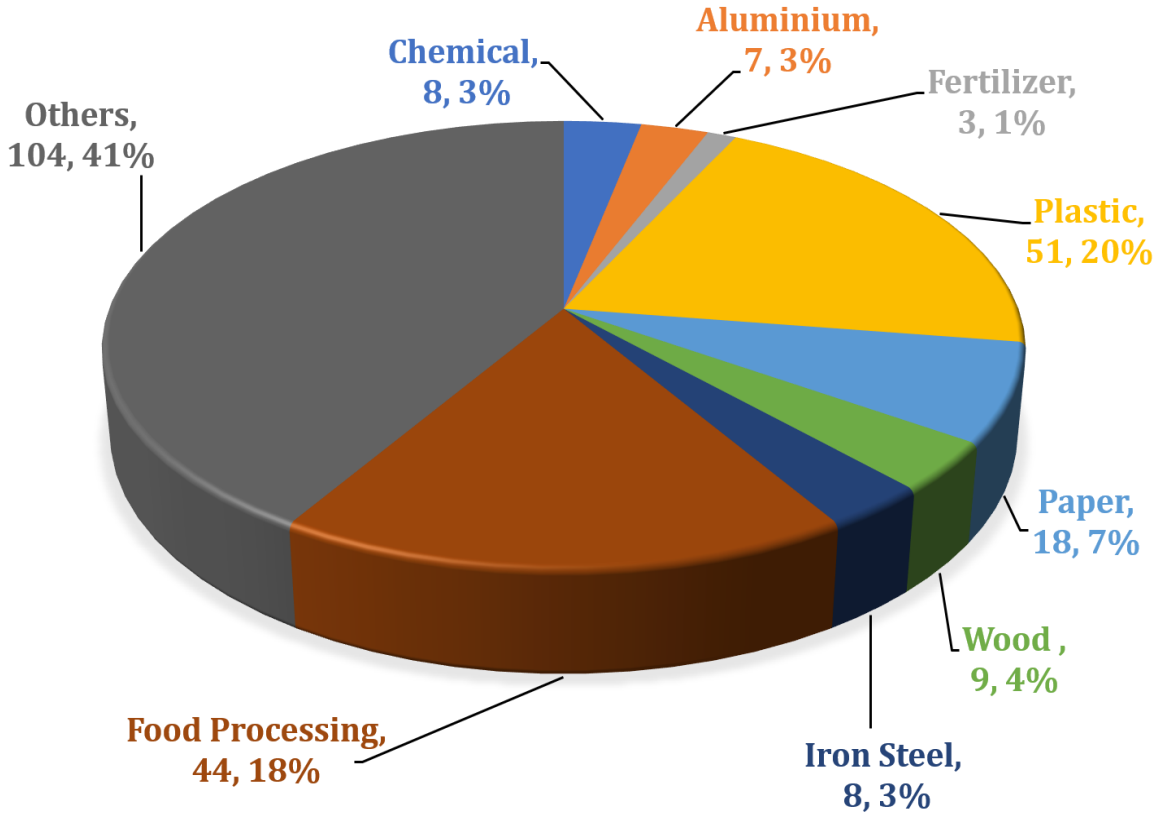


Figure 16: Sectoral classification of industries in Gorakhpur

Figure 17: Boiler at M/s Gallants Ispat Pvt. Ltd., AL-5, Sector-23, GIDA, Gorakhpur

Figure 18: Electrostatic precipitator (ESP-APCS) control panel in M/s India Glycols Ltd., E-1, Sector-13, GIDA, Gorakhpur

c) Fuel usage in the sectors

i. *Number and range of capacity of combustion equipment installed in the industries*

Table 11: Number and range of capacity of combustion equipment installed

Sno	Capacity range	No.
A	**Boiler**	**30**
	<10 TPH	24
	10 to 100 TPH	5
	>100 TPH	1
B	**Thermo pack**	**7**
	Up to 10 lakh kcal/h	2
	10-20 lakh kcal/h	5
C	**Furnace (Oil furnace, Pit furnace, etc.)**	**19**

ii. *Fuel usage in Gorakhpur industries*

Diesel, used oil and Rice husk is the prominent fuel being used in the industrial processes. Types of fuel used by the various combustion equipment, as per their capacity is given as follows:

Table 12: Percentage of type of fuel source used in Combustion equipment

S.No.	Fuel Type	Consumption (kg/day)	% Consumption
1.	Rice Husk	616800	46.88
2.	Processed Biomass	49050	3.73
3.	Coal	159800	12.15
4.	Diesel	1940	0.15
5.	Slop	455000	34.58
6.	LPG	700	0.05
7.	Wood	32000	2.43

**Source- UPPCB – Regional Office, Gorakhpur*

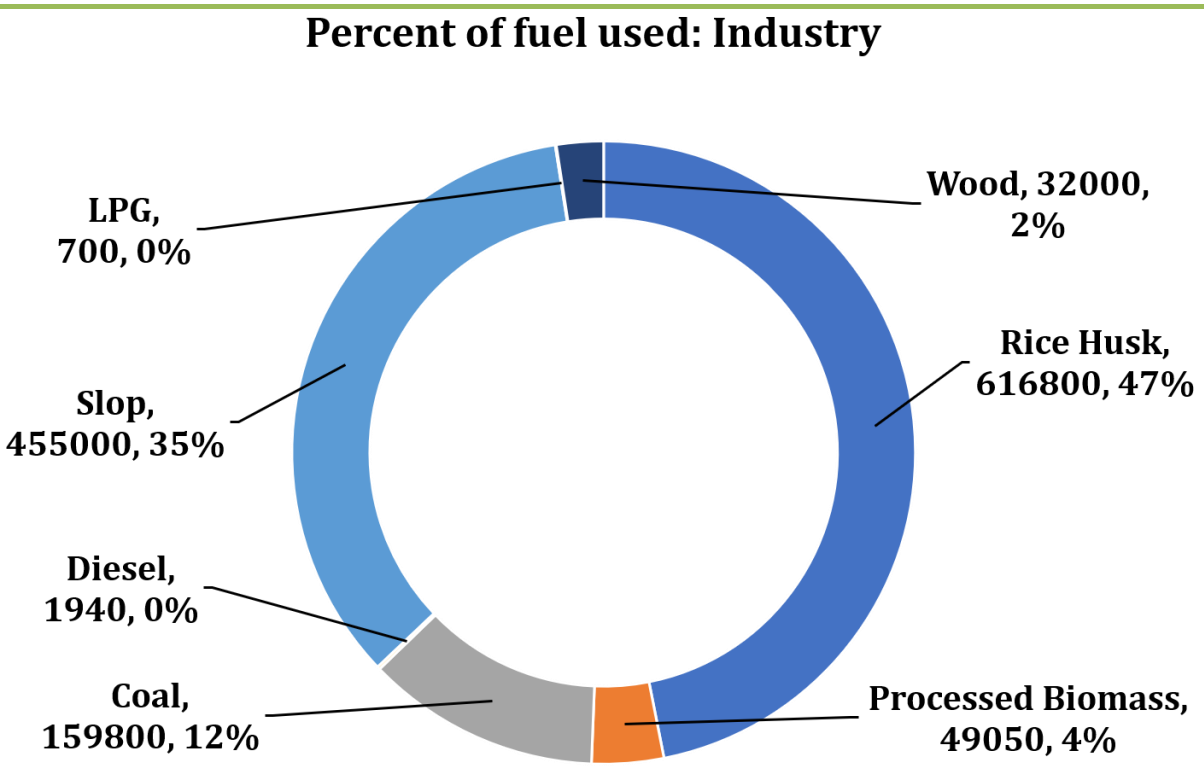


Figure 19: Fuel Type Industry

d) *Emission Estimation from industries in Gorakhpur*

The information on the number of industrial facilities and their activity data were collected from UPPCB-Regional office, Gorakhpur. There are approximately 49 industries throughout the Gorakhpur district that are air polluting in nature and require consent to operate from the state pollution control board to run the industry, have been considered for the study. The emissions of various pollutants such as SO_2, NOx, PM_{10}, $PM_{2.5}$, and CO were estimated from the activity data from each fuel type and then were summed. The emission factors given by CPCB (2011) were used to calculate the emission load given as follows in **Table-13,** and is represented graphically in **Figure-20**:

Table 13: Percentage of type of fuel source used in Combustion equipment

Boiler/Furnace Type	Fuel used in Boiler/Furnace	No of Furnaces/ Boilers	Fuel Quantity (kg/day)	PM10 (kg/day)	PM2.5 (kg/day)	SO2 kg/day)	NOx (kg/day)
Baby Boiler	Wood, Processed Biomass and Diesel	4	714	10.44	6.27	0.38	0.88
Boiler	Coal, Wood, Diesel, Rice husk, Processed Biomass	26	1139264	3073.53	1844.12	5387.3	4461.67
Furnaces/Oven	Coal, Wood, Diesel, LPG, Slop	19	57302	187.22	112.33	539.58	613.35
Heaters	Coal, Diesel, Rice husk, Processed Biomass,	8	118385	712.92	427.75	28.22	66.23

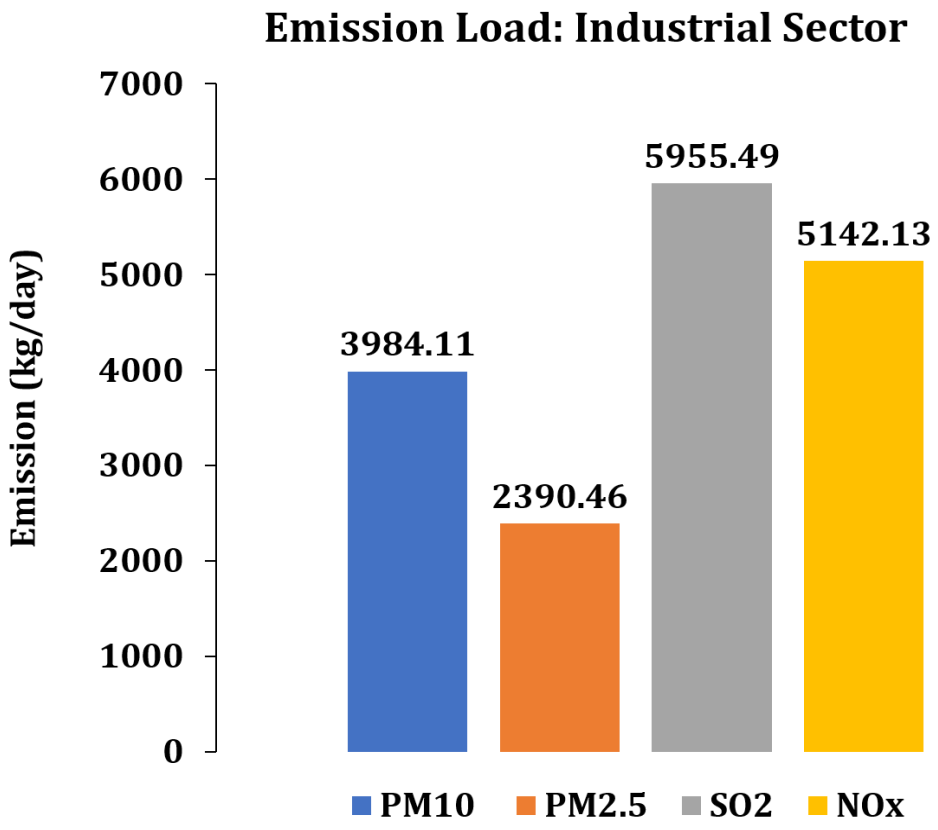


Figure 20: Emission Load for Industries

i. *Observations*

From the above estimation, the order of pollutant emission from industries in Gorakhpur is found as follows: **SO_2>NOx> PM_{10}> $PM_{2.5}$.** The emission load for SO_2 and NOx is observed to be the highest. It is inferred that high emission is due to heavy usage of low-quality coal, rice husk and slop usage. Higher pollutant emission is result of inept or no air pollution control devices. Improper management of rice husk ash also annex the particulate emission. Emission loads from different sources for various pollutants are as follows: -

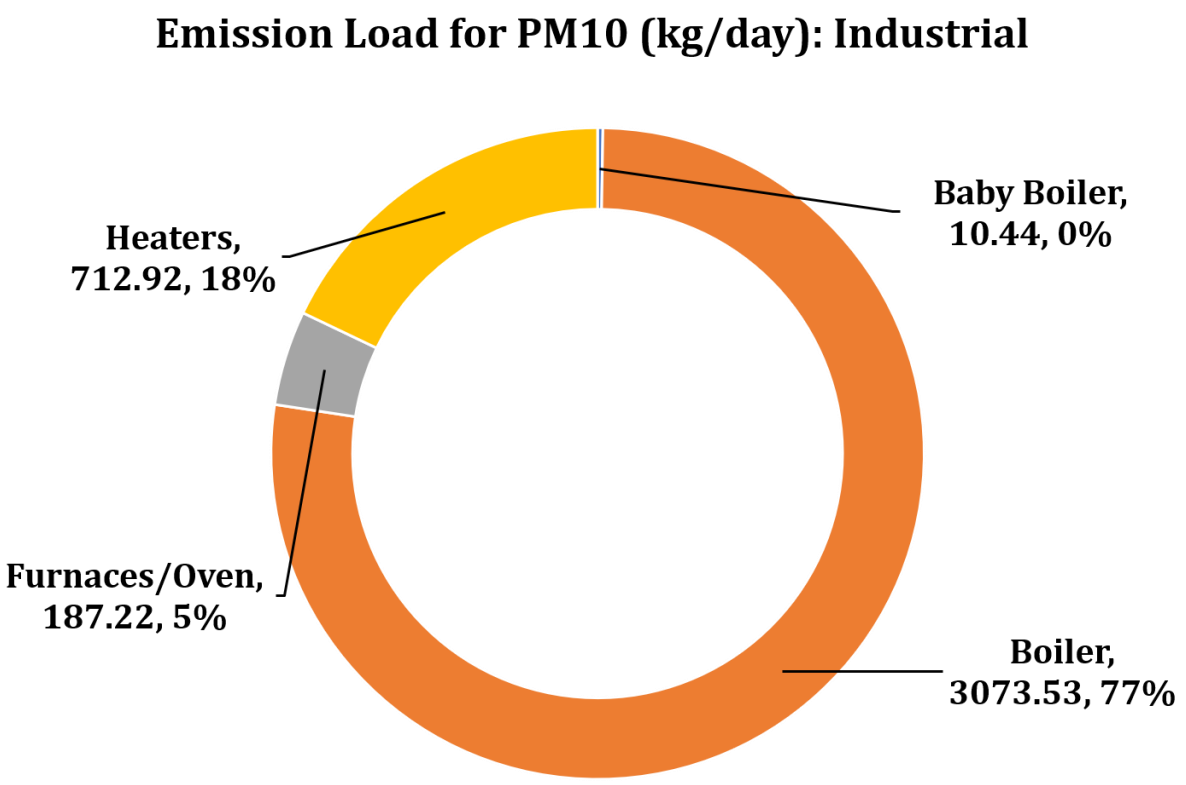


Figure 21: PM10 Emission from Industries

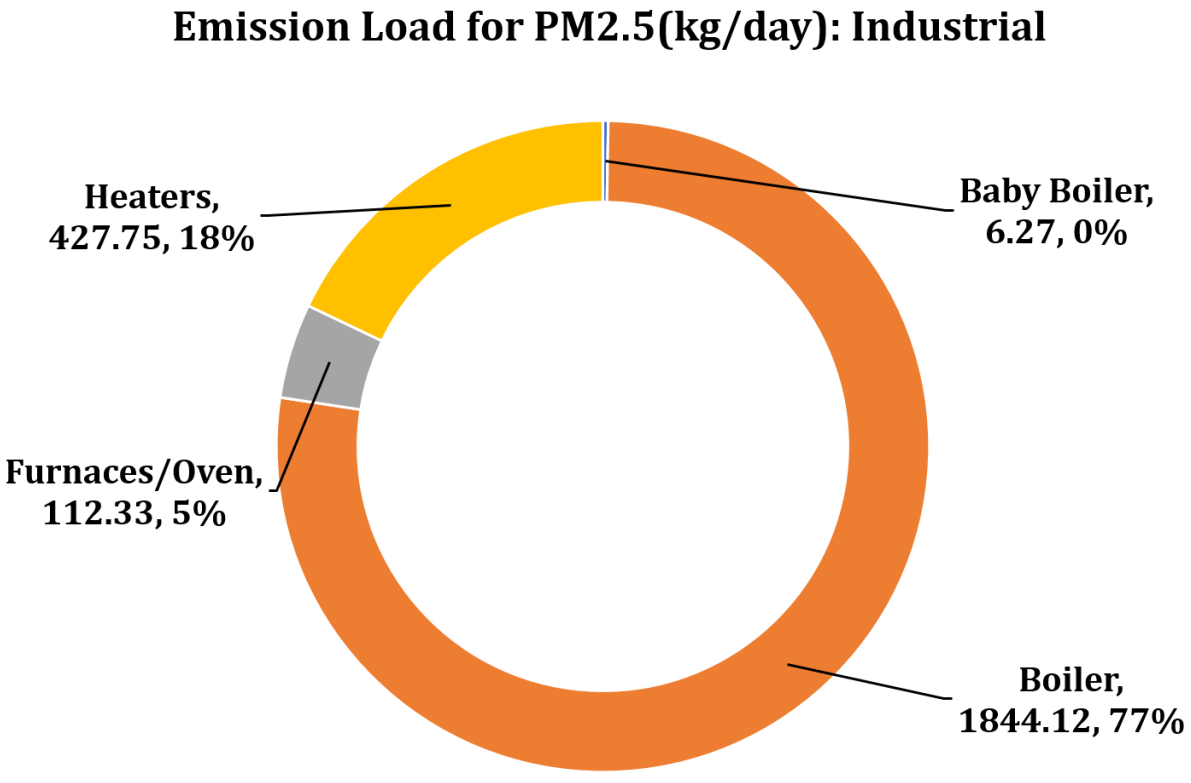


Figure 22: PM2.5 Emission from Industries

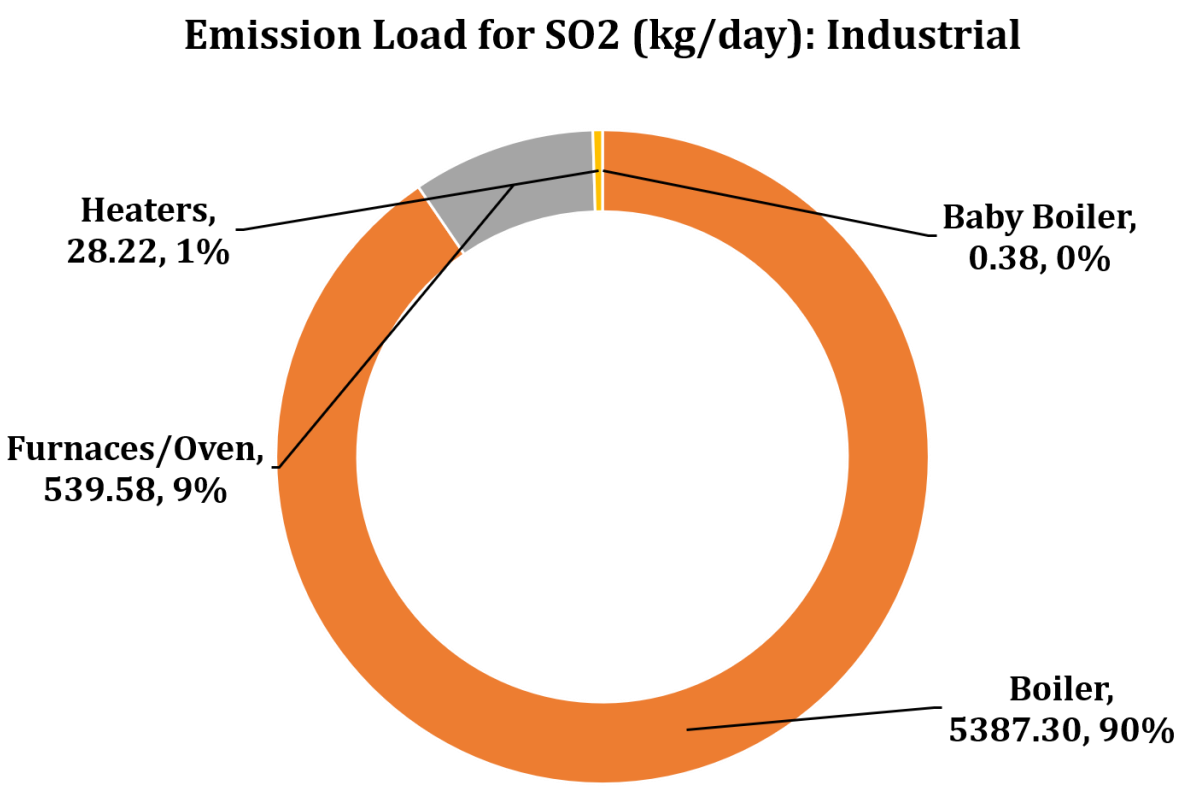


Figure 23: SO2 Emission from Industries

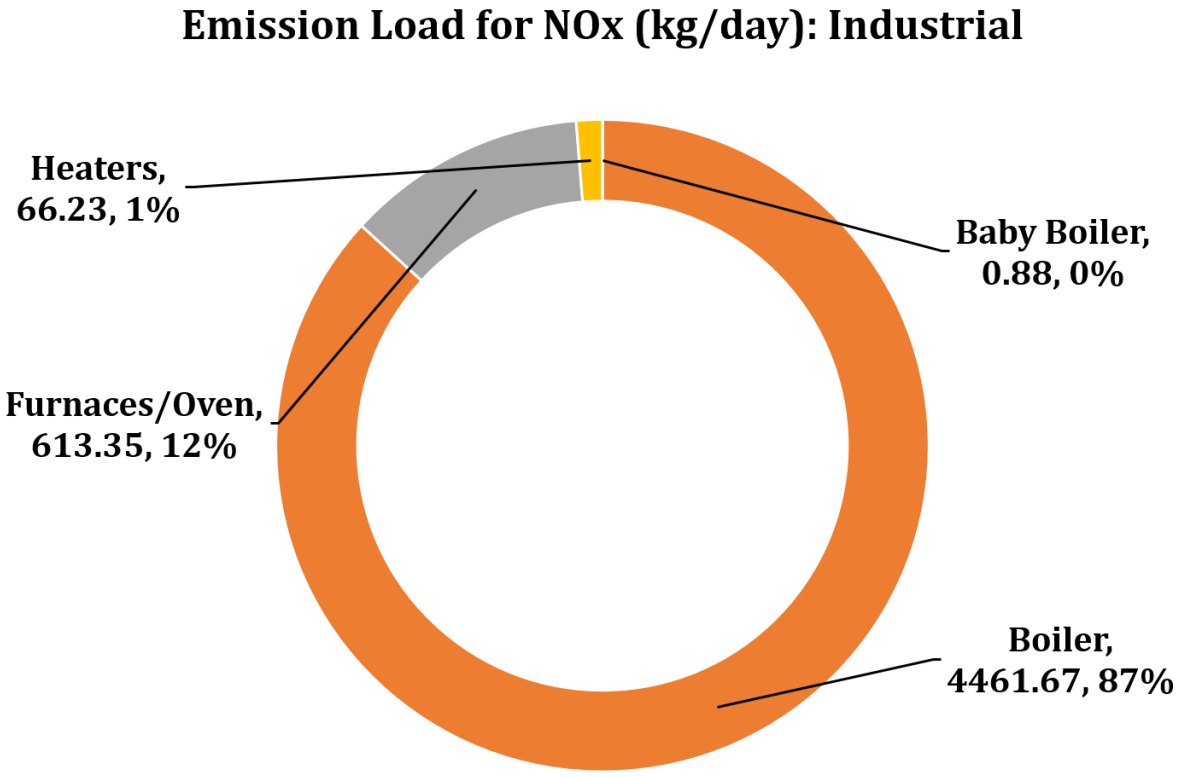


Figure 24: NOx Emission from Industries

It is evident from **Fig. 21, 22, 23, and 24** that boilers are the prime contributors of particulate matter (PM), SO_2 and NOx emission in industrial emission load.

e) *Issues of Industrial pollution*

i. **Poor quality of inventory data** - Although UPPCB had attempted an inventory of industries, it was often incomplete and at times inaccurate. Many industries either did not have data on fuel consumption or a very accurate inventory of the pollution sources and their capacities, thus making the evaluation of pollution load a bit challenging. It is recommended for all the regulators to prepare a complete, updated, and accurate inventory of the industries which will further assist in identifying the areas or sectors of concern from the perspective of environmental pollution.

ii. **Inadequate data on small scale sectors** - There is little to no data on small scale industries or other unorganized sectors in most of the areas. These sectors are significant contributors to the overall pollution loading in industrial areas. Gorakhpur Regional Office did not have a detailed inventory and there was no database on illegal small-scale units operating in their areas.

iii. **Lack of clear fuel policy –**A clear fuel policy is required which mentions which fuels are banned and which clean fuels are recommended for industries to use now and in the future. Fuels that can be used in the long run by industries need to be made clear. Especially with the cost dynamics between coal and PNG, a lot of industries are looking at agro-waste as a potential fuel that they are willing to use but are unsure if this will be allowed in the future. The regulators should also mention proper timelines for the implementation of such a policy to fast-track the change in fuel use and subsequently reduce the pollution load.

iv. **Lack of manpower and capacity in UPPCB**- It was observed that the UPPCB lack manpower and the available manpower are highly over-utilized. The periodic inspection and monitoring of the industries (specifically small-scale industries) by the regulatory bodies to check and ensure compliance could not be conducted since the concerned officer is involved in various administrative assignments. There is an urgent requirement for UPPCB to develop the capacity of its existing officials and increase the manpower. It is also important to shift to technologies and systems which need the least monitoring and ensure maximum compliance to reduce the unrealistic workload on officials of the board.

v. **Restructuring of CTOs to include relevant information on fuel, equipment, etc.** – Reliable industrial equipment and fuel consumption data is not available in many industries; the required data is extracted from the CTO of industries. The basic requirement to estimate and analyze the pollution load is the detail of combustion equipment/pollution source of the industries and the type of fuel used in the industry. It is observed that there is no standard pro forma for CTO and the information is either not mentioned or partially available in the document. Regulators should standardize the CTO format to include all the important information (related to industries' production capacity, fuels consumed, combustion equipment installed and its capacity, and air pollution control devices installed) in a structured manner.

vi. **Economic costs for switch over to natural gas** – It is observed that many industrial areas have access to natural gas as proper infrastructure is available, but the cost of shifting from conventional fuel to piped natural gas doesn't go well with the industries resulting in their unwillingness to switch over to PNG. The non-coverage of PNG under Goods and Services Tax (GST) and the application of Value Added Tax (VAT) on it makes it even more expensive compared to other fuels. The cost dynamics of different fuels with respect to the generation of per kg of steam is shown in the table below. (rate of natural gas has been considered as Rs 35 per SCM).

Table 14: Cost of the steam generation with various fuels

Fuel	Price of steam (Rs/kg)
Coal	1.6-1.7
Furnace Oil	1.8-1.9
Natural Gas	2.2-2.3
Light Diesel Oil (LDO)/High-Speed Diesel (HSD)	3.9–4.1

*Source: Nestle Inc., 2019

v. **No data is available on the number of operational hours of industries and their DG sets** - Information related to operating hours of industries and the DG sets installed is not available with UPPCB. DG consumes a significant quantity of diesel in the industrial areas and contributes to the loading pattern. Therefore, there is a need to make a complete inventory of DG sets along with the number of operating hours for each of them.

vi. **Poor road infrastructure, which adds substantially to fugitive dust emissions** - In Gorakhpur Industrial Development Authority Industrial Area, it is observed that the condition of the roads is very poor and traffic chicken-necks are resulting in traffic congestion of heavy vehicles. Moreover, GIDA Industrial Area does not have a proper drainage system which results in waterlogging. As an effect, the condition of the road deteriorates and a lot of road dust is generated out of drying of silt. The agencies responsible for the development of industrial areas should develop a robust system for the maintenance and development of infrastructure in industrial areas. Industrial areas have poor road conditions with the movement of heavy vehicles on them which led to the high amount of PM10 fugitive emissions in the area.

vii. **Improper industrial waste management and open burning of industrial waste** One of the most important aspects of industrial area development is the management of industrial waste which is generated in that area. It has been observed in most of the industrial areas that waste disposal is not proper. GIDA Industrial Area has many rice mills in which a lot of solid wastes including rice husk ash (RHA) is generated. Rice Husk Ash (RHA) is a great environmental threat

causing damage to the air, land, and the surrounding area in which it is dumped. Rice husk removal during rice refining, creates disposal problems due to less commercial interest. Also, the handling and transportation of RHA are problematic due to their low density. Also, many industrial units produce a lot of ash which is dumped in the nearby areas that are causing degradation of land and air pollution in the GIDA Project Area. RHA is also a potential environmental problem causing damage to the air, land, and the surrounding areas in which it is dumped. No management strategy has been adopted till now for the solid wastes in the area.

viii. **Issues with land-use planning concerning communities living in close vicinity of industrial areas** - It has been observed in the industrial areas that residential colonies/areas are in close vicinity of the industries, making people prone to different diseases due to air pollution. There seems to be an issue in urban planning in the area since the industries came into existence first and people started to settle in these areas slowly and gradually. The labor force of industries is provided by such colonies at the cost of the health of their residents. It is recommending that all the industrial area development agencies and urban planning departments should properly coordinate to clearly demarcate industrial and residential areas, and come up with remedial measures or buffer zones to prevent the residential population from the effects of air pollution from industries. Proper land-use planning should be done for upcoming industrial areas or the expansion of the existing ones. Meteorology of the area should necessarily be considered while planning.

ix. **Good practices by industrial associations** - In many of the industrial areas, industrial associations are doing a good job in maintaining the infrastructure in the industrial area, following good environmental management practices, and also working towards the development of the area in association with the administrative bodies. It is recommended that industrial associations should be identified and considered as major stakeholders in the air pollution action plans being prepared by the concerned departments including UPPCB. They can play a very significant role in improving air quality.

x. **Requirement of technology-based standard for small scale industries** - Norms for small scale industries should be technology-based rather than concentration based, since existing concentration-based norms are impossible to monitor, especially given the current capacity of UPPCB.

xi. **Centralized steam generation units for industrial sectors -** Most of the small-scale industries have installed individual low-capacity boilers for the purpose of steam generation. The opportunity to install a centralized steam generation system should be explored specially in GIDA Industrial Area. This will help in improving the efficiency of the system and indirectly reduce fuel consumption in the industrial areas. It would also make it much easier to monitor a few centralized steam generation units rather than a large number of baby boilers located in small industries.

xii. **The high levels of PM_{10} & $PM_{2.5}$ in GIDA-** The high level of PM10 and particularly sharp rise after 2017 may be attributed to poor road conditions, road dust & construction dust in GIDA Industrial Area.

xiii. **High level of SO2 and NOx in the Industries of Gorakhpur:** Emission Inventory shows that SO2 and NOx emission is very high in industrial emission. Genesis of such high emission is due to heavy usage of low-grade coal, diesel and bio-based fuel. An increase in NO_2 may be attributed to local sources which are LPG Bottling Plants and some waste oil burning units. There have been instances of burning plastic in industrial boilers also.

xiv. **Inept quality and quantity of APCD:** In our study, it is found that only 25 Industries are equipped with proper APCDs. Some MSMEs don't have effective Air Pollution Control Devices particularly the plywood industries. It is also a major cause of pollutant release in ambient air without treatment.

f) *Specific Issues of Industrial Pollution in Gorakhpur*

i. Hindustan Urvarak & Rasayan Limited (HURL) fertilizer plant in the northern part of Gorakhpur city is operational and further construction project is in progress. This red category industry is located within the city limits and is a potential air polluting industry like production of fertilizer results in the emission of particulate matter and toxic gaseous. The major sources of pollutant emission are Prilling towers, which manufacture urea prills or pellets, ammonia and urea plants, acid plant. Therefore, to avoid any future challenges to air pollution downwind to the city, stringent check on environmental compliances and air pollution control guidelines at the plant. Regular and efficient APCD must be installed and continuously monitored.

ii. Spent iron particles emission from Gallant Ispaat Industry is also troublesome for people living nearby.

iii. Plywood Industries in Gorakhpur also burn rubber and polythene which results in high emission of NOx and other toxic gases.

Figure 25: Boiler ash dumped by M/s Raina papers and M/s Gallant Ispat Ltd in Gorakhpur

g) *Issue of air polluting industries in non-conforming areas*

Gorakhpur has been the hub for various kinds of MSME industries especially wheat flour, oils, biscuits, flour, dal, tobacco, furniture, soap, bricks, metalware, and sports goods etc. Some of the industries operating in residential areas also contribute the pollution load in the ambient air. The mapping of such industries operating in non-conforming areas has never being attempted and is a bit difficult exercise also as coordination of ULB, Electricity Department along with Administration and Police is required for this exercise. Such units operating in nonconforming areas do not comply with the requirement for industrial setup as per standards set by CPCB and UPPCB. Such units shall have to be mapped & as a long-term intervention may be shifted as per the norms to the conforming areas with the handholding by the Government. However, shifting of industries is a complicated affair, therefore it is better to first do the mapping and finding out the ways that how the air pollution issues due to these units may be quantified and addressed as an immediate measure.

h) *Strategies for Control of Air pollution due to industries*

Based on the various issues related to pollution due to industries in Gorakhpur as discussed above, the following strategy is proposed-

i. Adoption of best environmental practices in GIDA Sahjanwa Area
ii. Upgradation of Roads & Drainage System in GIDA for control of dust and congestion of heavy vehicles
iii. Ensuring strict compliance with air pollution control standards
iv. UP gradation of inadequate Air pollution Control Devices installed in Plywood and other small-scale units
v. UP gradation of APCS in Gallant Ispat Limited, GIDA, Gorakhpur

vi. Centralized steam supply in GIDA
vii. Control of NO2 emissions from bottling plants and oil-burning units in GIDA Sahjanwa
viii. A complete ban on the reuse of spent oil and high sulphur diesel.
ix. Biofuel complex which is under development in Dhuriyapar can provide alternative cleaner fuel that can be used in the industrial sector
x. Proper waste management in an industrial area will help in ceasing waste burning.
xi. Laying of Infrastructure for supply of clean fuel (PNG) to the industries in GIDA.

D. Brick kilns

The brick sector is a resource-intensive and highly air polluting sector. It is a largely unorganized labor-intensive sector. India is the second-largest brick producer globally with an estimated production of 250 billion bricks a year. Bricks can be of many types and the most popular type is fired clay brick. Clay fired bricks are produced in small enterprises mostly located in peri-urban and rural areas.

There are 228 brick kilns in the Gorakhpur district, out of which 163 brick kilns have CTO air compliance. In Gorakhpur city boundary, there are 15 brick kilns. District's geographical locus in the Terai region provides it abundant clay-soil which is an essential raw material for brick manufacturing results in such a high number of brick kilns in the region.

Green bricks are fired at approximately 1000^0 C temperature for high strength and durability. Brick firing is an energy-intensive process. Coal, wood, and many agricultural wastes such as mustard stalk, rice husk, etc. are used as fuels for firing bricks. There is heavy dependence on coal for firing which results in high particulate matter emissions, CO_2, and black carbon.

Fixed Chimney bull trench kiln (FCBTK) is the most used firing technology in Gorakhpur district which accounts for approximately 80% of total kilns present in the district. There is a trend of adopting cleaner firing technology like zigzag Kiln but the number of such kilns is very less.

Brick kilns provide mass employment to the local people of Gorakhpur and the nearby region.

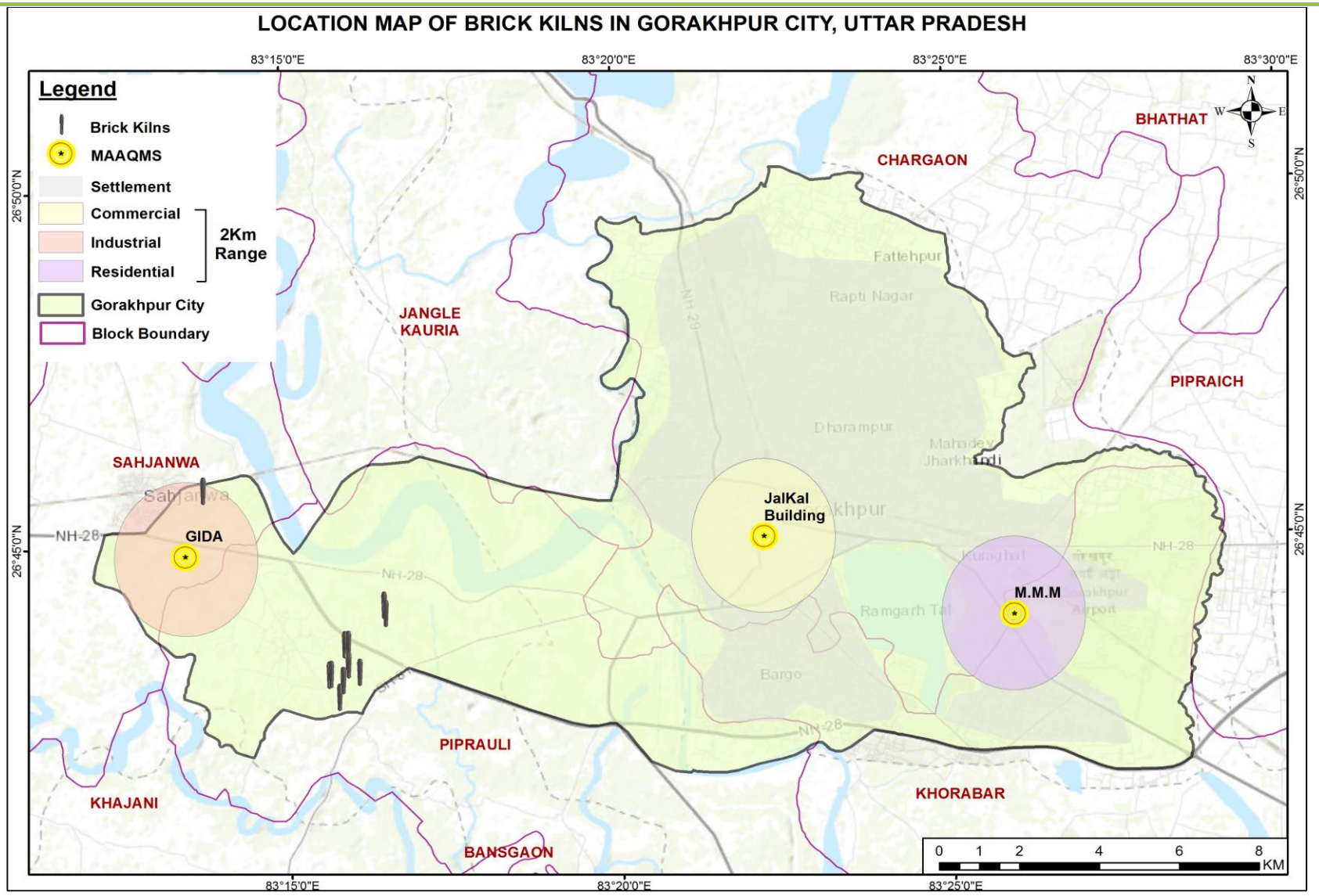


Figure 26: GIS Map showing Brick kilns in the Gorakhpur city

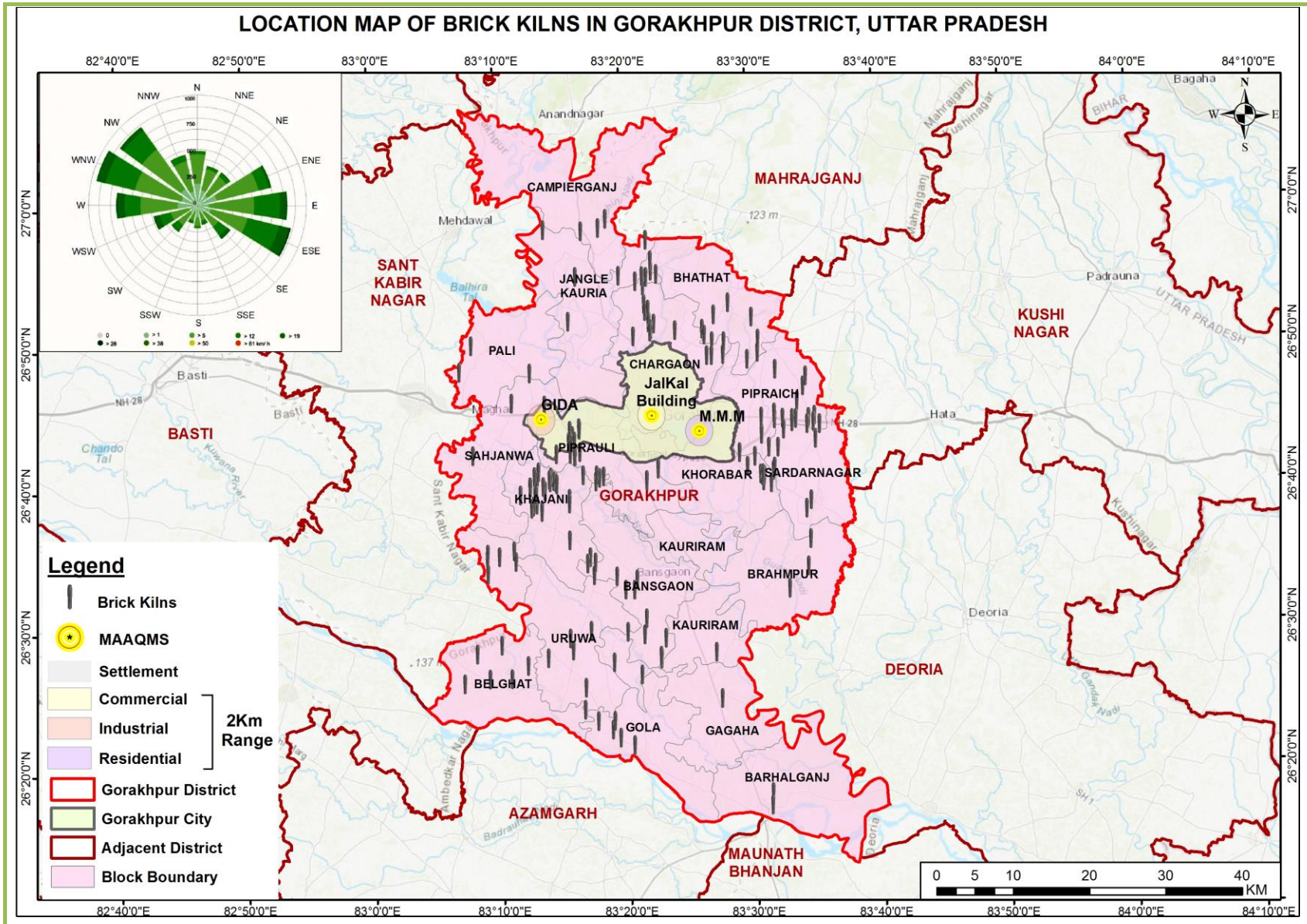


Figure 27: GIS Map showing brickkilns in Gorakhpur district

Table 15: Status of brick kilns in Gorakhpur

1	**No. Of brick kilns**	**228**
2	Capacity	19952 Bricks/day (for 228 kilns)
3	Fuel used	Coal
4	Quantity of fuel used	909.8 MT/day (for 228 bricks)
5	Converted to zig-zag	78
6	Consent status	Granted-163, Not Applied-65

a) *Emission Estimation for Brick Kilns*

For the emission estimation calculation, Brick kilns within the city periphery and in the Northwest downwind direction of Gorakhpur district are taken into consideration. The graphical representation in **Fig 28** schematically shows the pollutant emission from considered Brick kilns in Gorakhpur district:

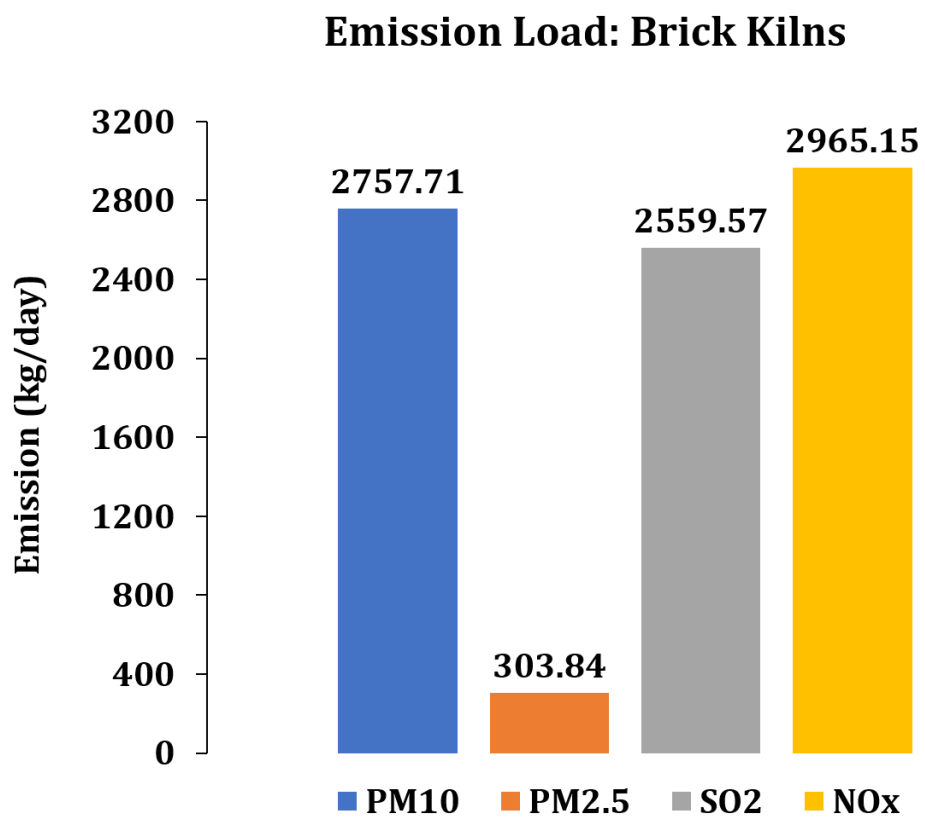


Figure 28: Emission Load from Brick Kilns in Gorakhpur

i. *Observations*

The order of pollutant emission is observed as **NO_x > PM10 >SO_2 >PM2.5** which shows that Brick Kilns are the potential contributor of pollutants in Gorakhpur city. Nitrogen oxide (NOx) emissions in brick making mainly originate from the oxidation of nitrogen in the atmosphere by burning (high temperature) which depends mainly on chemical reactions and not much on direct emissions. Higher PM10 and SO_2 level is a result of incomplete combustion of fuel, use of Sulphur rich coal and biomass. The quantum of the dust evolved from non-chimney sources in the brick kiln area is very high. These runaway clouds of dust at the site contribute to the low visibility conditions in and around the brick kilns. The releases of toxic substances from the brick kilns are adversely affecting soil, plants, animals, and people in their surroundings being the most severe for brick workers.

b) *Major issues of brick kilns in Gorakhpur*

i. **Conversion of FCBTK to Zigzag:** Out of 228 brick kilns in Gorakhpur district, only 78 brick kilns have been converted into Zigzag.

ii. **Low-quality Coal:** Use of low-quality coal generates more ash content, SO_2 emission.

iii. **Use of agricultural waste and hazardous waste as an alternate-**The simple reason behind the use of agricultural waste is its easy availability and lower price. Apart from this, many other hazardous wastes such as carbon from tyre pyrolysis plants, rubber waste, shredded plastics, etc., were seen being used at few kiln sites.

iv. **Fugitive emission at kiln sites -** The sources of fugitive emissions are Coal Crushing Unit, openly stored fuel, loading and unloading of bricks, dust on the road within the premises of the kiln, rubbish stored at the kiln, and the area where green bricks are prepared.

c) *Strategy to control air pollution from Brick kiln*

Based on the survey findings and analysis, the following strategy is proposed to ensure that the kilns are constructed with a proper design that improves operational practices and minimizes emissions.

i. **Seminar and Training** - District level seminars and exposure visits to Zig-Zag kilns for brick entrepreneurs to acquaint them with the new technology. Also, regular training programs and courses on cleaner kiln technology and their viability will be designed and organized for kiln entrepreneurs, workers, and technicians at institutes such as ITI, etc. Training program for the concerned people is an essential requirement for reducing the environmental footprint of brick kilns. In this regard, UPPCB is preparing an online training program.

ii. **Capacity building of regulators** - Setting up of an expert committee at the state/district level to monitor the conversion of the kilns. SPCBs to work jointly with other government departments and local NGOs to stop the usage of hazardous fuels. Enforcing the construction of platform and approach ladder to reach porthole at the chimney, to facilitate stack emission monitoring. Ensuring covered fuel storage, water sprinkling facility concretized haul road, and use of PPEs.

iii. **Advanced cleaner Production Technology:** Zig zag kilns produce more class 1 bricks at lesser coal consumption and pollutant emission than FCBTK. Retrofitting of existing FCBTK to Zigzag kiln structure is a win-win approach for brick entrepreneurs and the environment. There is a need to study the scope and techno-economic aspects for implementing energy-efficient technologies like Tunnel Kiln, Hoffman Kilns, etc.

iv. **Shift toward Resource-efficient Bricks (REBs)**: Production of perforated and hollow burnt clay brick synergize in saving clay and fuel, reducing manpower requirements, and production cost. There is a need for establishing the demand/market for resource-efficient products.

v. **Control of Fugitive emission:** Pavement of approach road and the road around the brick kiln, crushing of coal in enclosed equipment/ area, covering ash layer in the preheating zone with plastic sheet/tirpal, etc can help in controlling fugitive emission

vi. **Use of Solar energy**: Machines like pug mill, crushing roller, extruder, etc can be operated on solar energy.

vii. **Improving operational practice**: Adoption of single man fuel feeding process, double-wall wicket gate closing mechanism & use of insulated feed hole cover.

viii. **Use of Air pollution control device Devices:** APCDs can help in controlling stack emission of brick kilns. The particulate removal efficiency of different designs of Gravity Settling Chamber (GSC) generally ranged from 20-63%.

E. Diesel Generator Sets (DG Sets)

The DG sets are used as a backup, approximately 450 commercial DG sets are installed in sectors such as Industries, Hotels, Banquet halls, Hospitals, and Residential apartments in Gorakhpur city. The majority of the electricity generator sets operate on diesel. It is assumed that DG sets operate for one hour per day (primary survey finding). The minimum capacity corresponding to the production of the industry and stack height has been worked out and assumed as the capacity of the DG while estimating emissions. The unit of the activity data is KWh power generation.

a) *Emission Estimation for DG sets*

The calculation is based on Eq (1), where ER, overall efficiency reduction was taken as zero. The CPCB (2011) emission factors were used for emission estimation. The total emissions from DG sets are shown in **Figure 29,** as follows:

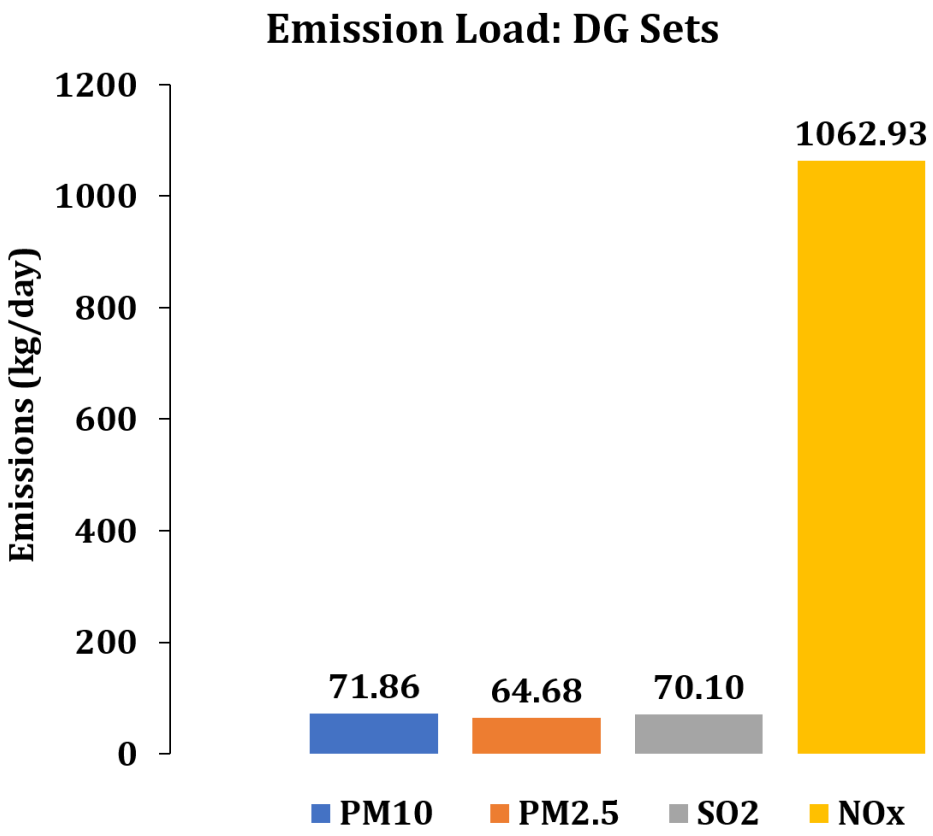


Figure 29: Emission Load Estimation for DG sets

i. *Observations*

The emission for NOx was observed to be highest from DG set sources. It is due to the use of Diesel as the only source of fuel. The percentage emission of various pollutants from various sectors i.e., Industrial DG sets, Hospital DGs, Apartments DG sets, hotels, and banquet hall DG sets is given in **figures 30, 31, 32, and 33.**

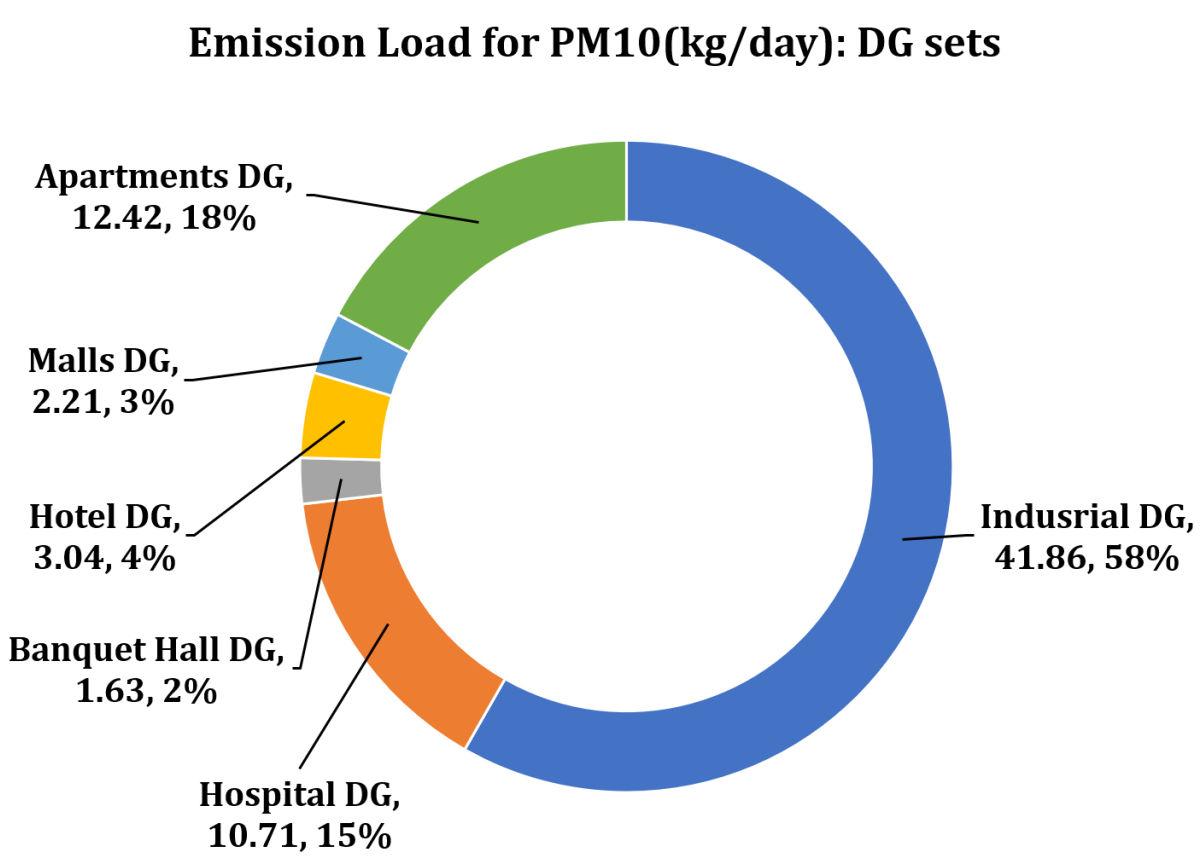


Figure 30: PM10 Emission from DG sets

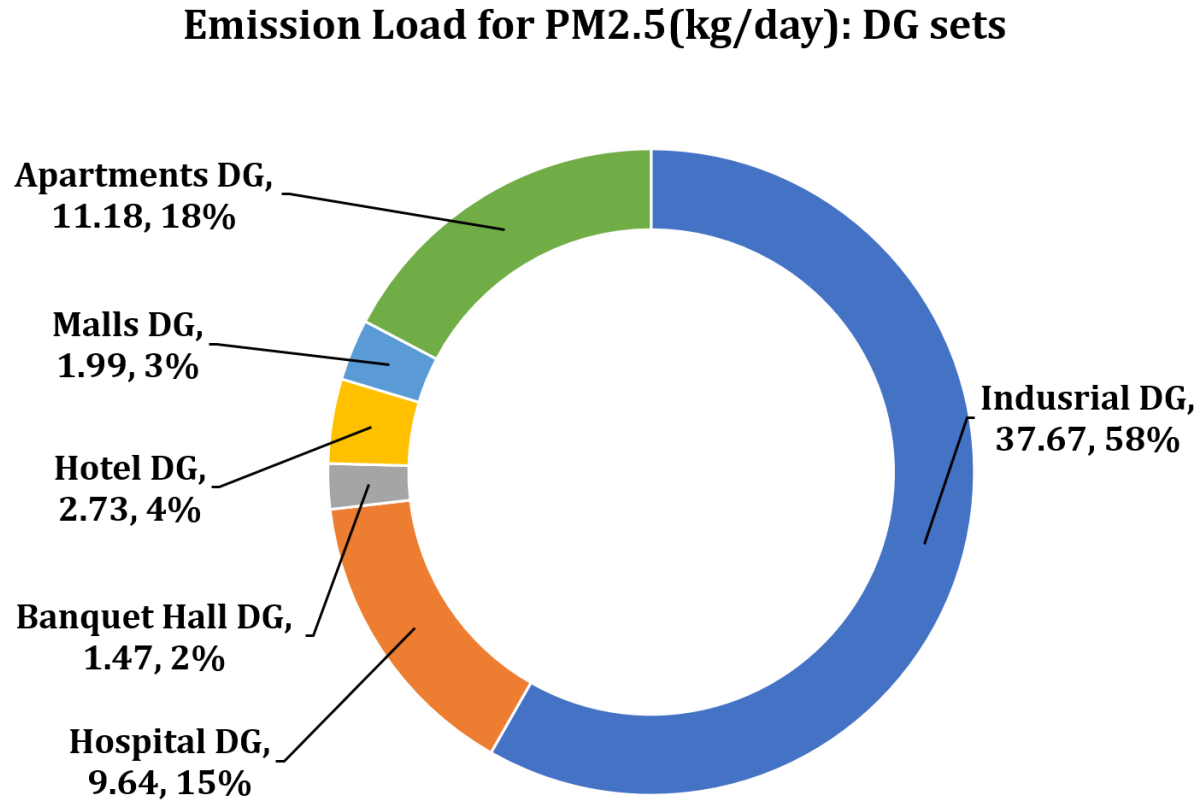


Figure 31: PM2.5 Emission from DG sets

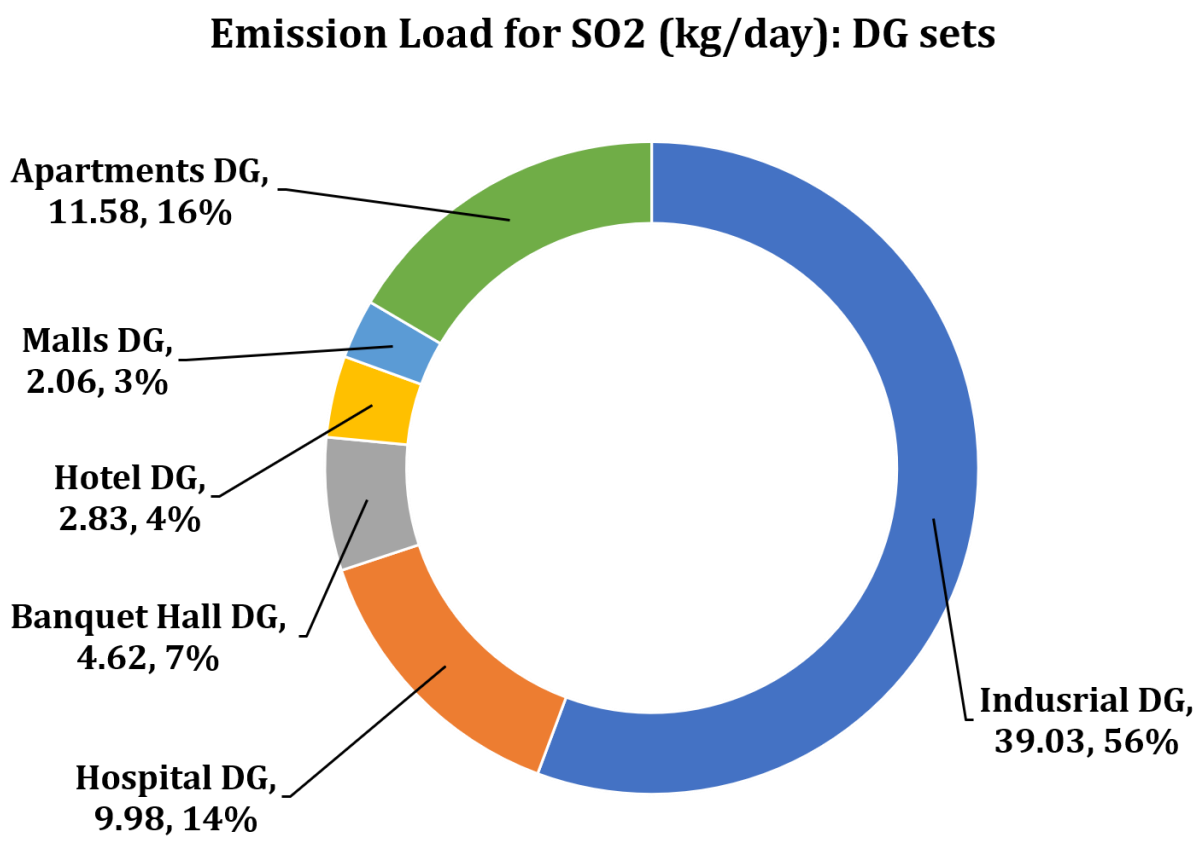


Figure 32: SO_2 Emission from DG sets

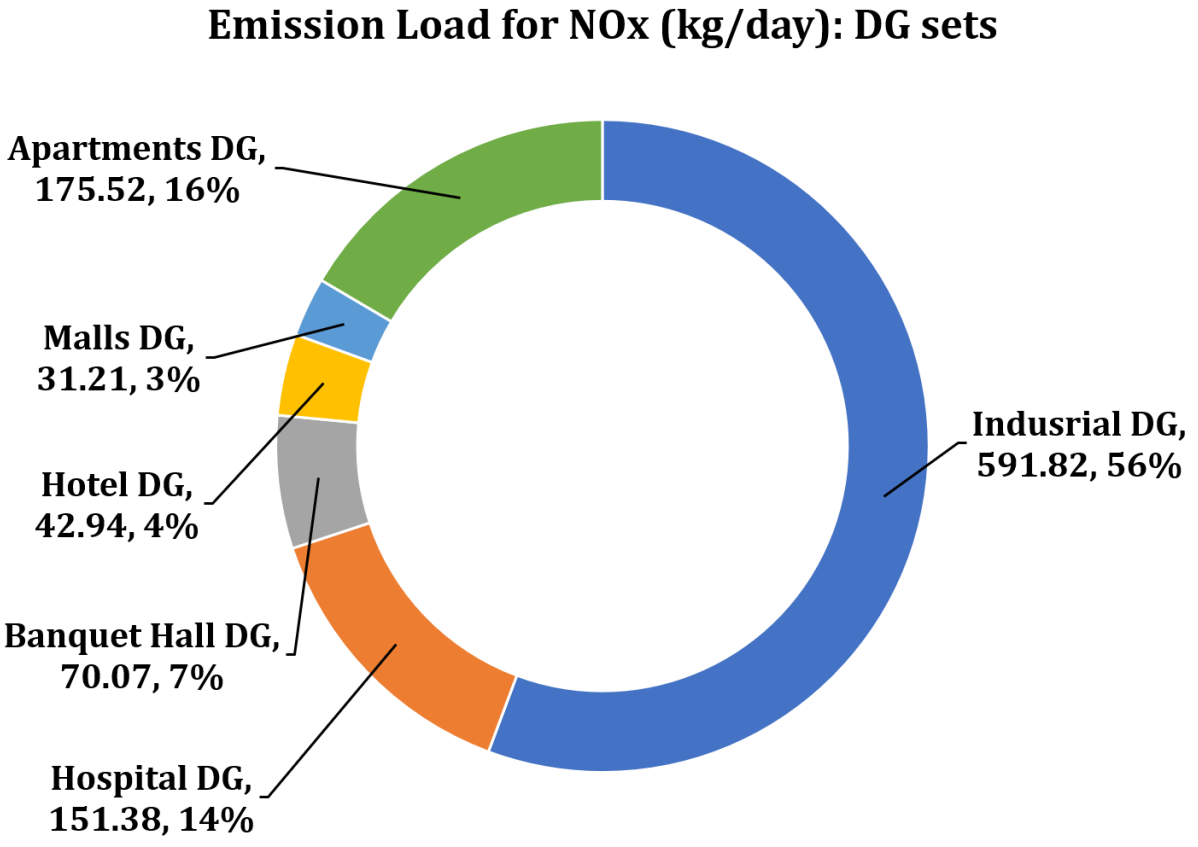


Figure 33: NOx Emission from DG sets

From the above doughnut charts, it can be concluded that major emission through DG sets is from industrial sources which further increases the contribution of Industries as major point source pollutants.

b) *Measures to control emission from DG sets*

i. Central Pollution Control Board (CPCB), has been regulating emissions from diesel generators at the manufacturing stage (through product certification) since 2005.

ii. Besides manufacturing reforms, better operational and management practices are essential to maintain the performance of DG sets. Inadequate operational and management practices like Poorly maintained fuel injection pump, Faulty nozzle, blocked fuel filters, improper cooling water circuit, loading below optimal, reduction in the air-fuel ratio(higher air intake temperature) due to poor cross ventilation, etc. should be timely addressed and resolved to control high fuel consumption and pollutant emission.

iii. Installation of a retrofitted emission control system in DG sets will also help in reducing emission load.

Figure 34: DG sets at (a) Orion mall (left), (b) Riaz hospital (right) in Gorakhpur city

F. Hot-Mix Plant Emission Estimation

Hot mix asphalt is used primarily as paving material and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities.

Hot mix asphalt plants have two major categories of emissions: ducted sources (those vented to the atmosphere through some type of stack, vent, or pipe), and fugitive sources (emitted directly from the source to the ambient air). The major sources of air pollution in the hot-mix asphalt are (i) drier, and (ii) bitumen heating tanks. To get a proper heating effect to the aggregate in the drier, a draft is created by providing an induced draft (ID) fan. This operation emits particulate matter (PM) and a variety of gaseous pollutants.

Other emission sources found at HMA plants include storage silos which temporarily hold the HMA; truck load-out operations, liquid asphalt storage tanks; hot oil heaters, and yard emissions, which consist of fugitive emissions from the HMA in truck beds. Fugitive emissions are also generated from vehicular traffic on paved and unpaved roads, aggregate storage and handling operation.

Intending to minimize the plant's impact on ambient air quality, air pollution control equipment, and practices must be in place for the point as well as non-point sources of air pollution. The operation of an asphalt plant causes the emission of many different pollutants. The most common pollutant emitted from hot mix asphalt plants is particulate matter (PM10).

The total Hot- Mix Plant unit present in the Gorakhpur district is 10, given in the **Table-16**, out of which only 7 are operational. Among these hot mix units, V/Y Khand, PWD, Gorakhpur is operational within the bound city, while others are located in the exterior frontier of Gorakhpur city. Data for Activity rate calculation has been collected from UPPCB and emission factors have been obtained from CPCB (2011) have been used to estimate the emissions from Hot- Mix Plant.

Table 16: List of Hot Mix Plants in Gorakhpur District

S.No	Location & Adress of Hot Mix	Capacity	Unit	Production Capacity Kg/day	Operational/Non-Operational
1	V/Y Khand, PWD, Khorabaar, Gorakhpur	50	ton/hr	200000	Operational
2	M/S C.T Construction Badhagarh	45	ton/hr	180000	Operational
3	M/s Shakuntala Singh Near Badhagarh	45	ton/hr	180000	Operational

	Jaralhi Road				
4	M/s Umesh Sahi Mahabir Chapra	45	ton/hr	180000	Non-Operational
5	M/s V.S. Enterprises Near Badhagarh Jaralhi Road	45	ton/hr	180000	Operational
6	M/s Chatrashakti Infra Construction Bargadhi (Near Bhathat)	2.65	ton/batch	106000	Operational
7	M/s Ravindra Kumar Singh Kadjaha (Gorakhpur-Deoria Road)	25	ton/hr	100000	Non-Operational
8	M/s Ambey Traders Devipur, Moti Ram Adda, Gorakhpur	45	ton/hr	180000	Operational
9	M/s Harshit Enterprises Kadjaha (Gorakhpur-Deoria Road)	50	ton/hr	200000	Operational
10	M/s Ajay Associate Kutahwa, Inar, Gorakhpur	45	ton/hr	180000	Non-Operational

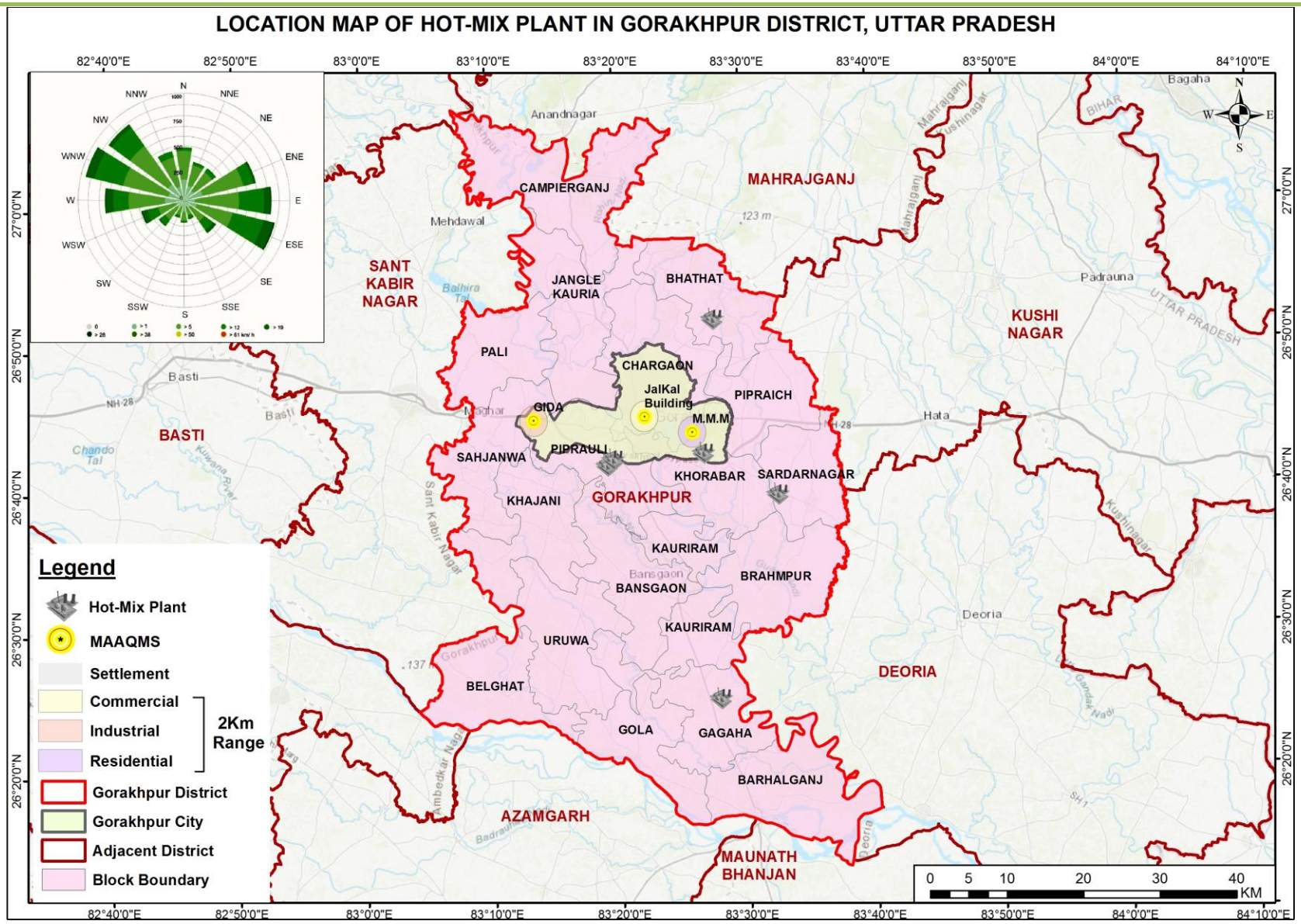


Figure 35: Hot-Mix Plant of Gorakhpur District

a) *Emission Estimation for Hot mix plant*

For emission load calculation hot mix plants within the Gorakhpur city bounds and in range of 2 km from the city boundary are considered. The total emissions from Hot- mix Plant is shown in **Figure-36**, as follows:

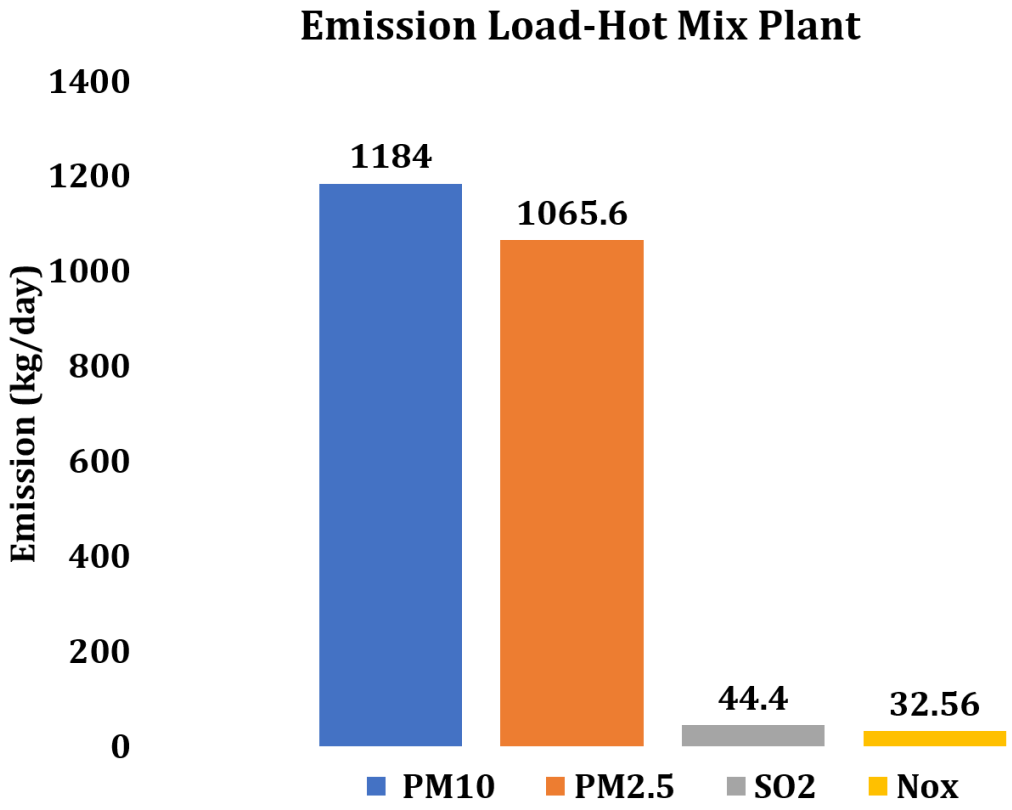


Figure 36: Emission Load estimation for Hot-Mix Plant

i. *Observations*

PM_{10} and $PM_{2.5}$ are the peak pollutant observed from Hot-mix Plant. This is due to the emission of Particulate matter during the handling, loading and unloading process along with emissions from the stack attached to the power sources.

b) *Measures to be taken for control and abatement of air pollution*

i. MoEF & CC's notification dated 25.01.2018 has laid down dust abatement measures during construction and demolition activities, the same should be applicable for transportation, handling, and transfer of raw materials in a hot mix plant. The SOP should also be adhered to with regard to the construction of paved roads and sprinkling.

ii. The conveyance channel for feeding into the drier and bitumen tank should be closed to minimize fugitive emissions.

iii. A combination of dry scrubbing system/filters and wet scrubbing system should be installed for drier and flue gases from bitumen heating process respectively.

iv. The closed silo should be used for the addition of dust at the Wet Mix Plant to avoid fugitive emission of particulate matter.

v. Stack of at least 6 meters height should be installed. The stack should have a porthole and monitoring platform as per Emission Regulatory Guidelines (Part III) of the Central Pollution Control Board.
vi. Earlier, Furnace oil was a prominent fuel in Hot mix plants, however, after being banned by the Hon'ble Supreme Court most of the plants have switched to LDO. In order to minimize the impact, new plants should be permitted only on LPG kits, these are already being used in hot mix plants in UP-NCR cities.
vii. Preferably, a PTZ camera should be installed for purpose of remote monitoring of operations and visible emissions from the hot mix plant.
viii. Metalled road should be constructed inside the premises to avoid fugitive emission
ix. Hot mix plants should install separate energy meters for pollution control systems.
x. Adequate green buffer should be maintained around the hot mix plants.

G. Emission Estimation from Domestic Sector

After obtaining the total population of the city (Gorakhpur Municipal Corporation) as per the AMRUT report and Census 2011, the emission density for the city is calculated for different pollutants (PM10, PM2.5, SO2, NOx, and CO). Emission factors provided by CPCB (2011) and AP-42 (USEPA, 2000) were used for each fuel type.

For emission calculation of different pollutants, emission per capita for the total population was calculated, as activity data was available based on per capita. The fuel usage pattern of the households for the study area (GDA) is presented in **Table-17.**

Table 17: Fuel Usage Pattern

Fuel Type	Percent used
Firewood	9.90%
Crop Residue	1.50%
Coal/Charcoal	0.10%
Kerosene	1.70%
Cow Dung	15.80%
LPG	71%
Total	**100.00%**

The overall emission from domestic sources is presented in **Figure-37.**

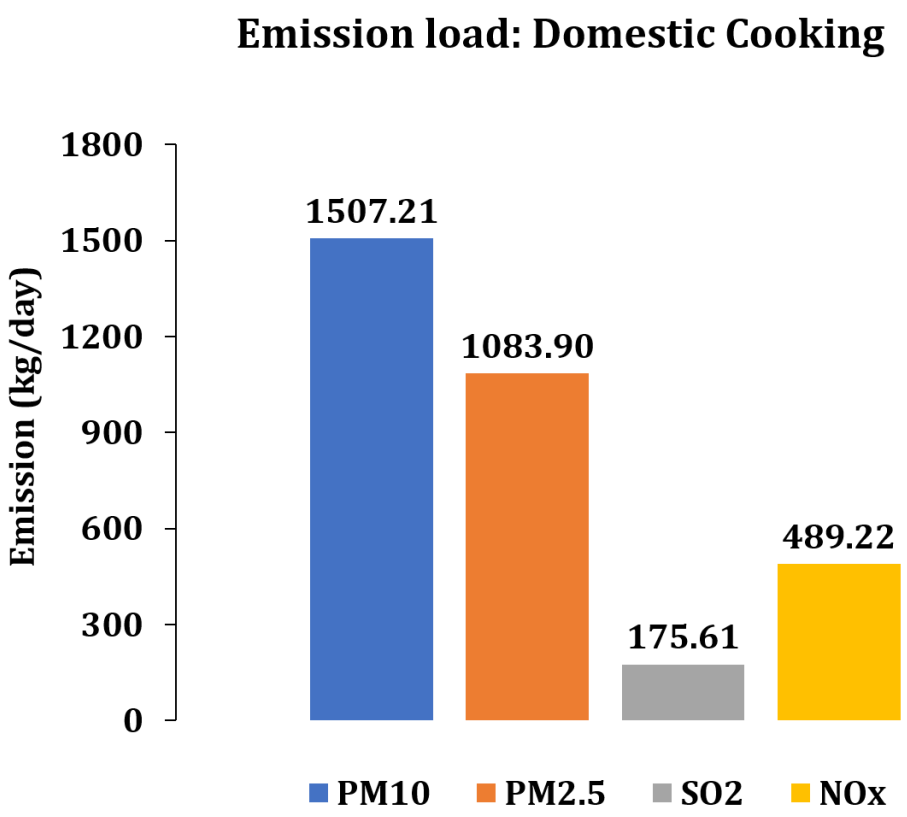


Figure 37: Emission Estimation for Domestic source

a) *Observation*

The LPG penetration in Gorakhpur City is 71% (PPAC Primary survey on household cooking fuel usage and willingness to convert to LPG report, 2016). PM10 emission is observed to be the highest. This is due to the high activity rate and emission of fuel sources such as Cow dung and firewood. This could be better understood through emission contribution from different fuel types to different pollutants as shown in **Figures 38, 39, 40, and 41.**

Gorakhpur has 110 notified and 56 not notified slums with 58237 households. They mostly used cow dung, firewood, and coal for cooking.

More LPG penetration will help in removing the dependency on cow dung and firewood which consequently aid in reducing pollutant emission in ambient air.

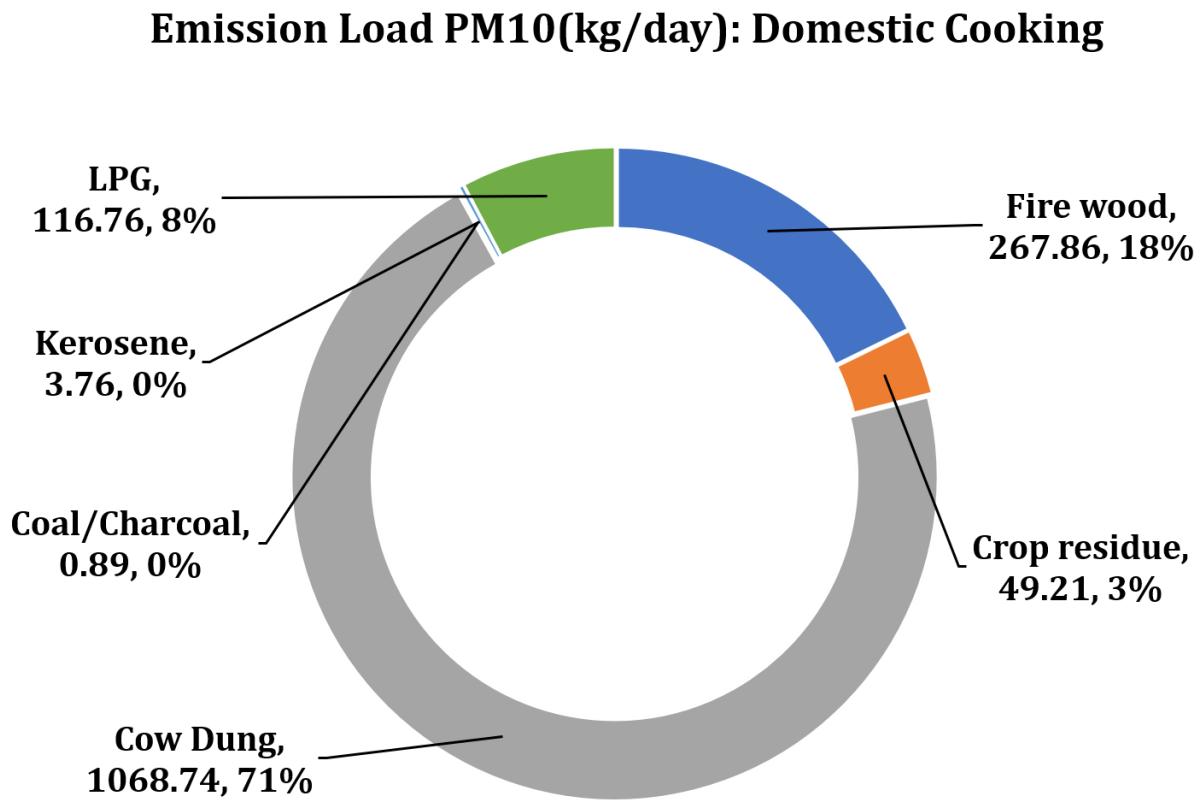


Figure 38: PM10 Emission Load from Domestic Cooking in GDA (kg/day)

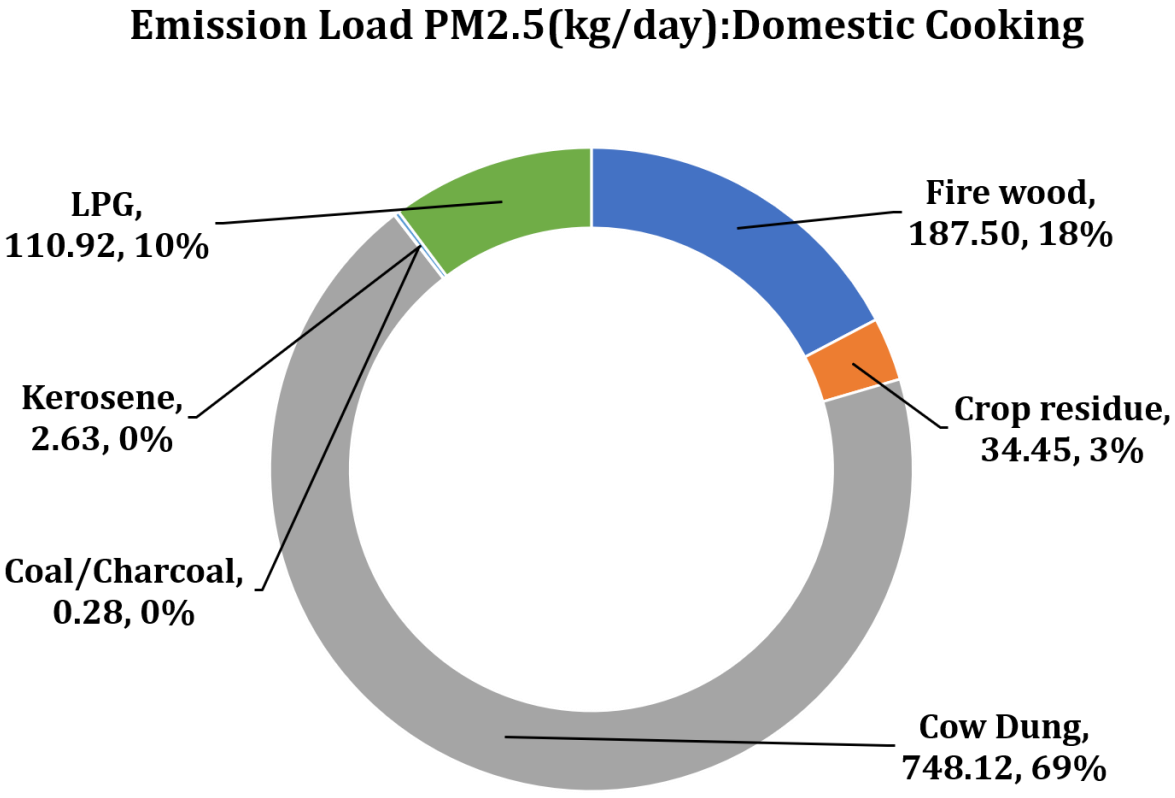


Figure 39: PM2.5 Emission Load from Domestic Cooking in GDA (kg/day)

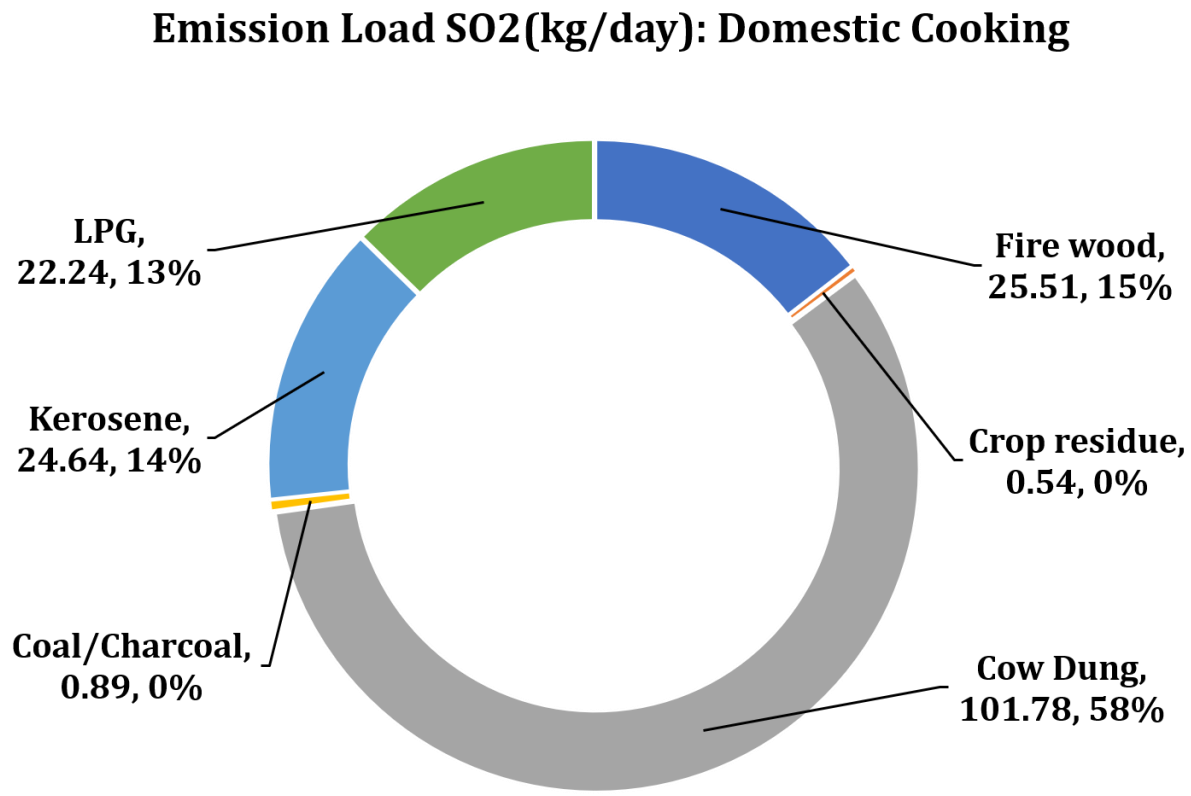


Figure 40: SO2 Emission Load from Domestic Cooking in GDA (kg/day)

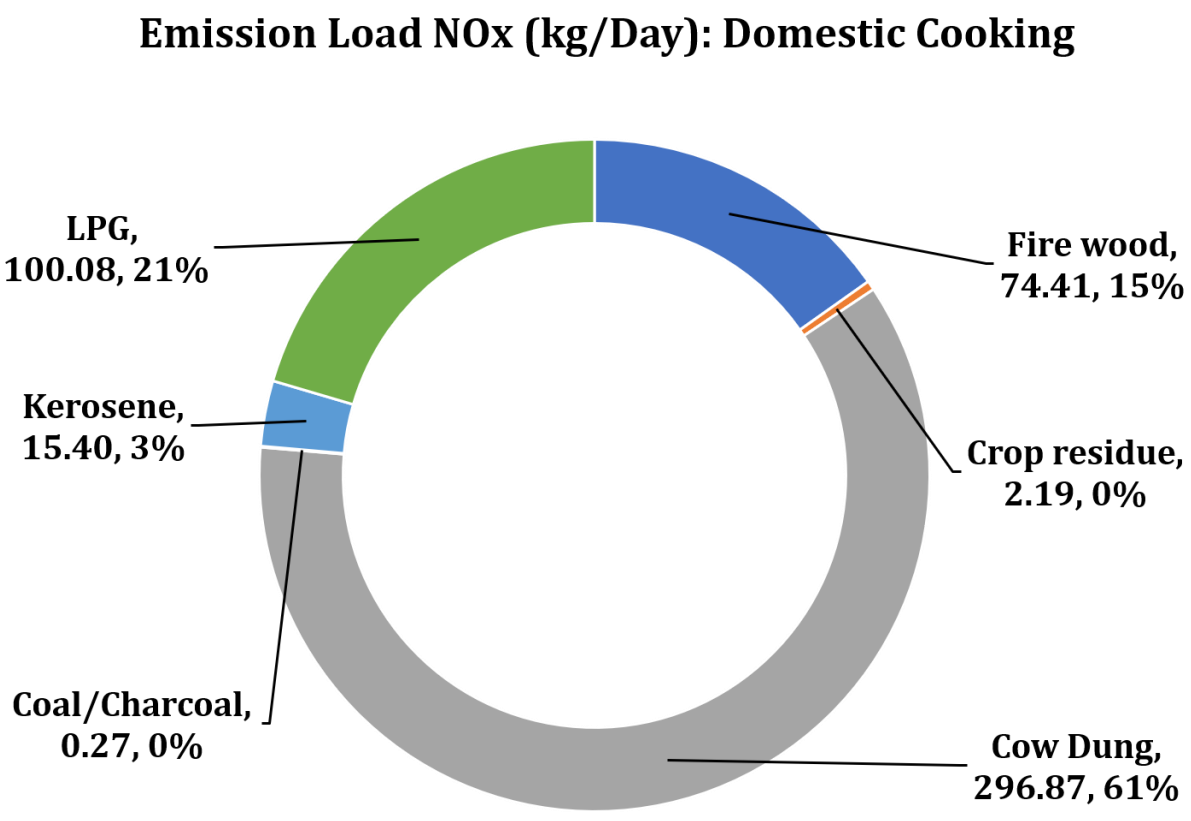


Figure 41: NOx Emission Load from Cooking in GDA (kg/day)

H. Hotels and Banquet halls emission estimation (Kitchen emissions)

The primary survey was conducted by UPPCB- Regional office, Gorakhpur team to identify the hotels and banquet halls. During the field survey, it was observed that hotels, banquet halls, etc. use coal as fuel in tandoors. The average consumption of coal in tandoor based on the survey was 22 kg/day. The total number of Hotel and Banquet halls enterprise was approximately 95. The common fuel other than in tandoor is LPG. The fuel consumption for each fuel type was estimated. In most of the cases, it was found that there were no control devices installed at these activities. The emissions of various parameters such as SO_2, NOx, PM_{10}, $PM_{2.5}$, and CO were estimated from the activity data from each fuel type and then were summed up in each grid cell. The emission factors given by CPCB (2011) were used. The overall emission from the kitchens of Hotels and Banquet halls is shown in **Figure-42 and 43 respectively.**

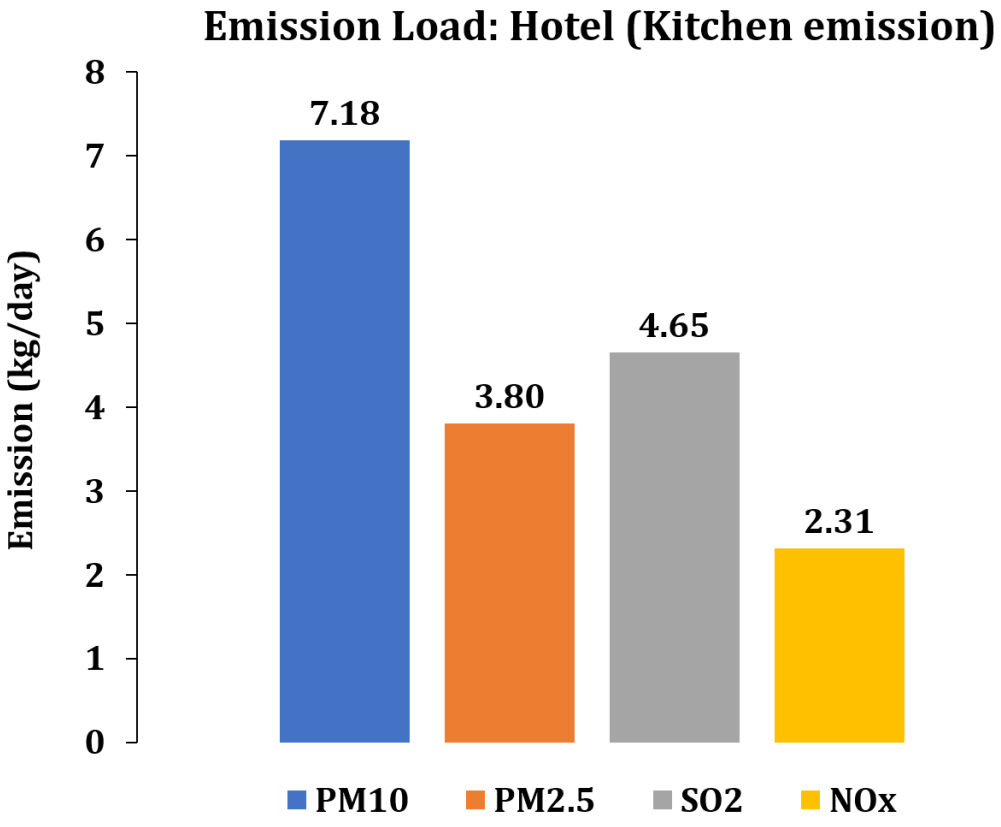


Figure 42: Emission Load from Hotels

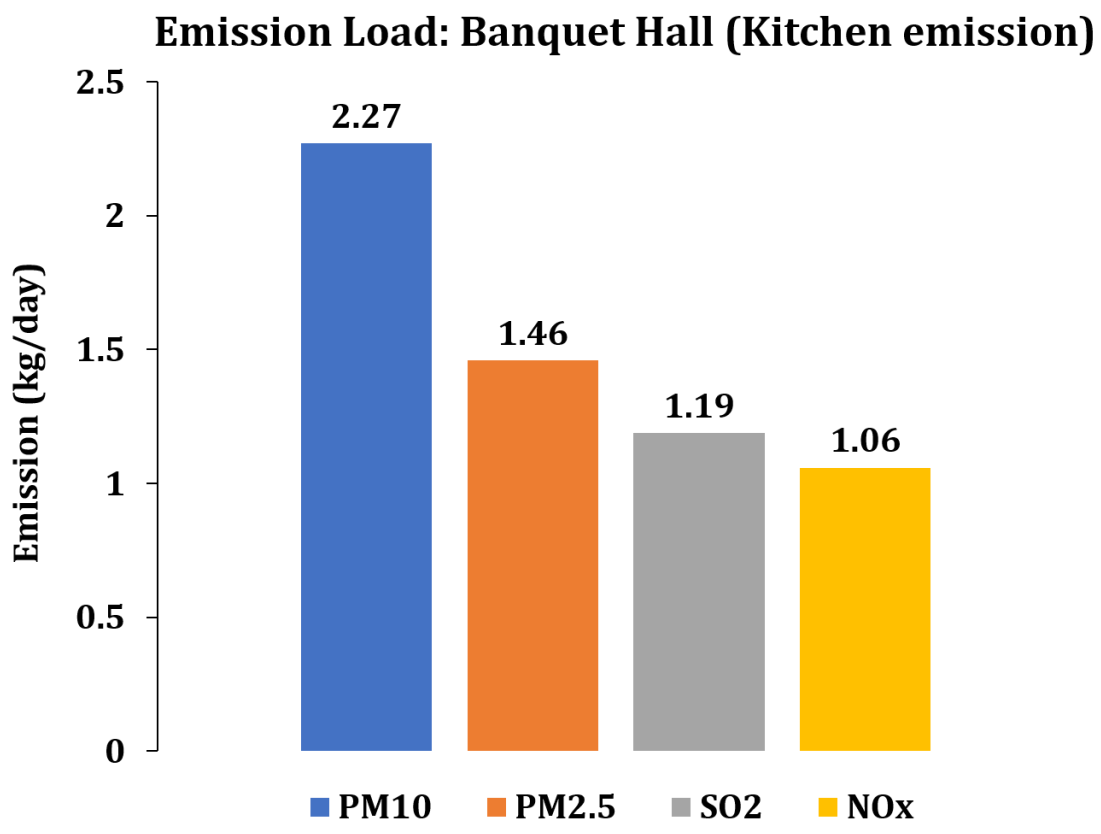


Figure 43: Emission Load from Banquet Halls

a) *Observation*

The PM10 emission from cooking in Hotels and Banquets is 7.18 kg/day and 2.27kg/day respectively.

I. Vehicular Pollution and traffic congestions

Vehicular pollution is another major issue in the city of Gorakhpur and being an old city, the road infrastructure of the city is not optimal for the hassle-free flow of traffic and needs strengthening. Rising vehicle count and traffic congestion severely contributed in air pollution. Because of narrow roads as well as the increasing encroachment on the roads created complicated traffic problems. The problem is more acute in the Dharmshala crossing because the pukka portion is less wide on this crossing. Shahpur crossing has the maximum carriageway. Thus, the traffic load in the city is increasing swiftly. The width of the roads has not increased since they were constructed. At present, national highway 28 has the highest transport pressure mainly due to unplanned expansion of the city and urban activities along either side of the road. Apart from these thousands of loaded trucks arrive daily in Gorakhpur from Lucknow, Kanpur, Varanasi, Allahabad, and various parts of the U.P, Bihar, and West Bengal.

a) *Major Traffic and Transportation problems in Gorakhpur*

The following problems have been observed and identified by city residents, daily commuters, and people frequently visit this city to pursue business and other affairs.

i. *General Problems Related to Traffic and Transport facilities*

- **Capacity Constraint**: Most of the roads have Capacity Constraint: the width or road especially in inner built-up areas, inner cordon roads, and even at some points the regional and outer cordon roads have lesser width/related infrastructure in context to the traffic volume they have to bear.
- **Inadequate Road hierarchy**: Road hierarchy is not as per the acceptable level, so the traffic movement is not smooth, the primary corridors, secondary corridors do not follow the norms.
- **Encroachments**: Most of the roads in the area are encroached by permanent or temporary encroachments, leading to diminution of road width and capacity. At most of the places the hoardings, shop displays, advertising panels are placed in ROW even on the Mettlled areas. The roads have also encroached the chajja projections, ramps, and other civil features constructed in the row.

Figure 44: Traffic congestion due to encroachment in Gorakhpur city

- **Mixed Traffic**: Most of the roads in the city are subjected to mixed kind of traffic, the slow, very slow, fast-moving traffic move on the same roads /traffic corridors, due to which the average speed of city is lowered down.
- **Traffic management**: The city has very weak traffic management; the traffic is regulated by traffic police, which is mostly untrained/not properly trained in traffic affairs, which fails in regulating traffic.

- **Absence of Traffic Management Plan**: No comprehensive Traffic Management Plan is prepared for the city; the only methodology adopted is the traffic plan by police which is done in a non-technical way.
- **Poor road quality**: The quality of roads in the inner cordon, middle cordon, and outer cordon, as well as regional roads, is of poor quality in terms of surfacing, gradients.
- **Weak Traffic infrastructure**: The entire infrastructure is weak to cater to the magnitude of traffic
- **Slow average traffic speed**: The average speed of traffic in the city is very low leading to the deterioration of efficiency of the city.
- **Inadequate Pedestrian facilities**: The Pedestrian facilities on all most all the roads of different levels are inadequate, promoting less pedestrian but more traffic movement
- **Limited provision for bicycles**: In the entire city provision required infrastructure to promote cycle movement in the city is very limited
- **The problem of informal marketing on the roadside**: Hawkers, roadside vendors, informal squatting of vegetable /grocery item vendors is a serious problem in the city, affecting road efficiency.

Figure 45: Traffic congestion at Gorakhpur city

ii. *Problems Related to Parking Issues*

- A large number of markets, commercial and other activity centers on various roads in Gorakhpur are suffering from inadequate parking facilities. On most of these stretches, the root cause of the congestion on the street is caused due to on-street parking.

- Problems of Parking, unorganized and unauthorized parking area located at following points in the city: Golghar Chauraha, Mohaddipur, Bargadwan Chauraha, Khajanchi Chauraha, Paidleganj-GIDA Road, Gorakhdham Mandir Road, Kudaghat, Medical College Road, Nausad Chauk, Nanda Nagar, Dharmashala Kachehari Road, etc.

iii. *Problems Related Intersections, Round About & Junctions*

The detailed traffic and transportation surveys were got conducted by the authorities and concluded that some of the intersections and crossings had several problems leading to huge clogging of traffic and slowing down of average speed

- **Ghantaghar Chauraha**: This intersection having improper road Geometry is located in an old commercial and residential area of Hind Bazar is one of the busiest areas in the city leading to huge traffic at peak hours, temporary and permanent encroachments, the problem of a huge member of roadside vendors, parking of rikshaw, and private vehicles leading to an inefficient intersection
- **Narmal Chauraha**: This intersection is situated near Narmal School has continuous traffic congestion due to a private taxi stand
- **Lal Diggi Chauraha**: This intersection is located in the commercial area which has a Wholesale Commercial Centre around it, leading to an inefficient intersection.
- **Hasiganj Chauraha**: This intersection is surrounded by old commercial establishments and so has heavy traffic. Improper road Geometry, temporary and permanent encroachments, roadside vendors, improper parking of rickshaws, tempos, busses, and private vehicles amplify the problem of an inefficient intersection.
- **Vishvidhyalaya Dakshini Chauraha**: This intersection is located in NH 28 where private buses are parked and have huge traffic.
- **Mohaddipur Chauraha:** This intersection is on NH 28, Asuran Railway Colony Road & University Road where the internal traffic of the city meets the external traffic. Heavy traffic in this intersection leads to traffic congestion.
- **Malgodam Chauraha**: This intersection is located near a weighbridge which becomes the prime reason for congestion.
- **Dharmashala Chouraha**: This intersection is having huge traffic besides this it is having improper road Geometry, there are several temporary and permanent encroachments, the problem of roadside vendors, parking of rickshaws, private vehicles leads to the inefficient intersection.
- **Golghar & Indira Chauraha**: This intersection is surrounded by the City's biggest commercial establishments so is having huge mixed kind of traffic, besides this, it has improper road hierarchy of roads network, temporary and permanent encroachments, roadside vendors, unauthorized and unplanned parking leads to heavy traffic congestion and slow traffic movement
- **Vijay Chauraha**: This intersection is located at the junction of Golghar, Cinema Bazar Aryanagar Marg, and Bank Road. It also has four Cinema Halls, big Commercial

Centers, and Banks. The road/ Carriageway width is less with inefficient Geometry, so is having huge mixed kind of traffic often leading to traffic congestions.

- **Bank Road Chauraha**: This intersection is located at the junction of the busiest roads of the city namely Bank Road and Bakshipur Road which is always congested owing to the economic activities of the City.
- **Gandhi Chauraha**: This intersection is surrounded by offices of Nagar Nigam, Gorakhpur Development Authority, Townhall and Court, etc besides it is located in the main Commercial Area of the City. The Petrol Pump near this intersection also adds to traffic congestion.
- **Maya Bazar Chauraha**: This is the intersection of Kotwali Road, Town Hall Road, Reti Road, Hospital Road has two hospitals near it. This is also one of the busiest intersections that often face the problem of traffic congestions.
- **Tarang Humayupur Railway Crossing Chauraha**: This intersection has the traffic going towards Farenda-Nautanawa and Siddharthnagar besides the local traffic going across the railway line. This intersection is congested during the daytime which aggravates when the level crossing is closed for the passing of the train.
- **Transport Nagar Chauraha**: This intersection is located on NH 28 near Mandi. This is always busy due to vehicles commuting to Lucknow-Varanasi, Gorakhpur City, and Mandi.

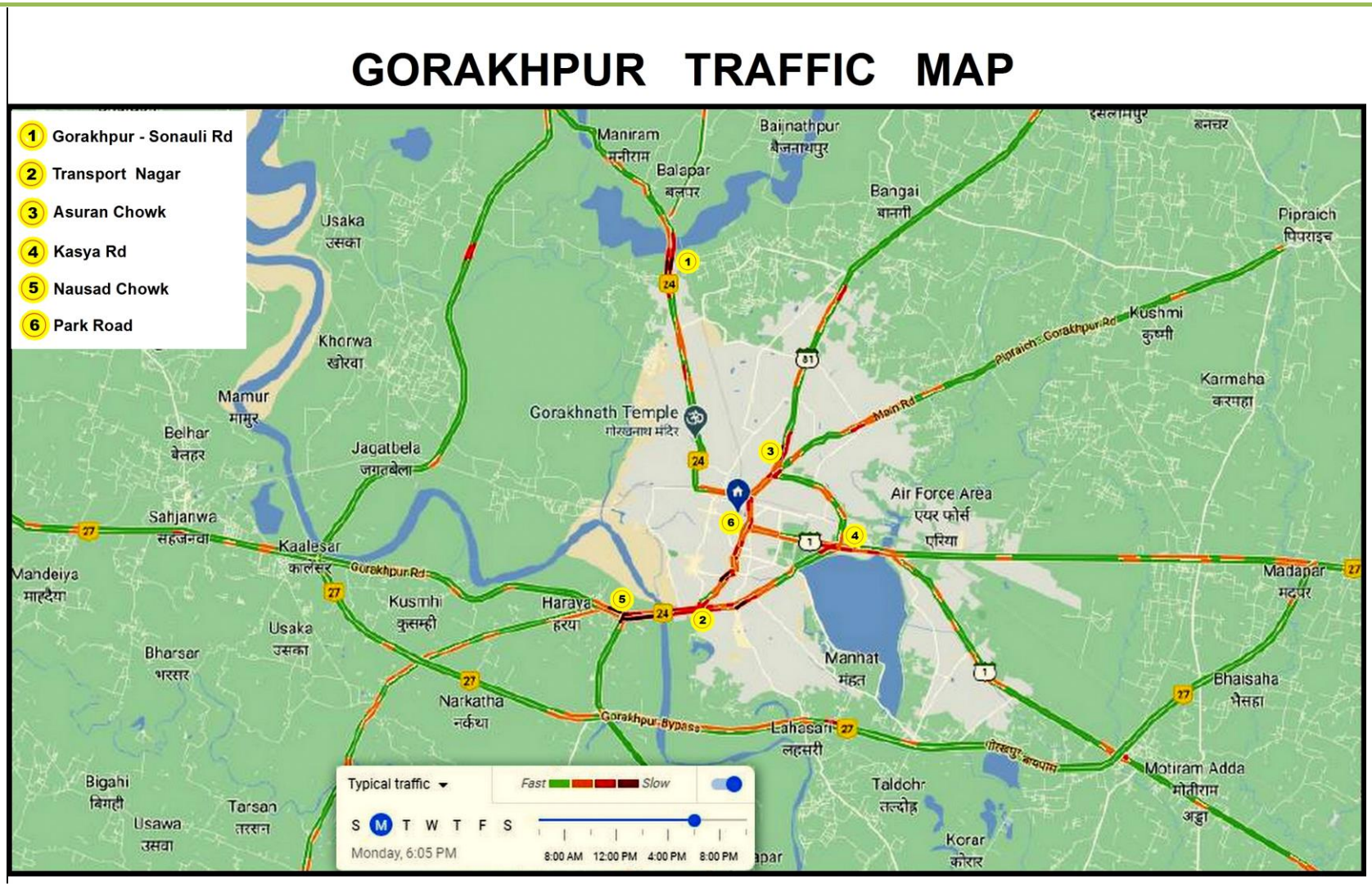


Figure 46: Google Traffic map of Gorakhpur

b) *Traffic Congestion points in Gorakhpur city*

The following table shows the major Traffic Congestion points in Gorakhpur city:

Table 18: Major congestion points in the Gorakhpur city

S. No.	Area		Latitude	Longitude
1	Rustampur Chauraha		26°44'5.18"N	83°22'6.86"E
2	Fal mandi chauraha		26°44'4.00"N	83°21'49.00"E
3	Maheva Mandi		26°43'58.00"N	83°21'49.00"E
4	Transport Nagar		26°44'3.00"N	83°21'33.00"E
5	Kacheri Chauraha		26°44'58.73"N	83°22'11.84"E
6	Shastri Chowk		26°44'50.47"N	83°22'8.61"E
7	Betihata Chowk		26°44'35.95"N	83°22'7.63"E
8	Civil Lines		26°44'49.48"N	83°22'23.28"E
9	Golghar Chauraha		26°45'16.40"N	83°22'19.19"E
10	University Chowk		26°45'9.41"N	83°22'51.72"E
11	Mohaddipur Chowk		26°44'58.84"N	83°23'51.51"E
12	Chandra Bose Chowk		26°44'40.23"N	83°23'7.53"E
13	Gorakhpur Bypass		26°44'48.23"N	83°15'2.96"E
14	Asuran Chowk		26°46'3.96"N	83°22'46.21"E
15	Bargadwa Chauraha		26°48'14.58"N	83°21'9.05"E
16	Khajanchi Chauraha		26°47'46.87"N	83°23'19.85"E

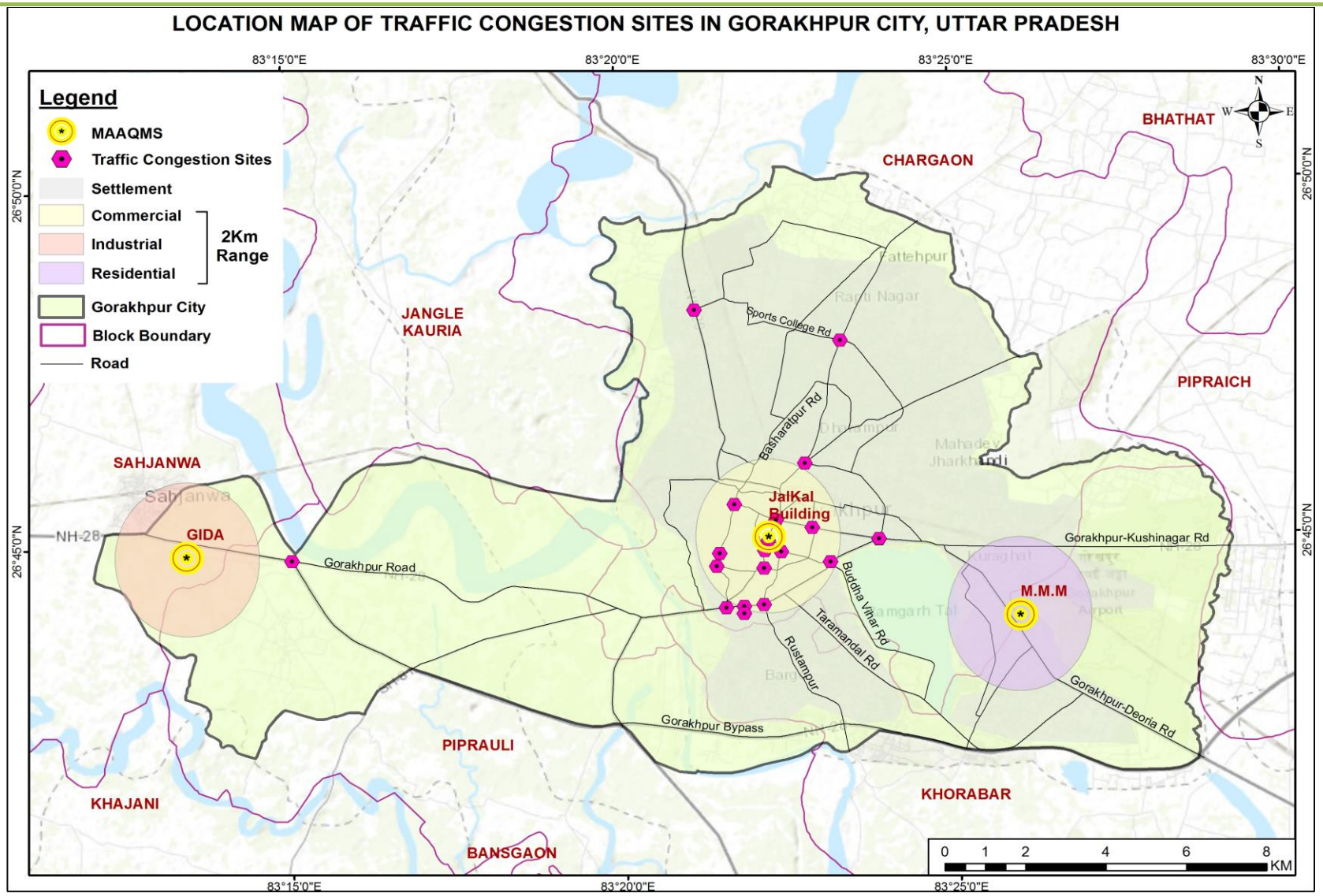


Figure 47: Map showing major congestion points in the Gorakhpur city

c) *Emission estimation for vehicular pollution*

Road lengths for major and minor roads were calculated. The information on traffic flow from traffic counts was translated into the vehicles on the roads. The number of registered vehicles from 2005 to 2020 was taken into account for the study according to data provided by RTO, Gorakhpur. The emissions from each vehicle category for each grid is estimated and summed up. The emissions from railway locomotives are not taken into considerations, as the emissions are negligible in comparison with the vehicles and other sources. ARAI (2011) and CPCB (2011) emission factors were used to calculate the emissions. The emission from vehicles is shown in **Figure-48** Emission contribution of each vehicle type in the city of Gorakhpur is presented in **Figures-49, 50, 51, and 52.**

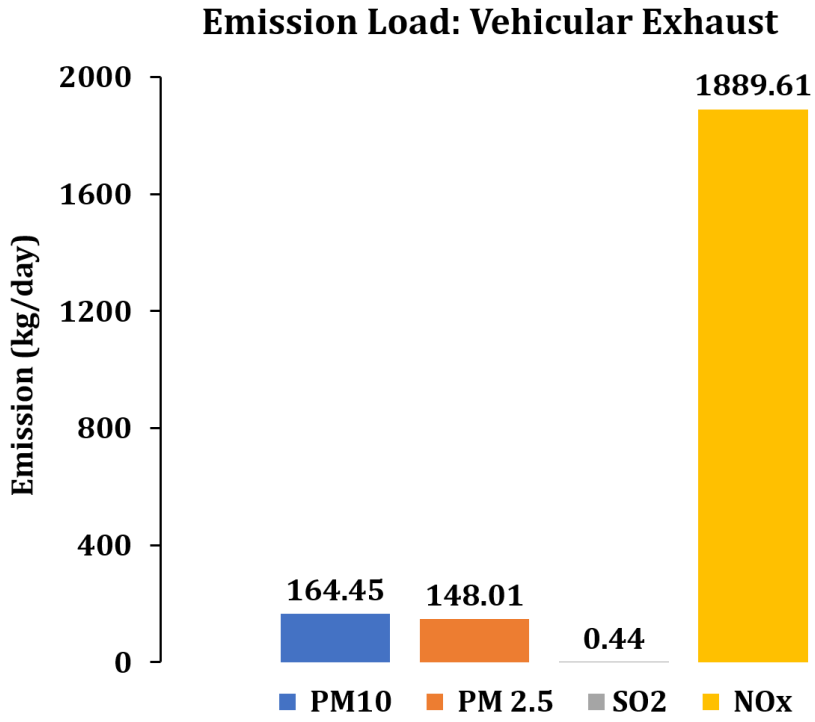


Figure 48: Emission estimated loads from Vehicular Exhausts (kg/day)

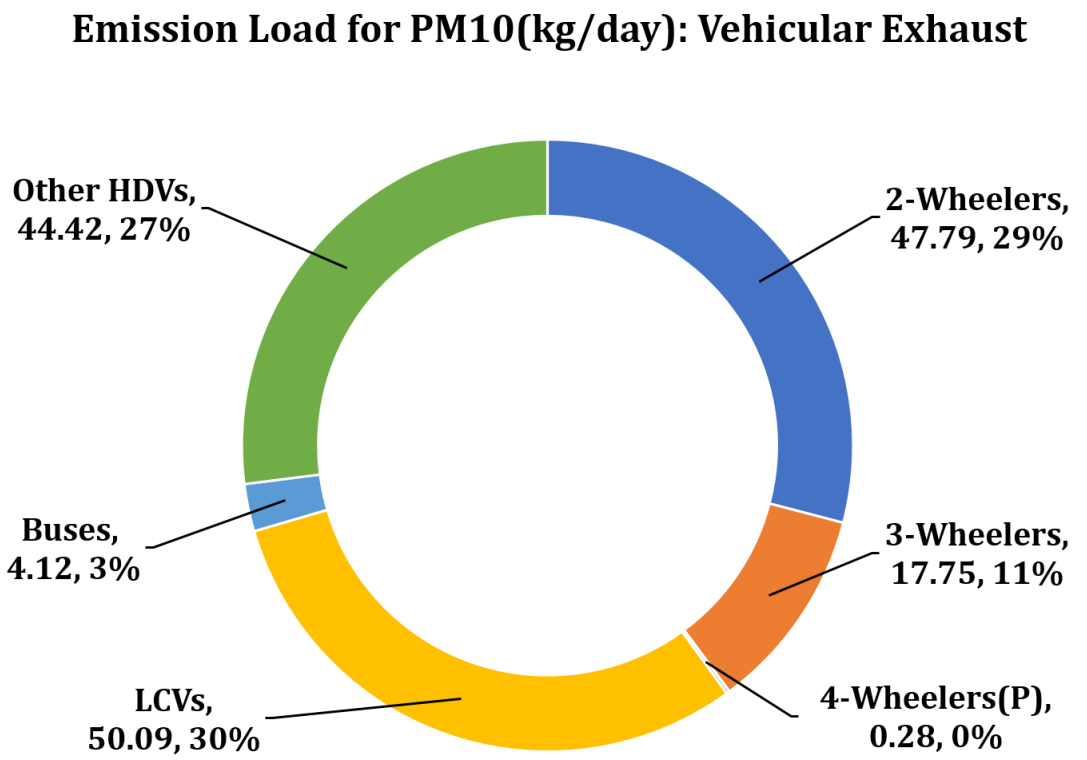


Figure 49: PM10 Emission Load contribution of each vehicle type in Gorakhpur city

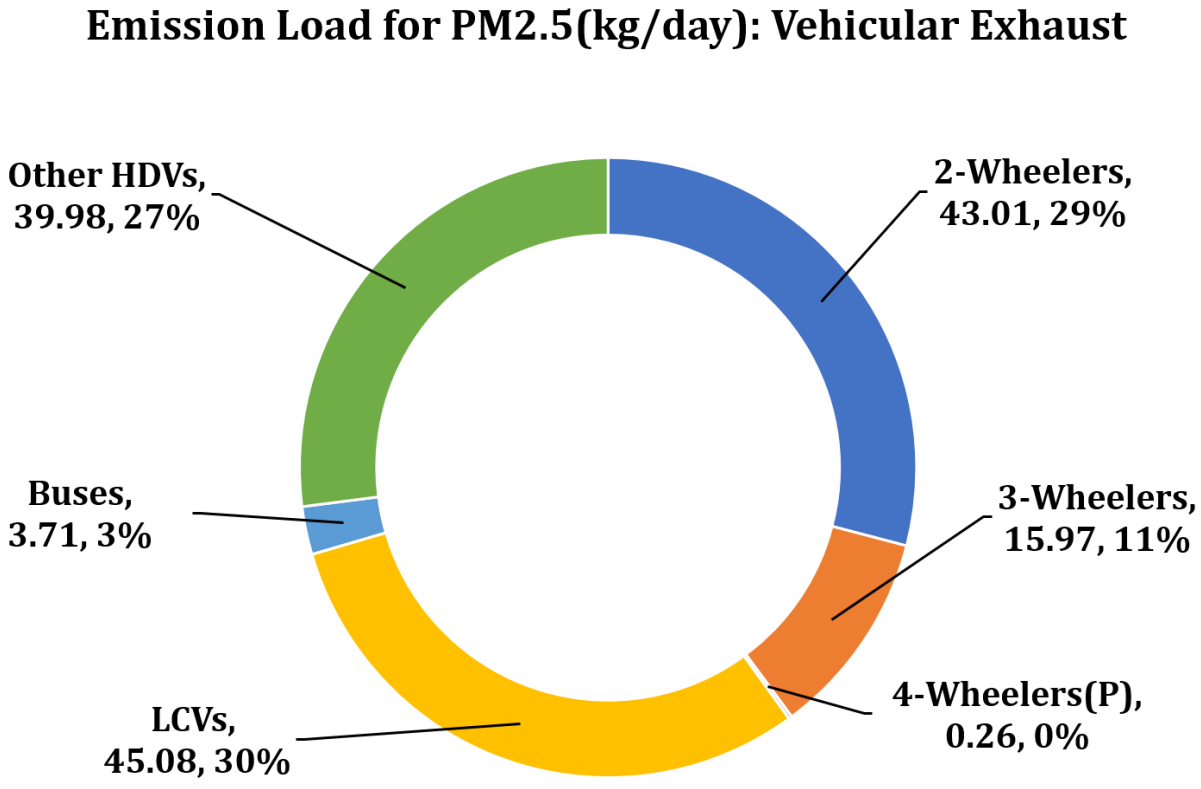


Figure 50: PM2.5 Emission Load contribution of each vehicle type in Gorakhpur city

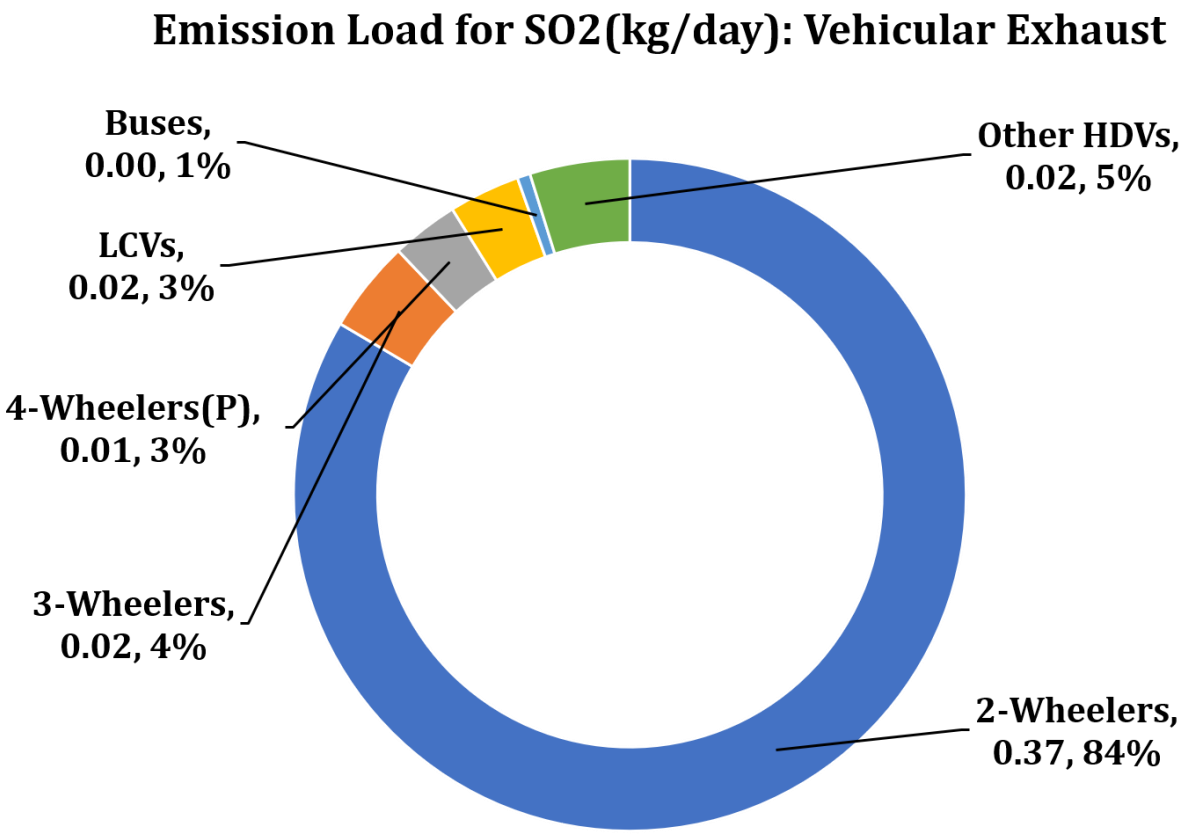


Figure 51: SO_2 Emission Load contribution of each vehicle type in Gorakhpur city

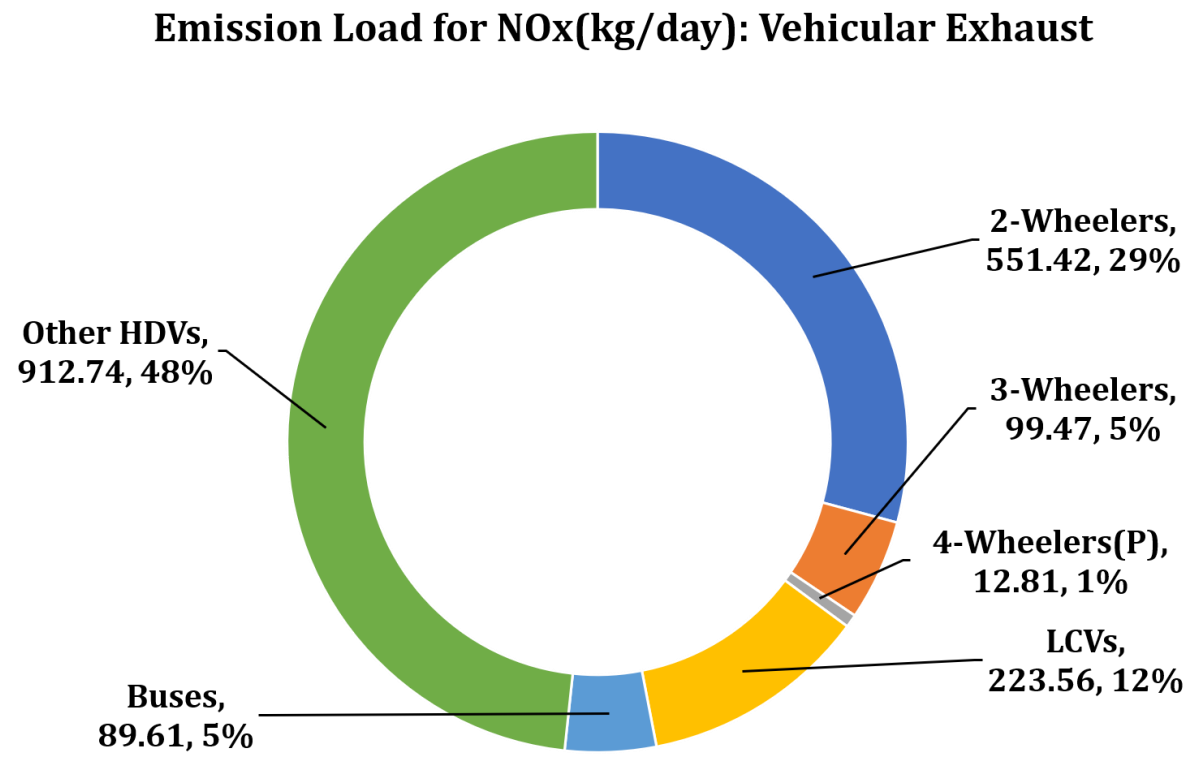


Figure 52: NOx Emission Load contribution of each vehicle type in Gorakhpur city

i. *Observations*

NOx emission is very high in total vehicular emission of Gorakhpur city. Heavy-duty vehicles (HDVs)are major contributors to NOx emissions. LCVs, 2 wheelers, and HDVs are the top three contributors to PM_{10} and $PM_{2.5}$ whereas SO_2 release is mostly from 2-wheelers.

d) *Measures to improve traffic plan and control emission*

i. *Proposals of Gorakhpur Master Plan 2021*

Road Pattern and Typology in Gorakhpur Master Plan 2021 a total of 2.07% of land i.e., 117 hectares of land was earmarked for Transportation Land Use. The major recommendations of Gorakhpur Master Plan 2021 regarding roads are-

- 100-meter-wide outer ring road
- Widening of all regional roads, and Fly Overs
- Development and enhancement of Main Intersections
- Establishment of Truck Stands on all external roads
- Development of new transport nagar
- Development of Inter-State Bus Terminal
- Development of Parking Spaces
- Development of Comprehensive Traffic Management Plan
- 45-meter-wide bypasses on Haward Bund (from Sonauli Road to NH-28) and Malauni bund (from NH-28 Lucknow Road to Deoria Bypass Road)
- 30-meter-wide bypass from NH-28 Kasaya Road to Gorakhpur Pipraich Road and Gorakhpur Maharajganj Road
- Development of bus stands near proposed bypass on Gorakhpur Pipraich Road.

ii. *Future Strategy*

A good quality Comprehensive Mobility Plan needs to be updated and implemented with clearly defined timelines.

- Mobility Corridor Plan
  - Missing Links
  - Road capacity augmentation
- Public transport plan
  - Mass Transit
  - Fleet augmentation
  - Infrastructure
  - Relocation of Inter-city bus terminals
- Non-motorized transport plan
  - Footpath
  - Grade separated pedestrian crossing
  - Dedicated Cycle track
- Freight management plan
- Parking management plan

- Nallah corridor plan
- Short term traffic improvement measures

iii. *Fuel improvement*

Use of alternative fuel cleaner than gasoline and diesel in vehicles like CNG, LPG, electricity, ethanol-blended fuel, etc. will immensely aid in pollutant control emitted from vehicles.

iv. *Vehicle Fitness*

Regular checks on vehicle fitness and write-off of old unfit vehicles will reduce the pollutant emission in ambient air.

J. CONSTRUCTION AND ROAD DUST

Road dust and dust arising from construction and demolition (C&D) are the major contributors to the pollution in Indian cities. According to the CSE report, India recycles just 1% of its construction and demolition (C&D) waste.

The construction upswing across Gorakhpur city is a boon for city development but the air quality monitoring data reveal that it has deteriorated the air quality of the city.

The potential control options are sweeping and watering of roads, better construction, and maintenance, growing plants, grass, etc., to prevent re-suspension of dust. City-specific plans need to evaluate the options of mechanical sweeping, greening, and landscaping of the major arterial roads, identification of major-impact roads, including national highways, etc. Spraying of water twice per day (before peak hours of traffic) is very effective in reducing air-borne dust load. Grassing of open spaces with native grasses also prevent dust pollution and clean air. The mechanical sweepers were introduced in the State as manual sweeping by brooms blow more dust particles in air than it cleans off the ground. The State has now more than 25 mechanical sweepers, which keeps the road free of dust. At present, the dust collected is mostly taken to the landfill sites and dumped. When the wind blows, these particles return to the city rendering the entire sweeping process ineffective. Even a light wind is able to raise a dust storm if the dumped dust is not dampened with water or have a green cover over it. There is no proper mechanism or standard operating procedure (SOP) on how to dump the dust collected so that they do not return to the city after disposal. The government has notified Construction & Demolition (C&D) Waste Management Rules, 2016, which had been an initiative towards effectively tackling the issues of pollution and waste management. The basis of these rules is to recover, recycle, and reuse the waste generated through C&D. Segregating C&D and depositing it to the collection centers for processing is now be the responsibility of every waste generator. Local bodies are to utilize 10%–20% material from C&D waste in municipal and government contracts. It was noted that there was no regulation prescribing preventive measures to be taken for the management of dust, including road dust and C&D dust that arises during construction. Taking note of the increasing air pollution and to keep dust material under control in towns and cities, the MoEF&CC has issued a Dust Mitigation

notification in January 2018 under EPA, 1986; making mandatory dust mitigation measures in infrastructural projects and demolition activities in the country. This would help to keep the dust under control to reduce air pollution in metros and cities. The notified rules inserted 11-point measures in the existing act, thereby empowering the ministry to issue notices against local authorities and state agencies for non-implementation of those actions.

a) *Road Dust*

Road Dust has been acknowledged as an important source of urban Air Pollution. Traffic related non-exhaust particulate sources and road dust are an increasingly important source of PM_{10} and $PM_{2.5}$ Air Pollution. Except from being emitted directly to the air, non-exhaust particles deposit and accumulate together with dust from other sources on road surface to form road dust. The particles deposited on the road surface originate from direct emission from vehicles tail pipe, particles emitted by tyre and break wear process and particles that settle on the road from both nearby and distance sources. Dust deposition or in the vicinity of the roads may be re-entrained, or re-suspended into air through vehicle induced turbulence and shearing stress of tires, increase air pollution. The amount of this dust that is generated and then re-settles on the road surface depends on various factors including traffic speed, vehicle weight, local road conditions and rainfall. The strength and direction of the wind is a highly influential factor on its transportation. This action is present on both paved and unpaved roads.

The coarser fraction has local road safety, agricultural and environmental impacts on travelers and on residents near unpaved roads. It is highly likely that impacts of long-term exposure to dust experienced by children and adults living close to and travelling regularly along unpaved roads will be additive to the high concentration levels from exposure to other sources of particulates (biomass fuels) that cause the 1.5 – 2.0 million premature deaths amongst mostly women and children in developing countries.

To quantifying deposition of total dust and dust particle up to 75 microns on the roads, **Regional Office, U.P. Pollution Control Board, Gorakhpur** has carried out monitoring of total dust load and dust particles up to 75 microns (Aerodynamic particles size) on certain selected roads of Gorakhpur city.

i. Monitoring Locations

Roads selected for dust monitoring are as follows:

- Gorakhpur-Lucknow road, near Dana-Pani Restaurant GIDA, Gorakhpur.
- Kali mandir Shashtri chowk road, near Jal-kal building, Golghar, Gorakhpur.
- Gorakhpur-Maharajganj road, near Khajanchi chauraha, Gorakhpur.
- Gorakhpur-Sonauli road, near Bargadwa chauraha, Gorakhnath, Gorakhpur.

- Gorakhpur-Deoria road, near Madan Mohan Malviya Technical University, Gorakhpur.

ii. Methodology

More than 200 grams of road dust samples collected within marked area across width (m^2) of the roads through sweeping of the roads, using a Vacuum cleaner fitted with a Brush on the suction end and Nylon Bag on the delivery end to collect the dust samples. Collected dust put in chain locked sachet. Sachet marked with permanent marker for identification of locations/address of road and area. Samples carried in the laboratory for further analysis. Total weight of the samples recorded. Entire samples dried in the oven at 105^0C for 12 Hours. Dried Samples reweighed and moisture contents of sample calculated. 200 grams of total dried sample screened properly using 200-mesh standard size sieve using mechanical shaker. Particles up to 75 microns properly segregated and collected in a pan and weighed. Mass (grams/ m^2 area of the road) of dust calculated.

Observed values of total dust and dust particle up to 75 microns depicted in T**able-19** specifying the location/ coordinates of roads selected for monitoring. Ambient Air Quality of Gorakhpur City and temperature, humidity and PM_{10} level depicted in **Table-20.**

iii. Observation

On perusal of the data depicted in **Table 19 and 20** following observations are drawn:

- Mass of total dust has been found in the range of **32.7 to 37.7 g/m²**. Maximum value 37.7 g/m^2 has been found at Kali mandir Shashtri chowk road near Jal-kal building, Golghar, Gorakhpur and minimum value 32.7 g/m^2 has been found at Gorakhpur-Maharajganj road, near Khajanchi chauraha, Gorakhpur.
- Mass of dust load up to 75 microns (Silt load) has been found in the range of **6.29 to 8.19 g/m².** Maximum value 8.19 g/m^2 has been found at Gorakhpur-Maharajganj road, near Khajanchi Chauraha, Gorakhpur and minimum value 6.29 g/m^2 has been found at Gorakhpur-Deoria road, near Madan Mohan Malviya Technical University, Gorakhpur.
- Quantification of mass of total dust load in respect to area of road per kilometre distance (L*W) reveals that **maximum total dust load 918.4 Kg per kilometre** has been found at Gorakhpur-Deoria road, near Madan Mohan Malviya Technical University, Gorakhpur and **minimum 568.98 Kg per kilometre** has been found at Gorakhpur-Maharajganj road, near Khajanchi Chauraha, Gorakhpur.

Table 19: Monitored Values of Total Dust and Dust up to 75 microns

S.No.	Location with Geo-Coordinates	Location Photographs	Total Dust (grams/m^2)	Dust upto 75 microns (grams/m^2)	Average Width (m)	Total Dust (kg/km)	Dust up to 75 microns (kg/km)
1	**Gorakhpur-Lucknow road Near Dana Pani Restaurant GIDA, Gorakhpur.** Lat.-26.75118 Long.-83.22507		34.5	7.438	18	621	133.8
2	**Kali Mandir Shashtri Chowk Road Near Jalkal Building Golghar Gorakhpur.** Lat.-26.750850 Long.-83.370339		37.7	6.335	20	754	126.7

3	**Gorakhpur-Maharajganj Road Near Khajanchi Chauraha Gorakhpur.** Lat.-26.797263 Long.-83.389036		32.7	8.19	17.4	568.98	142.5
4	**Gorakhpur-Sonauli Road Near Bargadwa Chauraha, Gorakhnath, Gorakhpur**. Lat.-26.806463 Long.-83.25126		36.208	7.59	18	651.744	136.62

5	**Gorakhpur-Deoria Road Near Madan Mohan Malviya Technical University, Gorakhpur.** Lat.-26.72987 Long.-83.43112		32.8	6.29	28	918.4	176.12

Table 20: Ambient Air Quality Monitoring details during Dust Collection at of Gorakhpur City

S. No	Date	Location	Temperature (^{0}C)	Relative humidity %	Wind Direction	Value of PM_{10} ($\mu g/m^3$)
1.	23.11.2020	MMM University of Technology, Gorakhpur	16-28	32-58	West to East	110.56
2.	23.11.2020	Indian Glycol Limited, GIDA, Gorakhpur	17-30	30-60	West to East	319.26
3.	26.11.2020	Jal-kal Bhavan, Golghar, Gorakhpur	19-33	30-62	West to East	203.38

Source- Manual Monitoring

b) *Emission Inventory of road Dust*

Dust emissions from paved and unpaved roads have been found that these vary with the 'silt loading' present on the road surface and average weight of vehicles travelling on the road. The term silt loading (***sL***) refers to the mass of the silt-size material (equal to or less than 75 µm in physical diameter) per unit area of the travel surface. The quantity of dust emissions from movement of vehicles on a paved or unpaved road can be estimated using the following empirical expression:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

Where-

E: Particulate Emission Factor (same units as "k")

sL: silt load (g/m^2)

W: Mean Weight of the Vehicle fleet (Tons)

k: Constant (function of particle size) in g VKT-1 (Vehicle kilometer Travel) (e.g., k = 0.62 for PM_{10} and k=0.15 for $PM_{2.5}$).

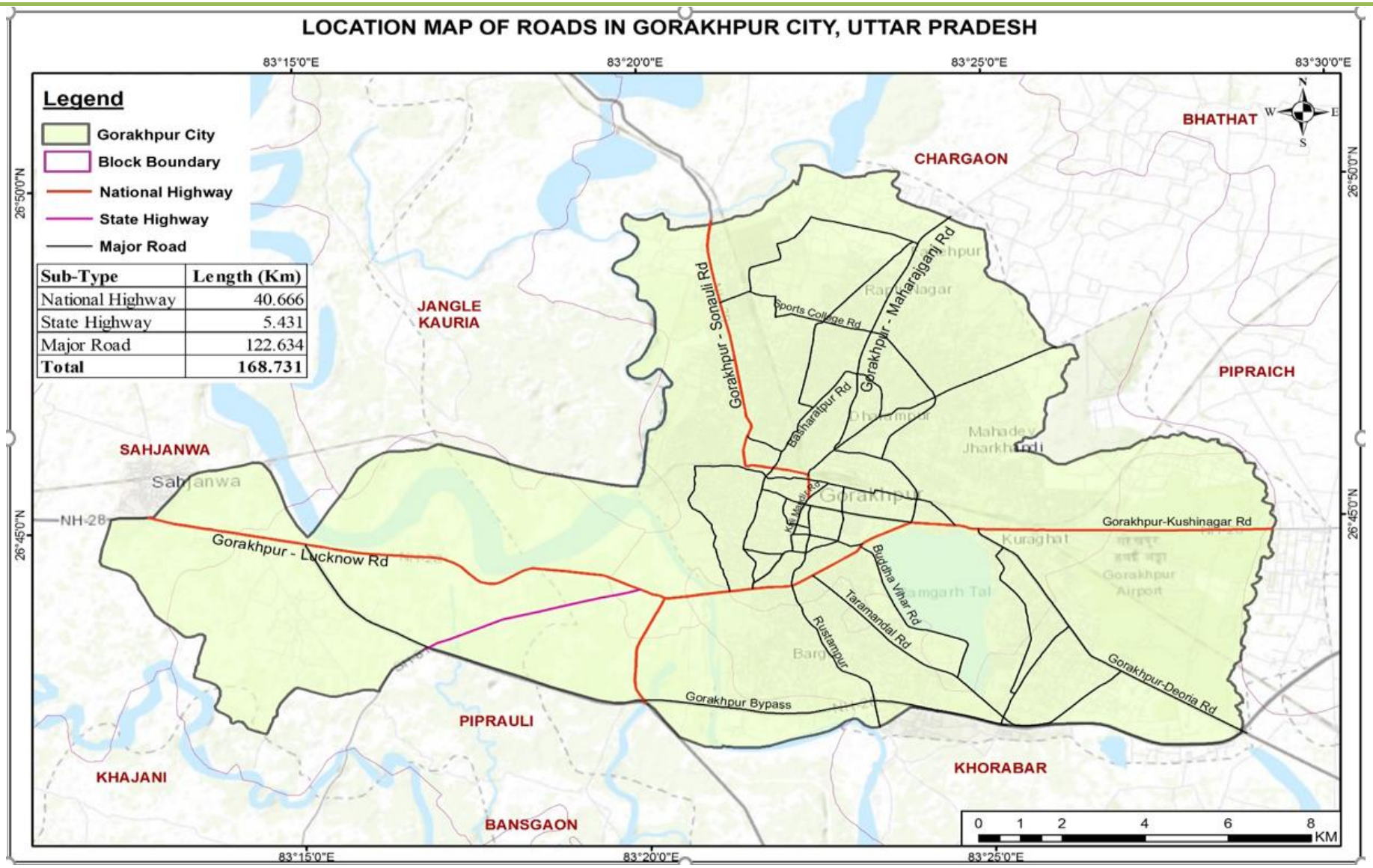
The silt loads (sL) samples from major 05 roads were collected (**Table-19**). Then mean weight of the vehicle fleet (W) was estimated by giving the weightage to the percentage of vehicles of all types with their weight. Then emission rate (g VKT-1) was calculated based on above Equation. VKT for each road was calculated by considering the tonnage of each road. Then finally the emission loads from these roads were calculated.

A digital map showing the national & state highways, major roads are attached **(Fig 53)**. The municipal boundary length of the major roads, national & state highways of the city are as follows:

Road Type	Municipal Length of Road (Km)
National & State Highway	45
Major Roads	123

In this case study following assumptions is taken in calculations for emission inventory of PM_{10} & $PM_{2.5}$ from road dust-

- As the monitoring road locations (Gorakhpur-Lucknow road, near Dana-Pani Restaurant GIDA, Gorakhpur, Gorakhpur-Maharajganj road, near Khajanchi chauraha, Gorakhpur, Gorakhpur-Sonauli road, near Bargadwa chauraha, Gorakhnath, Gorakhpur & Gorakhpur-Deoria road, near Madan Mohan Malviya Technical University, Gorakhpur) are connected with state/National highways so the vehicle fleet pattern is taken same for them. Total length of said 04 roads are taken as 45 Km with in the city.
- Road Location (Kali mandir Shashtri chowk road, near Jal-kal building, Golghar, Gorakhpur) is internal road of Gorakhpur city so total length of said road is taken as 123 Km with in the city.
- Average emission rate of PM_{10} & $PM_{2.5}$ from road dust in Kg/Km/Day by 05 monitored road are taken for calculation of city level emission rate (Ton/Day).



-Figure 53: Location map of roads in Gorakhpur city

Table 21: Observed Values of Silt Load (sL), Mean weight of the vehicle fleet (W) & Emission Rate of PM10 (Kg/Km/Day) & PM2.5 (Kg/Km/Day) from road dust in Gorakhpur city

S. No.	Location with Geo-Coordinates	Location Photographs	Silt Load sL (gm/m2)	Mean Weight of the Vehicle fleet (W) (Ton)	Emission Factor for PM_{10} (gm/VKT)	Total Emission of PM_{10} (kg/Km/day)	Emission Factor for $PM_{2.5}$ (gm/VKT)	Total Emission of $PM_{2.5}$ (kg/Km/day)
1	Gorakhpur-Lucknow road near Dana-Pani Restaurant GIDA, Gorakhpur. Lat.-26.75118 Long.-83.22507		7.43	3.99	15.82	484.77	3.82	117.28

2	Kali Mandir Shashtri Chowk road near Jal-kal Building Golghar Gorakhpur. Lat.- 26.750850 Long.- 83.370339		6.33	0.89	2.98	88.97	0.72	25.52
3	Gorakhpur-Maharajganj road near Khajanchi Chauraha Gorakhpur. Lat.- 26.797263 Long.- 83.389036		8.19	3.99	17.27	529.18	4.17	128.02

4	Gorakhpur-Sonauli Road Near Bargadwa Chauraha, Gorakhnath, Gorakhpur. Lat.-26.806463 Long.-83.25126		7.59	3.99	16.11	493.78	3.89	119.46
5	Gorakhpur-Deoria road near Madan Mohan Malviya Technical University, Gorakhpur. Lat.-26.72987 Long.-83.43112		6.29	3.99	13.58	416.18	3.28	100.69

Table 22: City Level Emission Rate of PM10 (Kg/Day) & PM2.5 (Kg/Day) from road dust in Gorakhpur city

Road Type	Municipal Length of Road (Km)	Average PM_{10} (Kg/Km/Day)	Average $PM_{2.5}$ (Kg/Km/Day)	Emission Rate PM_{10} (Ton/Day)	Emission Rate $PM_{2.5}$ (Ton/Day)
National & State Highway	46	480.98	116.36	22.12	5.35
Major Roads	123	88.97	25.52	10.94	3.14
City Level Emission Rate				**33.07**	**8.49**

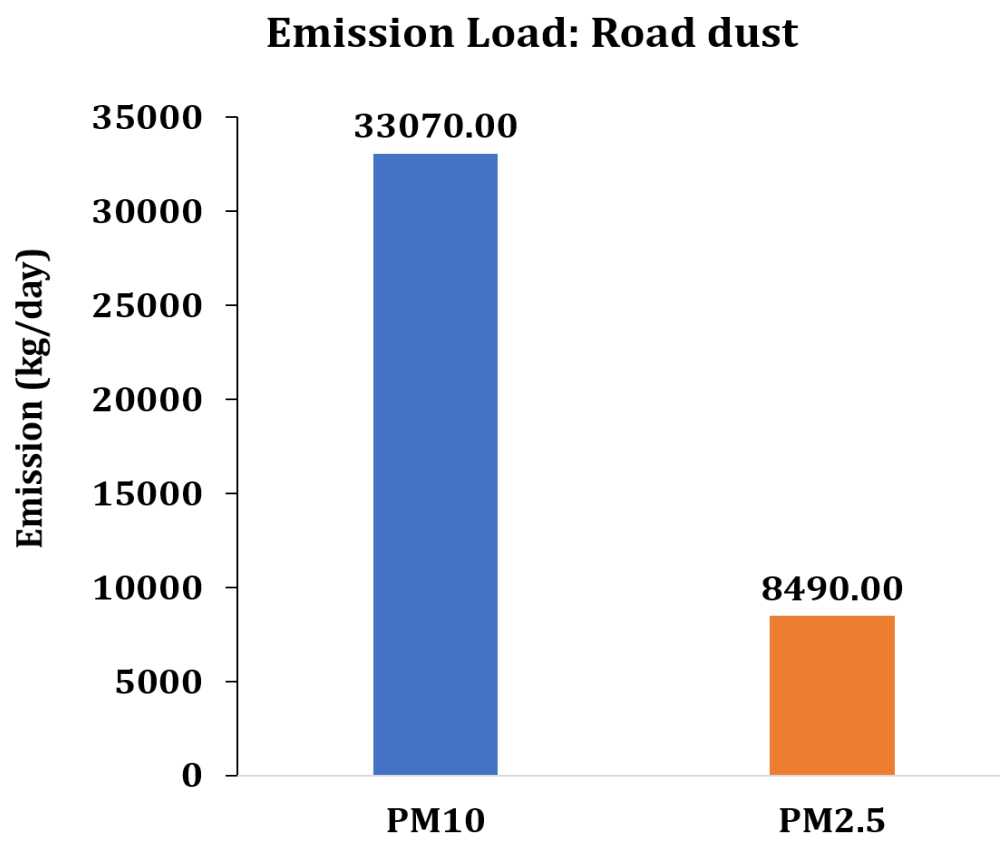


Figure 54: Emission load for road dust in Gorakhpur city(kg/day)

c) *Measures to control Road dust*

The strategy for control of road dust include-

i. Edge to edge paving/greening, Road shoulder (unpaved part) should be covered with interlocking tiles or grass.
ii. Water sprinkling on unpaved roads
iii. Making the roads pothole free
iv. Roads should be regularly cleaned using mechanical sweeping machines and collected dust should be dumped at proper place, so that it could not deposit again on the roads
v. Night washing of the paved roads using treated sewage from STPs.
vi. Regular monitoring of the dust load on the road and its effective removal
vii. Ensuring that the building material is fully covered while transporting
viii. Wheel washing
ix. Ensuring no C & D Waste stored on the road side
x. Evolve SOP for addressing the specific issue of disposal of collected dust from mechanical sweeping, taking into consideration all the above cited factors.
xi. Stringent implementation of C&D Rules, 2016, and Dust Mitigation notification, 2018, of Government of India.
xii. Whenever, road washing is not possible, dense sprinkling through treated sewage mixed with dust suppressant should be done regularly.

xiii. Continuous operation of fountains at main roads crossing and parks should be done regularly.

xiv. Anti-smog guns should be installed at main hot spot areas.

d) *Construction and Demolition Dust*

The emission factors given by AP-42 (USEPA, 2000) were used for estimating the construction and demolition emissions. The major construction activities include buildings (including residential housing and apartments) and flyover development. The areas under construction activities were calculated based on data from UPPCB- regional office, Gorakhpur, and Google Earth. Total emissions from construction and demolition activities are presented in **Table-23** and **Figure-55**.

Table 23: Classification of Construction Activities Emission Load (kg/day)

S.No	Particulars	PM10	PM2.5
1	Building Construction	18895.93	7558.37
2	Flyover/Road Construction	7689.94	3075.98
	Total	**26585.87**	**10634.35**

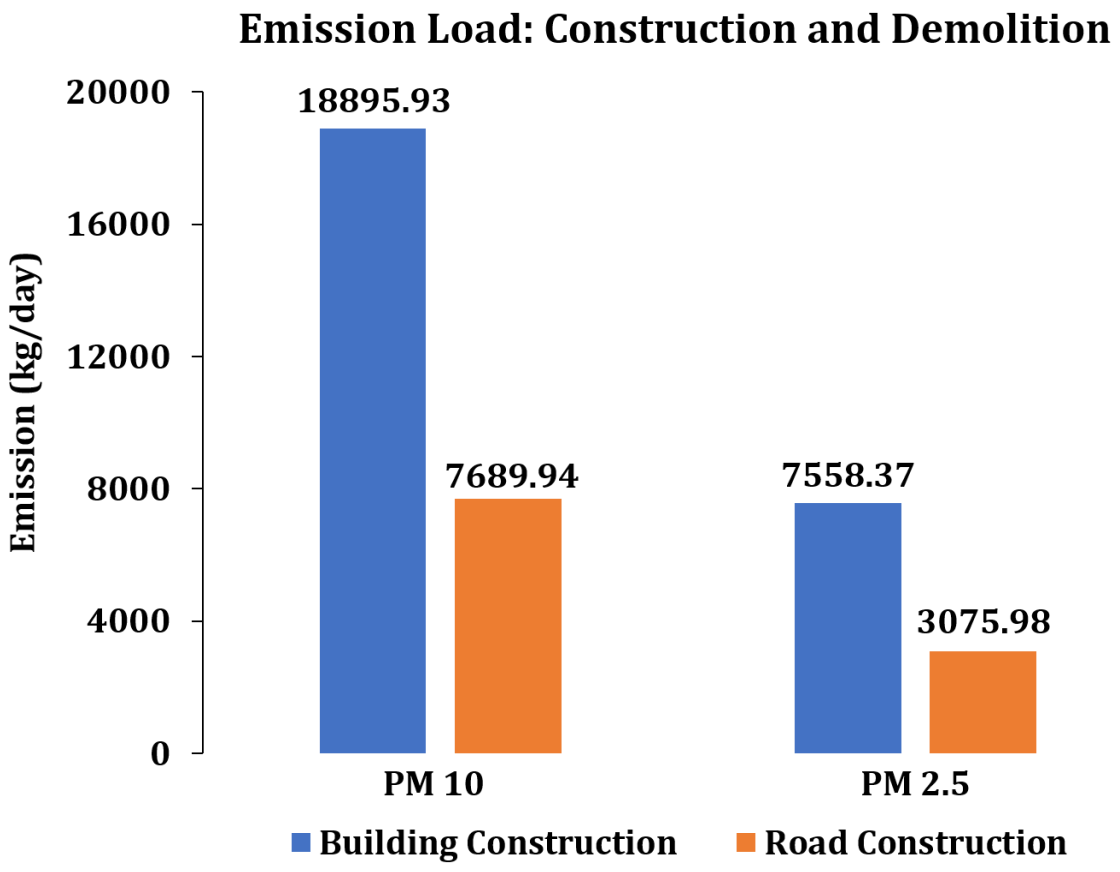


Figure 55: Emission Load from Construction and Demolition activities

The details are listed in the table below and depicted in the map below:

Table 24: Details of ongoing construction projects

S No	Construction site	Latitude	Longitude	Type of construction
1	LIG Building Part A	26°49'11.86"N	83°23'5.06"E	Residential Project
2	LIG Building Part B	26°49'12.09"N	83°23'8.69"E	Residential Project
3	LIG Building Part C	26°49'9.75"N	83°23'12.74"E	Residential Project
4	Lake View Vistar Building	26°43'39.36"N	83°23'24.00"E	Residential Project
5	Multiplex parking	26°45'7.92"N	83°22'12.00"E	Parking
6	Mahadev Jharkhandi	26°44'47.00"N	83°24'52.00"E	Residential Project
7	AIIMS Gorakhpur	26°44'47.00"N	83°25'14.00"E	Hospital
8	Near Nauka Vihar	26°43'24.00"N	83°23'48.00"E	Residential Project
9	Gorakhpur Zoo	26°42'45.00"N	83°24'26.00"E	Recreational construction
10	Gorakhpur-Maharajganj-Nichlol (11 Km strech)	26°46'4.77"N	83°22'47.03"E	Flyover Construction
		26°49'3.57"N	83°24'2.90"E	
11	Gorakhpur-Maharajganj-Nichlol (08 Km strech)	26°49'25.70"N	83°24'30.46"E	Flyover Construction
		26°53'49.09"N	83°29'15.04"E	
12	Sonauli Nautanva-Gorakhpur- Deoria-Balia Road	26°41'42.00"N	83°28'53.87"E	Flyover Construction
		26°38'31.49"N	83°35'21.73"E	
13	Nagar Nigam Sadan Bhawan	26.44'51'' N	83.22'5''E	Building Work
14	Pond beautification in jharna Tola	26.75'84''N	83.41'41''E	Pond Beautification
15	Chatth Mata mandir Pond beautification in Mahuisudharpur	26.72'86''N	83.36'99''E	Pond Beautification
16	Pond beautification in Gadariya	26.78'55''N	83.38'33''E	Pond Beautification

	tola/Khatik tola in Basaratpur			
17	Pond beautification in Chilmapur in Rustampur	26.43'39''N	83.22'21''E	Pond Beautification

The locations of the construction sites as shown in the map reveal valuable information that all the construction sites are in close vicinity of the monitoring stations. The status of the adoption of dust control measures in the construction sites of Gorakhpur is very poor. This explains the sharp increase in the PM10 levels in the monitoring data from 2017 onwards as most of the construction projects started from 2019 onwards. The control of construction dust shall be a major challenge and will have to be taken as one of the high priority actions in this Action Plan.

e) *Dust emission from Railway siding*

Railway siding in Gorakhpur is identified as high dust generating spot. The major causes of air pollution in this area near are siding, garbage fires, vehicular pollution, wind-blown dust through unpaved roads and over burdens traffic congestion in the area.

The height of material stack within storage areas must be kept below the height of the boundary wall. Three tire plantations all along the boundary wall and other available space at Railway Siding will be effective as dust barriers.

Figure 56: Dust emission at Railway siding, Gorakhpur

The practices to be adopted in the construction projects for control of dust emissions and mangement of demolition waste are given below:

i. The Construction and Demolition Waste Rules and Regulations, 2016 have mandated reuse of recycled material. A significant proportion of construction waste can be recycled and reused and brought back to construction to substitute naturally sourced material. This demands a circular economy that can turn C&D waste into a resource. This can help reduce energy intensity and environmental footprints of buildings and infrastructure. Usage of recycled aggregates can not only preserve the finite raw materials but also reduce energy consumption and overall construction costs.

ii. Certain components of demolition waste such as plasterboard are hazardous once landfilled as it is broken down in landfill conditions releasing hydrogen sulfide, a toxic gas. It is important for having a proper in-situ Construction waste management plan for Gorakhpur city with the facility of sorting and transformation.

iii. All areas for storing C&D wastes/construction material to be demarcated and preferably barricaded particularly those materials that have the potential to be dust borne.

iv. Use of demolition waste as a raw material in the brick-making as a substitute for fertile soil.

v. Fine material, such as sand, dust, etc. can be used as cover material over the sanitary landfill.

vi. Wet suppression is the most convenient method for controlling construction dust at the site.

vii. Speed of transportation vehicle at the construction site must be minimized to avoid fugitive emission.

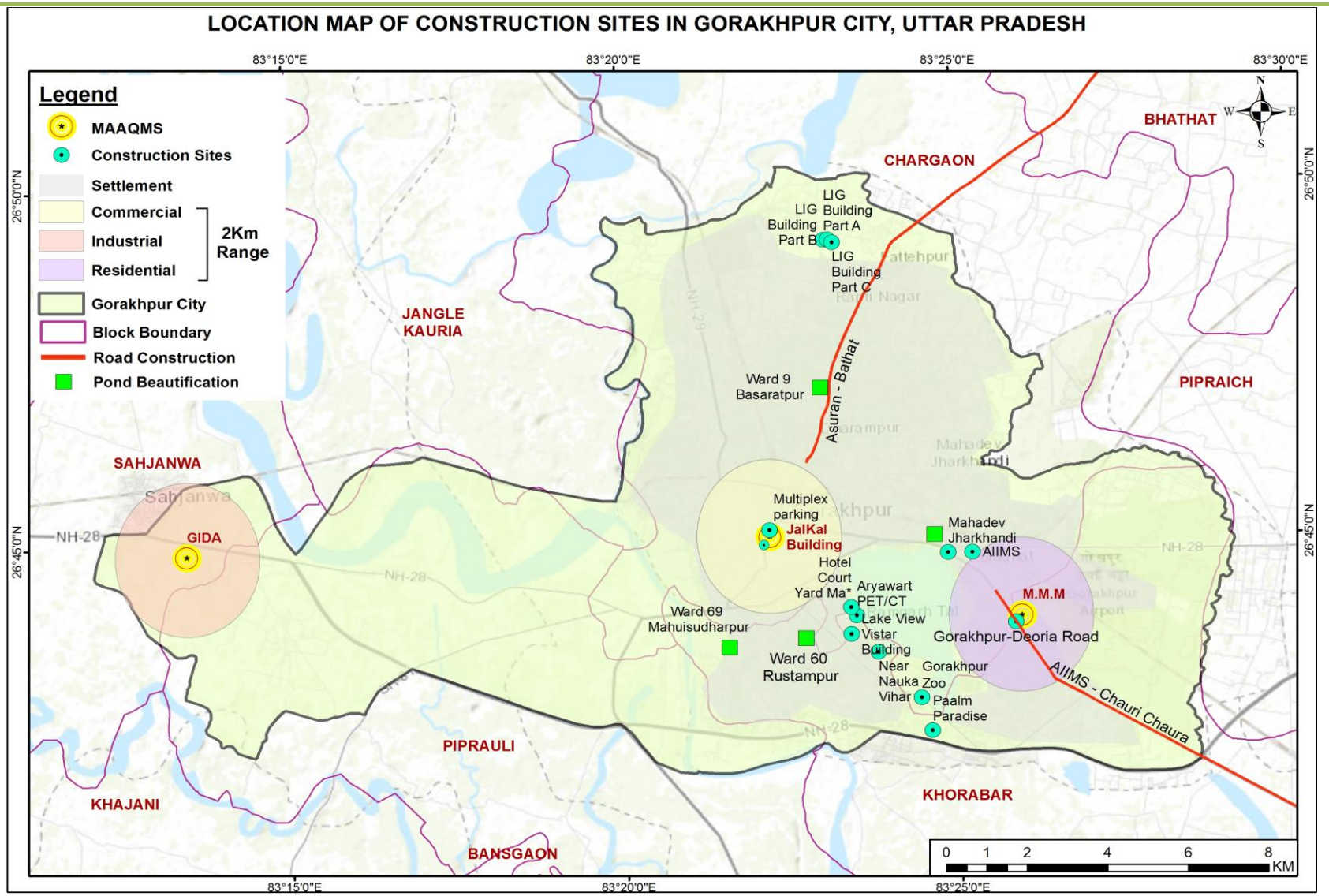


Figure 57: Construction Sites in Gorakhpur city

The practices to be adopted in the construction projects for control of dust emissions are given in the table below-

Table 25: Details of practices to be adopted for control of construction dust

Field	Practices to Reduce Emissions
Treated Water Application	Applying treated water to mitigate dust generation on the construction site. (Water can be applied by a variety of methods, for instance, **Anti-Smog Guns**, trucks, water pulls, water cannons, hoses, fire hydrants, sprinklers, etc.)
Dust Suppressants	Use of dust suppressants: (i) liquid polymer emulsions (ii) agglomerating chemicals (e.g., lignosulfonates, polyacrylamides); (iii) cementitious products (e.g., lime-based products, calcium sulphate); (iv) petroleum-based products (e.g., petroleum emulsions); and (v) chloride salts (e.g., calcium chloride and magnesium chloride).
Design	Designing the layout of the construction site to minimize fugitive dust generation potential, including access roads, entrances and exits, storage piles, vehicle staging areas, and other potential sources of dust emissions.
	Use of pre-fabricated materials and modular construction units.
	Minimize distances traveled for delivery of materials
Site Preparation	Utilize wind fencing around the site
	Use of scaffolding sheets/nets for dust control
	Stabilize completed earthworks with stone/soil/geotextiles/Vegetation/compacting
	Reduce certain activities during windy conditions
Storage Piles	Utilize enclosures/coverings for storage piles e.g. tarpaulins, plastic, agrished nets, or other material
	Utilize wind fences/screens for storage piles
	Storage pile activity (Loading & unloading) should be conducted downwind
	Properly shape storage piles so that they do not have steep sides or faces. Besides, sharp changes of shape in the final storage pile should be avoided.
	Properly schedule the delivery of landscaping materials to minimize the storage time on site
Vehicles and Equipment	PUC Certificate for vehicles used for transport of materials
	Covering of building material during transportation

	Ensuring adequate stack height and acoustic enclosures for DG Sets
Material Handling & Transfer Systems	Remove material from truck underbodies and tires prior to leaving the site as well as implement techniques to periodically remove mud/dirt track out/carryout from paved streets at the access point(s).
	Prevent PM emissions from spills
	Capture fugitive dust emissions
	Ensuring proper collection, Segregation and disposal of C& D Waste and maintenance of log book for disposal
	Minimize material drop height at the transfer point and ensure enclosure around transfer point
Road Surfaces	Surface improvements to unpaved road surfaces
	Proper maintenance of unpaved roads
Fabrication	Applying water spray in conjunction with cutting, grinding & drilling
	Apply wet process for Sand and grit blasting and façade cleaning
	Ensure Mixing processes in enclosures
	Dust suppression/collection equipment should be attached when using sanding and cutting machinery. In addition, vacuum cleaning should be used whenever possible.
Monitoring	Installation of display board in Construction site mentioning the Details of statutory environmental clearance, Name, address, contact no. & email of Site In charge and owner
	Installation of PTZ Camera with open access to UPPCB
	Whether internal daily Monitoring Protocols Developed
	Daily Monitoring Spreadsheet and status of Monitoring

UPPCB has developed an online system of **Self Declaration of Dust Control Audit** dustapp.upecp.in for construction projects through which every construction project has to self-declare online status of dust mitigation measures in the project. The objective is to guide the project proponents and their site in charges, the relevant dust control measures to be taken up on one side and enthuse in them the system of self-auditing. This declaration will also be periodical so that the shortcomings in the dust mitigation measures may be addressed and declared by the projects. Besides this, UPPCB has also issued directions under the provisions of Air Act for installation of Pan Tilt Zoom Cameras in the construction projects and providing its open access to UPPCB so that 24x7 virtual monitoring may be done from the UPPCB end.

Figure 58: Construction site in Gorakhpur city

K. Management of Solid Waste and garbage burning

a) *Municipal Solid Waste (MSW) Burning emission estimation*

Open burning activities are broadly classified into refuse and biomass burning. The refuse or municipal solid waste (MSW) burning depends on solid waste generation and the extent of disposal and infrastructure for collection. The contribution of MSW burning may surprise many persons. It is a myth that MSW is not burned in Gorakhpur. This emission is expected to be large in the regions of economically lower strata of the society which do not have proper infrastructure for the collection and disposal of MSW. The emission factors given by CPCB (2011) and AP-42 (USEPA, 2000) were used for estimating the emission from MSW burning using the same procedure of emission density in city w.r.t total population. There is one unauthorized dumping area in Akla Bandh, Near Rajghat, and Gorakhpur. The emissions from MSW burning are presented in **Figure-58.**

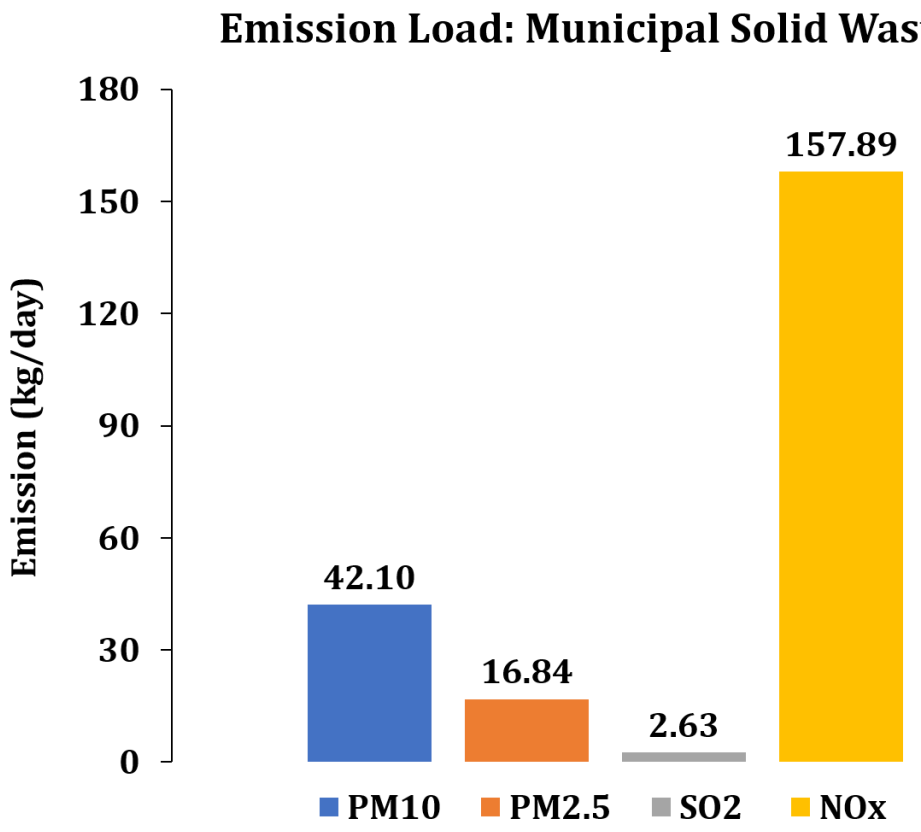


Figure 59: Emission Estimation for MSW Burning

b) *Status and Gaps in MSW management*

Gorakhpur, a low-lying and bowl-shaped city of Eastern Uttar Pradesh, is rich in cultural heritage and historical importance. At present, the municipal corporation Gorakhpur (MCG) has no solid waste management system in place. The whole solid waste generated is being disposed of either along the roads or are being used as landfilling material. It was found that daily on an average per capita solid waste generation from the residential area of the city is about 0.6 kg. The total quantity of waste generation in Gorakhpur is about 402TPD out of which only 350 TPD is being addressed. Household and commercial waste comprises the maximum percentage of solid waste generated. According to a study conducted on MSW in Gorakhpur, only 44.73% of total solid waste is of biodegradable nature. The recyclable waste (polyethylene, plastic, paper cartoon) which account 13.97% of total waste are often segregated manually by rag pickers. It is very necessary to know the future amount of solid waste generation because of technological development which is required to handle these wastes in an efficient manner.

The waste collected from one area is generally dumped in another, especially the low-lying water logging prone areas. The poorly maintained older landfill sites are silently contaminating the groundwater due to leachate production, but there is not much awareness about this. A lot of the waste is left piled up by the roadside to fall back into the drains. Ninety percent of the city's drains are not covered. Most of these drains are

along the roads. Doorstep collection is done in only in 10 out of the 206 colonies of the city, but the collection is not very regular. There are municipal solid waste collection points (Kura Garh) in 40 locations. The major markets and commercial establishments too contribute their share to this chaos of solid waste mismanagement.

According to the GMC, the city's 15 main commercial markets contribute about 30 tonnes per day of solid waste. Then there are the mixed zones comprising commercial (shops and markets) residential areas. Some 530 of them are used as small and medium vegetable, fruit and fish markets in the residential area. The Mahewa market is one of the biggest markets for vegetable, fruits and fish. The total waste generated by these markets is estimated to be about 10 tonnes per day. In the markets too, the system of primary collection proves ineffective as wastes are dumped by the generators on the streets/ roads. Water bodies in an around the city are under increasing threat due to the lack of a regular dumping ground. Garbage is dumped near the Chilua Tal, Maheva, Domingarh and many other low-lying areas. Refuse is thrown on the roadside in many of these places, sometimes set aflame or dumped into the fields. The Chilua Tal, a fresh water lake that ultimately drains into the Rohin river, is getting affected because of this. The Rohin too is getting affected. Solid wastes are also dumped into the area aside the Rapti river.

In Gorakhpur city both centralized and decentralized solid waste management are being practiced. The centralized waste management waste is not collected in efficient manner which results in overflowing garbage bins at the public collection site. One of the obvious advantages of a decentralized system is the improved aesthetic and hygiene condition in the locality. For cities like Gorakhpur, decentralized solid waste management will be more useful. Directly proportional to population increase, the solid waste problem has become one of the prime concerns for the city Government. The efficient collection of waste reduces the overflowing and sanitary conditions. In this regard a more efficient utilization of scientific invention for sustainable handling of the waste is required.

Figure 60: Municipal Solid waste dump site

c) *Proposed plan for Solid Waste Management*

Solid waste management facility of 240 TPD capacity is proposed to be installed and commissioned by December 2020. In addition, Material Recovery facility is also proposed by December 2020.

d) *Details of legacy waste dumping site*

Due to huge gap in the generation and treatment of MSW, the problem of legacy waste is very serious in Gorakhpur City. This necessitates the strict vigil in on burning of MSW by the Nagar Nigam and UPPCB as a short-term measure. The Municipal Corporation must take up the establishment of MSW Treatment facility on war footings. As per future plan, the remediation of legacy waste shall be completed within 02 years.

Table 26: Details of legacy Waste dumping Sites in Gorakhpur

S.No.	District	Name of Dumping site	Legacy/ Current	Estimated quantity of MSW (TPD)	Name of ULB/ Panchayat	Disposal Plan (Yes/ No)
1	Gorakhpur	Mahesara Jungle Hakim No. 1, Gorakhpur	Legacy	231340	Nagar Nigam, Gorakhpur	No
2	Gorakhpur	Akala Bandh, Nausad, right bank of riverRapti, Gorakhpur	Legacy	150000	Nagar Nigam, Gorakhpur	No

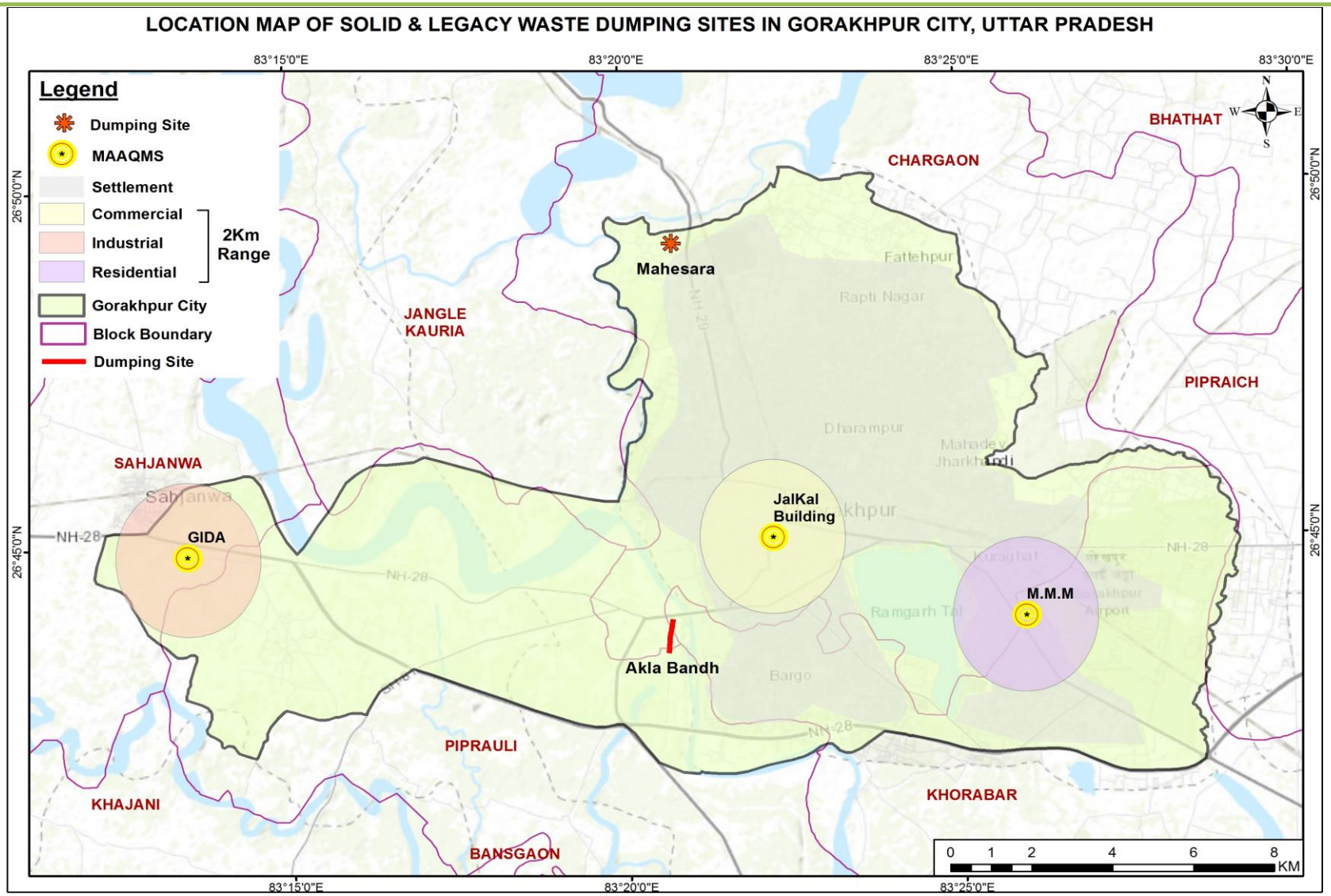


Figure 61: GIS map showing the Location of MSW treatment & dumpsites

Figure 62: Solid Waste Dump Site (unauthorized) at Akla Bandh, Gorakhpur

L. Greening & Afforestation

Population growth, climate change, resource depletion, pollution, and urbanization are all major global challenges facing humankind and nowhere more than in our cities. The quality of our urban environments is particularly at risk and vulnerable. As we move towards a more sustainable future cities must adapt to and address these contemporary challenges.

The role of green infrastructure in addressing the challenges of the 21st century cannot be underestimated. It is a natural, service providing infrastructure that is often more cost-effective, more resilient, and capable of meeting social, environmental, and economic objectives than 'grey' infrastructure.

The growth of future cities depends upon how well we can plan for the 'unplanned'. The generic theme evolving is that as cities expand, the 'informal' sector grows faster than the 'formal' sector. This means that our plans will need paradigmatic change to deal with the heterogeneous housing and mobility needs of growing city populations. We will have to plan spaces for activities that cannot always be well-defined and predicted. It is better to plan for what is inevitable than to turn a blind eye to the future.

In many cases a substantial transformation of city environments will be required to create effective Green Infrastructure and achieve a better balance between green and grey. However, by recognizing nature as an opportunity for an effective solution and by realizing that Green Infrastructure can be integrated and linked into existing and future built developments in an attractive way, the potential is there to create more livable cities with reducing impact of air population in particular on the people living in the Cities.

Urban particulate air pollution is a serious health issue. Green Infrastructure including trees within cities can remove fine particles from the atmosphere and consequently improve air quality and human health. Tree effects on PM2.5 concentrations and human health have been modeled and it has been found that the total amount of PM2.5 removed annually by trees varied from 4.7 tonnes to 64.5 tonnes, with annual values varying from $1.1 million in Syracuse to $60.1 million. Most of these values were from the effects of reducing human mortality.

a) *Green Infrastructures*

"Green infrastructure" is defined as open spaces, natural areas, urban woodland and parks; green streets, squares and public realm; sustainable drainage systems and healthy waterways, cycle ways and pedestrian routes within our city environments; and smaller scale green roofs, walls and facades. It has got following benefits-

Table 27: Benefits of Green Infrastructure

Environmental Benefits	Economic Benefits	Social Benefits
Improved Visual Amenity	Increased Property Prices	Encouraging Physical Activity
Enhanced Urban Microclimate	Increased Land Values	Improving Childhood Development
Improved Air Quality	Faster Property Sales	Improved Mental Health
Reduced Flood Risk	Encouraging Inward Investment	Faster Hospital Recovery Rates
Better Water Quality	Reduced Energy Costs via Microclimate Regulation	Improved Mental Health
Improved Biodiversity	Improved Chances of Gaining Planning Permission	Improved Workplace Productivity
Reduced Ambient Noise	Improved Tourist and Recreation Facilities	Increasing Social Cohesion
Reducing Atmospheric CO2	Lower Healthcare Costs	Reduction in Crime

b) *Types of GIs*

The following types of Green Infrastructures have been developed in the Cities across the world under different initiatives. However, this list is not exhaustive-

i. Miyawaki Forests
ii. Urban Forests
iii. Bio-diversity Parks & Wetlands
iv. Green Belts
v. Green Pavements
vi. Vertical Gardens & rooftop green houses
vii. Rooftop Greens
viii. Multi-layered and integrated green infrastructure
ix. Green Walls
x. Sustainable drainage system to clean by nature the Road run off
xi. Water roofs to attenuate storm water flows — by storing water temporarily on a flat roof.
xii. A pocket park: green space is valuable at all scales in the urban environment.

c) *Challenges*

The challenges for development of green infrastructure in particular reference to the Non-Attainment Cities of Uttar Pradesh include-

i. Absence of baseline and mapping of spaces available for retrofitting the City with nature
ii. Limited availability of space
iii. Know-how for development of Green Infrastructure & their SOPs
iv. Suitability of type of GI for a particular City and space available
v. Suitability of GIs on the basis of maximising the impact on air pollution and particulate matter
vi. Interventions for future city planning without infringing the development of the City
vii. Low-cost approach for development of suitable high impact GIs in consonance with the 7R principle

d) *Future Strategy*

i. Planned retrofitting of the City and development of green Infrastructures

UPPCB intends to institute a study for developing a plan for development of Green Infrastructures in Non-Attainment Cities of Gorakhpur along with the environmental & economic suitability and also providing with the Standard

Operating Procedures for all type's suitable GIs in a cost-effective manner for overall improvement of City Environment with particular reference to the reduction in air pollution & particulate matter. The proposed study includes preparation of a plan for development of GIs in 17 NACs of Uttar Pradesh including Gorakhpur under the following detailed scope-

- Reconnaissance Survey of all 17 NACs (Lucknow, Kanpur, Agra, Prayagraj, Varanasi, Jhansi, Khurja, Gajraula, Ghaziabad, Noida, Anpara, Bareilly, Moradabad, Meerut, Raibareilly, Firozabad & Gorakhpur) of Uttar Pradesh for the initial assessment of the types of space available for retrofitting the City with green Infrastructure
- Identification of Types of workable GIs for 17 NACs of Uttar Pradesh
- Suitability analysis of GIs with reference to Cost and reduction in pollution and specifically the reduction of air pollution in NACs on the basis of wind-rose diagrams
- Identification of ways and means of using the wastes for development and maintenance of GIs in order to reduce cost on the lines of 7R principle
- Preparation of SOPs for development of suitable GIs
- Preparation of GIS map of NACs to identify the spaces available for development of suitable GIs
- Development of an action plan for retrofitting the NACs with the GIs and suggestions for future planning for development of GIs after stakeholders consultation
- Publication of a bilingual field guide for the use of the ground level functionaries of the Government Department/Agencies to facilitate them the work of development of suitable GIs in cost effective and time bound manner.

ii. Taking up Afforestation on the basis of wind-rose study

The windrose for the four seasons have been plotted which indicate that the predominant wind direction is blowing from West North West, North-West, West, East North East,East and East South East direction. The wind pattern is very helpful in siting the locations preferable for plantation so that they may act as barriers to air pollution in the non prominent wind direction. The detailed area identification for plantation/development of Miyawaki Forests on the basis of wind rose pattern is enclosed as **Annexure No.- II**

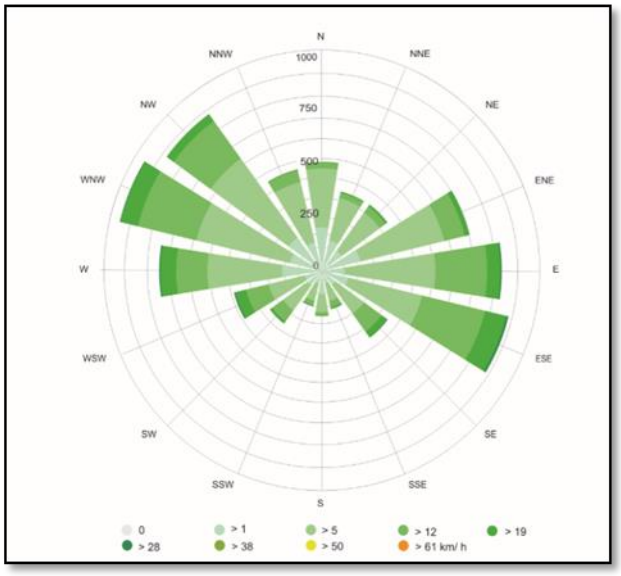


Fig: Yearly Windrose Pattern

M. Agriculture residue burning

Stubble burning creates a corollary in the form of emissions with implications for climate change, biodiversity, and human health in the affected region, disruptions in economic activity (traffic accidents and transportation delays). Apart from air quality lapse agriculture residue burning also cause losses in soil nutrients, soil organic matter, soil production and productivity, biodiversity, and water quality. The key factor responsible for stubble burning is the short time window available between rice harvesting and sowing of wheat in the rice-wheat cropping cycle.

The table below lists the number of burning incidents in Gorakhpur district during the months of October and November in the last 5 years. There is a significant decline in agricultural residue burning in 2019. In 2020, there is a slight increase in the burning incident.

Table 28: Details of agricultural residue burning incidents in Gorakhpur

Sources	Time Duration	No. of Crop Burning Cases in Gorakhpur
Paddy Crop Residue Burning	01-10-2016 TO 30-11-2016	67
	01-10-2017 TO 30-11-2017	115
	01-10-2018 TO 30-11-2018	142
	01-10-2019 TO 30-11-2019	20
	01-10-2020 TO 30-11-2020	61

Various measures have been taken at both the state and district level to stop agricultural residue burning. These measures include:

a) A ban on the burning of agricultural waste and crop residue has been imposed by the Environment Department under provisions of the Air act on 28.10.2015.

b) Govt. order dated 10.02.2017 has been issued by the Department of Agriculture to ensure the use of a combined harvesting machine and straw ripper with a binder to restrict the burning of agricultural residual waste.

c) A scheme of "Promotion of Agriculture Mechanization for In-Situ Management of crop residue is being run since the financial year 2018-19

d) Under the above mention scheme, the agricultural machines and equipment for in-situ crop residue management such as super straw management system for combine harvesters, happy seeders, hydraulically reversible MB plough, paddy straw chopper, mulcher, rotary slasher, zero till seed drill and rotavators are provided with 50 percent subsidy to the individual farmers and 80 percent subsidy for establishment of custom hiring centres.

Table 29: Details of stubble management Implements purchased or booked

A	**Stubble Management Implements Purchased/Booked by Farmers under In-Situ scheme:**		
		Purchased	Booked
1.	Individual Implements	22	181
2.	Farm machinery Bank of FPO/ Registered societies	8	3
3.	FMB of Gram panchayats, Cane and Cooperative Societies	11	
B	**Agricultural Implements Purchased under other Schemes:**		
1.	By farmers	248	

e) Information, Education and Communication (IEC) for awareness on in-situ crop residue management - financial assistance is provided

f) An order dated 05.01.18 has been issued by UPPCB for using a minimum 20% of bio briquette as fuel in the boiler/brick kilns depending upon its availability

g) Gorakhpur is one of the districts among the 31 District proposed to be covered under stubble waste decomposer usage. Order is placed for procurement of 260000 waste decomposer bottles for 31 districts with Microbiology division of IARI New Delhi and Shakti Bio fertilizers Orissa approved by National Council of Organic Farming, Ghaziabad

h) Fines and penalties are being charged if any burning case is reported

i) Under ex-situ management of crop residue, the paddy crop residue is being supplied to the cow shelters of the district.

j) Under ex-situ management of crop residue, Uttar Pradesh Govt in collaboration with Indian Oil Corporation (IOC) has sanctioned 01 second generation(2G) ethanol in Gorakhpur with 1600 TPD Bio-mass consumption capacity at defunct Dhuriapar Co-operative Sugar Mill. The technology and the plant, projected is capable of converting any biomass feedstock like wheat straw, rice straw, bagasse, cotton stalk, bamboo, etc. to alcohol

k) This 2G ethanol project will help in controlling stubble burning incidents and reducing vehicular emission by mixing ethanol in petroleum products.

l) One compressed biogas (CBG) plant of 40MT/ day capacity is under progress in Dhuriapur bio fuel complex which will process paddy straw to produce CBG for sale to motor vehicles in the same way as CNG.

All these efforts have resulted in decrease of burning incidents and strict implementation of all the measures will ensure complete stoppage of agricultural residue burning in the coming years.

N. Identification and Pollution Mitigation in the Hotspots

Air pollution hotspots in a region need to be identified for better environmental management. In this study identification of pollution, hotspots are considered within a 2 km radius area of a manual air quality monitoring station in Gorakhpur city. This focus on hotspot action is consistent with the global trend in which governments not only aim to reduce ambient air pollution but also protect vulnerable communities from extremely harmful local exposure; and strengthen health protection for all. There are 18 pollution hotspots in Gorakhpur city under different cause agents. Following Hotspots have been identified in Gorakhpur City-

Table 30: Details of hotspots in Gorakhpur

Source	Name of the Hotspot	Location	
		Latitude	Longitude
Road Dust/ Unpaved Roads	Gorakhnath-Dharmshala Road, Gorakhpur	26°45' 47.016" N	77°38'30.5"E
Industrial	Gorakhpur-Lucknow Road, Near Dana Pani Restaurant, GIDA, Gorakhpur	26°45' 4.248" N	83°13' 30.252" E
Vehicular/ Traffic Congestion	Gorakhpur-Kasia Road, Near Mohaddipur Chowk, Gorakhpur	26°44' 59.1468" N	83°23' 51.4752" E
	Kali Mandir-Shashtri Chowk Road, Near Jal Kal	26°45' 3.06" N	83°22' 13.2204" E

	Building, Golghar, Gorakhpur		
	Gorakhpur-Sonauli Road, Near Bargadwa Chauraha, Gorakhpur	26°48' 23.2668" N	83°15' 4.536" E
	Gorakhpur-Maharajganj Road, Near Khajanchi Chauraha, Gorakhpur	26°47' 50.1468" N	83°23' 20.5296" E
	Dharmshala - Golghar Road, Near Kali Mandir	26°45' 21.438" N	83°22' 23.0916" E
	Padleganj - Rajghat Road, Near Azad Chowk, Gorakhpur	26°44' 5.2332" N	83°22' 6.762" E
	Bank Road - Buxipur Road, Near SBI Bank, Gorakhpur	26°45' 16.686" N	83°22' 1.7868" E
	Sadar Hospital - Geeta Press Road, Near Ghosh Company Chok, Gorakhpur	26°44' 53.1492" N	83°21' 53.6652" E
	Ghantaghar Rajghat Road, Near Ghantaghar, Gorakhpur	26°44' 38" N	83°21' 25" E
	Reti Chowk-Ghantaghar Road, Near Reti Chowk, Gorakhpur	26°44' 49" N	83°21' 28" E
	Alinagar, Tarang Talkies Road, Near Alinagar, Gorakhpur	26°45' 30" N	83°21' 42" E
Construction	Gorakhpur-Deoria Road, Near Madan Mohan Malviya Technical University, Gorakhpur	26°43' 47.532" N	83°25' 52.032" E
	Paalm Paradise, Near Gorakhpur-Deoria By Pass Road, Taramandal, Gorakhpur	26°42' 17" N	83°24' 35" E
	Aryawart PET/CT and Gamma Camera Centre, Near Corporate Pass, Circuit House, Padleganj, Gorakhpur	26°43' 55" N	83°23' 29" E
	Hotel Court Yard Marriott, Near Circuit House, Padleganj, Gorakhpur	26°44' 2" N	83°23' 24" E

Garbage Dumping/ Burning	Akla Bandh, Near Rajghat, Gorakhpur	26° 43' 43.428" N	83° 20' 38.184" E

The hotspot action plans are expected to identify local pollution from non-compliant stack emissions, fugitive emissions, open burning of industrial waste, and municipal solid waste and dust generators for stronger local action. This will include penalty and deterrence. The pollution hotspot action plans will also provide for night patrolling and responsive action based on complaints. These hotspots have been identified by the Central Pollution Control Board (CPCB) and the UPPCB. The assessment of hotspots is currently generic and does not have any legal definition.

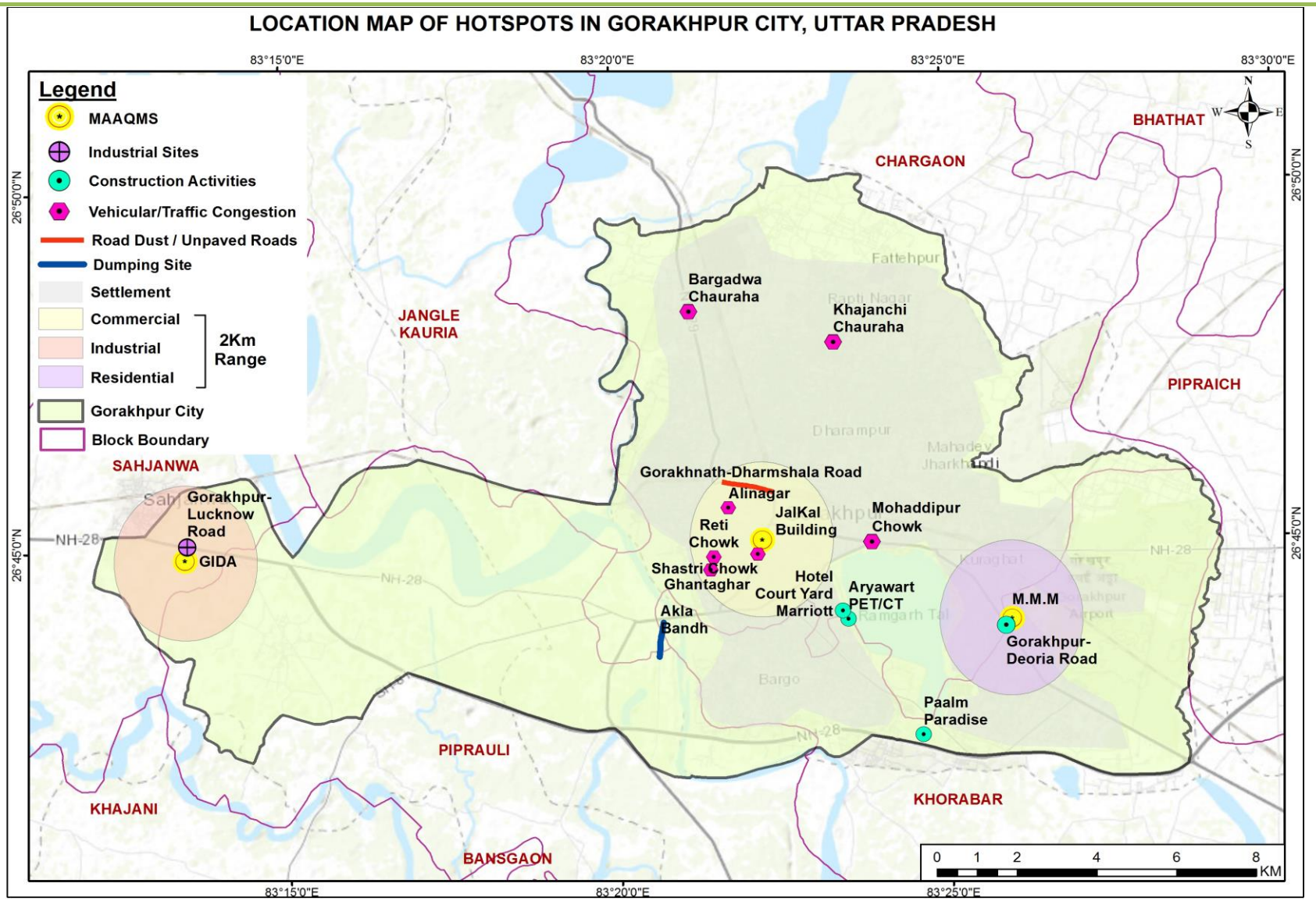


Figure 63: Location map of hotspots in Gorakhpur city

XI. PROPOSED ACTIONS

Short term &Long-term Action Plan along with the clearly defined timelines, cost estimates, Budget provisions and the responsible department/agencies is enclosed as **Annexure No-I**

XII. COST ESTIMATES

(All Figures in Rs. Lakhs)

S.No.	Interventions	Total Fund required	Funds Allocated	Funds released	Funds Utilized	Additional Funds Required
1.	Capacity building, monitoring network and source apportionment	884.306	245.56	234.56	34.56	638.44
2.	Public outreach	30	-	-	-	30
3.	Road dust activities	428410.58	298488.5	-	360.4	129922.08
4.	Construction activities	500	-	-	-	500
5.	Vehicles	23658.3	4321.7	2329.07	1600	19336.6
6.	Industries	90	-	-	-	90
7.	Waste and biomass-dumping and burning	9396.7	-	-	-	9396.7
	Total	**462969.9**	**3,03,055.79**	**2,563.63**	**1,994.96**	**159914.11**

XIII. MID TERM EVALUATION OF THE ACTION PLAN

The Action Plan shall be evaluated after the completion of comprehensive Source Apportionment Study and the Carrying Capacity Study is done in order to-

a) Review the impact of various actions based upon the monitoring of various pollution sources and their impact upon the ambient air quality

b) Prioritizing the action points on the basis of findings of the abovementioned studies

XIV. ANNEXURE -I

Summary

Basic Information		
Name of Non-Attainment City		Gorakhpur
Sate/ Union Territory		Uttar Pradesh
Name of Nodal Officer at PCB/ PCC		Rakesh Kumar Tyagi, Chief Environmental Officer
Email Id		ceolab@uppcb.com
Contact Number		7839891707
Action Point Code	Sector	Total Number of Actions
CB	CAPACITY BUILDING, MONITORING NETWORK AND SOURCE APPORTIONMENT	
PO	PUBLIC OUTREACH	
RD/ C&D	ROAD DUST AND CONTRUCTION & DEMOLITION	
VE	VEHICLES	
IP	INDUSTRIES	
BB/DF	WASTE AND BIOMASS- DUMPING AND BURNING	
AQ	AIR QUALITY DATA	

CAPACITY BUILDING, MONITORING NETWORK AND SOURCE APPORTIONMENT

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
CB1	**Installation& Commissioning of Monitoring Stations**													
CB1.1	CAAQMS	UPPCB	Number of CAAQMS	03 CAAQMS	01 (Feb.21) 02 (Dec. 21)	01 CAAQ MS	Yes	List of locations of CAAQMS	600.0(With purchase, installation and 05 years of O & M)	200	200	00	400 (With purchase, installation and 05 years of O & M)	15 FC/ MoEF &CC/ CPCB
CB1.2	Manual Stations: Upgradation & Establishment of background station	UPPCB	Number of Manual Stations	03 Manual Station's up gradatio n for PM2.5 & establish ment of 01 backgro und station	Dec. 2021	NA	Yes	List of locations of Installed Manual Stations	**39.556** 14.556 (for O&M per year) for 03 stations *As per CPCB guidelines under NAMP* Capex: 20 Lakh for upgradation & 5 lakhs for installation of background Total Capex: 25 Lakh	10.56 (for O&M per year) for 03 existing stations without upgradation	10.56	10.56	39.556	CPCB/ UPPCB /NCAP
CB3	**Assessment of sources**	UPPCB												

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
CB3.1	Emission Inventory	UPPCB	Yes	1	Dec. 2021	NA	NA	NA	15	0	0	0	NA	15 FC/ MoEF &CC/ CPCB
CB3.3	Source Apportionment Study	UPPCB	Yes	1	December, 2022	NA	NA	NA	55	0	0	0	NA	15 FC/ MoEF &CC/ CPCB
CB4	**Training & Capacity Building**							Steps taken						
CB4.1	Development of online training module with online test & certificate generation facility for training & skill development of public officials on Waste Management and ensure periodic trainings	UPPCB, Directorate of Environment & Concerned Departments	Number of modules developed & no of trainings organised	4 Modules	31.03.2021	4 modules	NA	Details of modules	35 Lakh	35 Lakh	24 Lakh	24 Lakh	11 Lakh	State/ UPPCB Consent Funds

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
CB4.2	Infrastructure development (Laboratory/ AQM Cell)	UPPCB	Yes	AQM Cell in Regional Office	June, 2021	NA	NA	NA	Capex 20.0 Opex 5.0/Year	0	0	0	NA	15 FC/ MoEF &CC/ CPCB
CB4.3	Enforcement Units	UPPCB /Nagar Nigam /Development Authority	Yes	3	Dec-20	_	NA	Details of Enforcement Units along with the facilities provided	24.75 lakh (@ 8.25 lakhs per unit including vehicles and 01 Staff)	0	0	0	NA	15 FC
CB4.4	Development of online training module with online test & certificate generation facility for skill development for improving operation of Air Pollution Control Systems installed at sources, operation of brick kilns, Cane Kohus etc. and ensure periodic trainings	UPPCB, Directorate of Environment & Concerned Departments	Number of modules developed & no of trainings organised	3	31.03.2021	_	NA	NA	30 Lakh	_	_	NA	NA	State/ UPPCB Consent Funds /CSR

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
CB4.5	Conduct study on development of Green Infrastructures in the City for Identification of suitable green infrastructures for control of air pollution and earmarking the places on GIS platform along with a publication of a field guide of SOPs	UPPCB	Yes	1	31.03.2022	Award of Study by UPPCB	Yes	Details of ToR and progress	10 Lakhs	_	NA	NA	NA	State/ UPPCB Consent Funds /CSR
CB5	**Emergency Response System**	State Disaster Management Authority/UPPCB	Yes	GRAP (Graded Response Action Plan) implemented	31.06.2021	Issuance of GO for implementation of GRAP	NA	Copy of GRAP & GO	NA	NA	NA	NA	NA	NA
CB6	**Carrying Capacity**													
CB6.1	Assessment of Carrying Capacity of NAC	UPPCB	Yes	1	March-23	NA	NA	NA	50.0	0	0	0	NA	15 FC/ MoEF &CC/ CPCB

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
CB6.2	Revision of Master Plan on the basis of Carrying Capacity of NAC	Gorakhpur Development Authority	Yes	NA	Dec 23	NA	NA	NA	NA	NA	NA	NA	NA	Gorakhpur Development Authority Funds
***In case timeline extends to more than one year the annual targets must be fixed.**														
****Mention specific numeric identity to the attachment. Example- Attachment-1**														

PUBLIC OUTREACH

Action Point Code	Action Point	Department / Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
PO1	**Public Outreach**													
PO1.1	Daily Air Quality Public Information Dissemination System	UPPCB/ CPCB	Yes	SAMEER App of CPCB is functional	Achieved	NA	NA	NA	NA	NA	NA	NA	NA	NA
PO1.3	Issue public advisory for prevention and control of air polltuion by newspaper publication and radio jingles	UPPCB	Number	Continuous Activity as and when needed	NA	NA	Yes	Number and detail of public advisories issued	10.0/Year	-	NA	NA	NA	15 FC/ MoEF&CC/ CPCB
PO1.4	Deeper public engagement and consultation (Hackathons/Workshops/ Programmes in schools/ colleges)	UPPCB/ DIOS/ University/ Colleges	Number	Continuous Activity	NA	NA	Yes	Number & details of public awareness events held	10.0/Year	-	NA	NA	NA	15 FC/ MoEF&CC/ CPCB
PO1.6	Develop & online awareness/orientation module with online test & certificate generation facility for Common Citizen in order to ensure their participation	UPPCB/Directorate of Environment	Yes	1	31.03.2021	NA	No	Number of Citizens trained/oriented	10.00 Lakhs	-	Nil	NA	NA	15 FC/ MoEF&CC/ CPCB

Action Point Code	Action Point	Department / Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
	(**ParyavaranPrahari**) in control of air pollution and ensure regular online training													
PO2	**Public GreivanceRedressal System**													
PO2.1	App Based System	UPPCB	Yes	Swacchavayu app is functional	Achieved	NA	No	Number of complaints registered and number of complaints resolved per month	NA	NA	NA	NA	NA	NA
***In case timeline extends to more than one year the annual targets must be fixed.**														
****Mention specific numeric identity to the attachment. Example- Attachment 1**														

ROAD DUST AND CONTRUCTION & DEMOLITION

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
RD1	**Road dust**													
RD1.1	Immediate lifting of solid waste generated from desilting and cleaning of municipal drains for its disposal	Nagar Nigam/Development Authority	No.	19 large drains	Regular activity	NA	Yes	List of Drains	NA	NA	NA	NA	NA	Nagar Nigam/ Development Authority Fund
RD1.2	Maintain potholes free roads	Nagar Nigam/ Development Authority	No.	02 Roads needs patch repair	31.03.2021	NA	Yes	(i) Infront of Buddha vihar part A, B & C parallel to deoria by pass length 2.45 km. (ii) west corner of champa devi park to residence of VC GDA length 0.48km.	11.78 3.10	-	NA	NA	NA	Development Authority Fund
RD1.3	Regular night cleaning of street surfaces and spraying of water to suppress dust.	Nagar Nigam/Development Authority	No.	For All Major Roads Purchase of 06 Water Sprinklers along with O & M cost for 4 years @ 50 L/Street Sprinkler	31.03.2025	To be Purchased and made operational by 31.03.2022	NA	NA	300	-	NA	NA	NA	Nagar Nigam/ Development Authority Fund

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
RD1.4	Black-topping of unpaved road	Nagar Nigam/Development Authority	km	44.50	31.12.2021	NA	NA	Seven Roads in Rapti Nagar Vikas Sheme.	2690.0	-	NA	NA	NA	15th Fiinance commission/ Nagar Nigam Nidhi. GDA Funds
RD1.6	To take appropriate action to remove road dust/silt regularly by using mechanical sweepers	Nagar Nigam/Development Authority	No.	For All Major Roads Purchase of 06 Mechanical Street Sweepers along with O & M cost for 4 years @ 2.5 Cr/Street Sweepers	31.03.2025	To be Purchased and made operational by 31.03.2022	NA	NA	1500	-	NA	NA	NA	Nagar Nigam/Development Authority Funds & NCAP Funds
RD1.7	End-to-end paving of the road	Nagar Nigam/Development Authority	Km	15	Regular activity	NA	NA	NA	540.00	-	NA	NA	NA	Nagar Nigam/Development Authority Funds

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
RD1.9	Introduce water fountain at major traffic intersection	Nagar Nigam/Development Authority	No.	10 major traffic intersections	31.03.2025	NA	NA	Major Traffic Intersection Points- 1. Ghantaghar 2. Townhall 3. University Student Union Building 4. University North 5. University South 6. Mohaddipur 7. Malgodam 8. Asuran 9. Golghar 10. Transport Nagar **Details attached as Annexure I (A)**	202.00	-	NA	NA	NA	Nagar Nigam Funds

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
RD1.11	Improvement of infrastructure for decongestion of road.	Nagar Nigam/Development Authority	2	NA	31.12.2023	NA	NA	1. Construction of 4 lane Gorakhpur Byepass 17.66 km	86,600	NA	NA	NA	NA	PWD/NHAI Funds
								2. Four laning widening and strengthening of NH-29E from km 81.420 to 99.00 sonauli - gorakhpur road (j)	28,800	288.53	-	83.53	NA	
								3. 4-lanning of varanasi Gorakhpur section of NH-29 from 148.00 208.300 km [package-iv]	2,98,200	2,98,200	-	276.87	NA	
								4. Smart Street Project	4900.0	NA	NA	NA	NA	State safe & Smart City
								5. ITMS project	4400.0	NA	NA	NA	NA	
RD1.13	Implement truck loading guidelines; use of appropriate enclosures for haul trucks; gravel paving for all haul routes.	Nagar Nigam, Development Authority, Construction Agencies	Yes	Regular Activity	NA	NA	NA	Guidelines will be included in terms and conditions of the contract bonds.	Not required	NA	NA	NA	NA	-

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
RD1.14	Identify road stretches with high dust generation	Nagar Nigam/Development Authority/ UPPCB	No.	5 Roads have been identified	31.03.2021	NA	01	Roads dust estimation has been carried out for 5 roads. 1. Lucknow road near danapani 2. kali mandir near jalkal building golghar 3. Gorakhpur maharajganj near khajanchi chauraha 4. Gorakhpur sonouli road near bargadwa chauraha 5. Gorkhpur deoria near MMMTU	Not Required	NA	NA	NA	NA	UPPCB
RD1.17	Development of infrastructure for use of treated water of STPs for dust suppression and irrigation	Nagar Nigam	02 Projects	Creation of infrastructure from 1. STP 30 MLD 2. STP15 MLD	DPR Preparation by 31.03.2022 Project Completion by 31.03.2025	NA	NA	NA	To be provided after DPR is prepared	NA	NA	NA	NA	Nagar Nigam/ UP Govt. Funds
RD1.18	Regular monitoring of dust load on major roads of the city	Jointly by UPPCB, Nagar Nigam & Development Authority	No of roads	Monitoring in 5 Roads is being done	Regular activity	Regular Activity	Yes	Monitoring Reports	NA	NA	NA	NA	NA	NA

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RD1.19	Preparation and implementation of Road dust hotspot action plan	Nagar Nigam/Development Authority	No of plans	05 hotspots identified	31.03.2020	NA	Yes	Progress of implementation	Not Required	NA	NA	NA	NA	NA
RD2	**Creation of green cover**													
RD2.2	Creation of green buffers along the traffic corridors and their maintenance	Forest Department/Horticulture/Nagar Nigam & Development Authorities	ha	1. 8.50km (2077 plants) roads side plantation in steel Tree Gaurds 2. 2.85 ha block plantation (3420 plants) 3. Beautification of Bandha at Gorakhpur Lucknow Road 4. 7000 Tree	31.03.2021 31.03.2022	NA	NA	8.50km road side plantation in steel Tree Gaurds. 2.85 ha block plantation in barbed wire fencing In 500-meter length, landscaping & Beautification of Bandha at Gorakhpur Lucknow Road, Nausad 7000 tree guard required for road side plantation.	65.38 lacs 28.32 Lacs 100.0 Lacs 70.0 lacs	- - - -	NA	NA	NA	Development Authority Fund 15th Fiinance commission/ Nagar Nigam Nidhi

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
				guards										
RD2.3	Necessary changes in byelaws- Greening of open areas, gardens, community places, schools and housing societies	Nagar Nigam & Development Authorities	Yes	NA	Achieved	Achieved	NA	Maps are sanctioned as per provision of master plan and building byelaws. 20% of total area will be green area where trees will be planted @125 tree/ha. (Building bylaws 3.1.2.2 (xi) (ka)	Not Required	NA	NA	NA	NA	Nagar Nigam & Development Authorities
RD2.4	Urban Greening with green infrastructures (vertical garden, green pavements, pocket parks, City Forest, Miyawaki forest & grasscrete tiles etc.)	Nagar Nigam, Development Authorities & UPPCB	No of green infrastructures developed	As per approved maps and CTE/CTO/EC Conditions	Regular Activity	NA	Yes	Details of Green Infrastructures developed	Not Required	NA	NA	NA	NA	To be done by Project Proponents & individuals

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
RD2.5	Builders should leave minimum 15% area for green belt in residential colonies to be made mandatory.	Nagar Nigam & Development Authorities	Yes	As per the conditions of approved maps	Regular Activity	NA	Yes	Provision has been made in (building byelaws 2.2.1 (kha)(i) Minimum 15 % area will be reserved for park and open area (residential layout)	Not Required	NA	NA	NA	NA	Funding by Project Proponent
RD2.7	Provision for maintaining at least 10% tree cover area in the city in master plan.	Development Authority	Yes/No	Revision in the Master Plan 2021	31.03.2022	NA	NA	Open areas are provided in master plan as per URDPF Guidelines. 10.45% of total urbanisable area in Gorakhpur Action Plan 2021. In addition to this, 15% land for park/green spaces are reserved in residential layout plan and 10% in non-residential layout plans as per building byelaws.	Not Required	NA	NA	NA	NA	-

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C&D1	**Construction Activities**													
C&D 1.1	Ensure transportation of construction materials in covered vehicles	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No of defaults and action taken	Regular activity	NA	NA	01	Guidelines will be included in terms and conditions of the contract bonds.	Not Required	NA	NA	NA	NA	-
C&D 1.2	Strict enforcement of CPCB guidelines for construction (use of green screens, side covering of digging sites, etc.)	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No of defaults and action taken	Regular activity	NA	NA	01	Guidelines will be included in terms and conditions of the contract bonds.	Not Required	NA	NA	NA	NA	-

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C&D 1.3	Restriction on storage of construction materials along the road.	Nagar Nigam/Development Authority/Construction Agencies	No of defaults and action taken	Regular activity	NA	NA	01	Will be complied by the concerned departments. GDA takes stacking charges (Malba Shulk) to sanction maps of plot area <2000 sqm. This stacking charges are utilized by Nagar Nigam Gorakhpur for cleaning and maintenance of roads. For plot area >2000 sqm, no stacking charges is realized the PP has to stack their construction material within their plots.	Not Required	NA	NA	NA	NA	
C&D 1.4	Covering of construction site.	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No.of construction sites	17 Construction Projects identified	Regular activity	NA	Yes	NA	Not required	NA	NA	NA	NA	To be done by PP
C&D 1.5	To create separate space/zone to handle solid	Nagar Nigam	No.	01 No of C&D waste Management Facility	31.12.2022	NA	Yes	Identification of land will be done by 31.03.2021	500.00	NA	NA	NA	500	SBM/15th Finance commission/ Nagar

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	waste, C&D waste and other waste in the city			will be established.										Nigam Nidhi.
C&D 1.6	To mandate facility of tar/brick/gravel lined road inside the construction site for movement of vehicles carrying construction material	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No.of construction sites	17 Construction Projects identified	Regular activity	NA	Yes	NA	Not required	NA	NA	NA	NA	To be done by PP
C&D 1.7	Promotion of the use of prefabricated blocks for building construction	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	Yes	To impose suitable conditions in the tenders for use of prefab building blocks along with amendments in SoRs	Regular Activity	NA	NA	NA	Not required	NA	NA	NA	NA	To be done by PP
C&D 1.8	Enforcement of Construction and Demolition Waste Rules	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No of defaulters found and ATR against defaulters	Regular activity	NA	NA	01	Guidelines will be included in terms and conditions of the contract bonds.	Not Required	NA	NA	NA	NA	To be done by PP

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
C&D 1.9	Control measures for fugitive emissions from material handling-conveying and screening operations	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No of defaulters found and ATR against defaulters	Regular activity	NA	NA	01	Guidelines will be included in terms and conditions of the contract bonds.	Not Required	NA	NA	NA	NA	To be done by PP
C&D 1.10	Develop and implement dust control measures for all types of construction activities -- buildings and infrastructure.	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	No of defaulters found and ATR against defaulters	Regular activity	NA	NA	01	Guidelines will be included in terms and conditions of the contract bonds.	Not Required	NA	NA	NA	NA	To be done by PP
C&D 1.11	Enforce restrictions on construction activities within urban air shed zones during high pollution period	Nagar Nigam/Development Authority/Construction Agencies/UPPCB	Yes/No	Implementation of GRAP	31.03.2021	NA	NA	Construction activity will be restricted within urban air shed zones during high pollution period vide order from the District Administration.	Not Required	NA	NA	NA	NA	-
C&D 1.12	Frame and implement policy for segregation of construction and demolition waste and provide a network of decentralized	Nagar Nigam/Development Authority/Construction Agencies	No. of decentralised units	Establishment of adequate number of collection centres and processing facility	31.03.2022	NA	Yes	Details of collection centres and the quantity of segregated waste collected and processed	To be provided after DPR is prepared	NA	NA	NA	NA	State/ULD /NCAP funding

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
	C&D waste segregation and collection sites across the city.													
C&D 1.13	Promote recycling of construction and demolition waste.	Nagar Nigam/Development Authority/Construction Agencies	No	All ongoing sites	Regular Activity	NA	01	Use of recycled bricks will be continued.	Not required	NA	NA	NA	NA	To be done by PP
C&D 1.14	Mandatory installation of PTZ Cameras in Construction Sites with open access to UPPCB	Nagar Nigam/Development Authority/Construction Agencies	No. of PTZ cameras	NA	15.10.2020	NA	NA	As per the latest UPPCB direction, all construction sites shall have PTZ cameras installed	Not Required	NA	NA	NA	NA	NA
C&D 1.15	Develop, ensure & monitor periodic online Self Declaration of Dust Control Audit by the Project Proponents/ Site in Charges on the portal http://dustapp.upecp.in/ developed by UPPCB	UPPCB	No of Self Declarations made	All Construction Projects	Regular activity	NA	Yes	NA	Not Required	NA	NA	NA	NA	The Dust app already established from UPPCB Consent Funds

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs.	Source of Funding
C&D 1.16	Appropriate combination of dry scrubber system/filters and wet scrubbing system should be installed for drier and flue gases to control fugitive and flue gas emission.	UPPCB/ Hot mix plant Agencies	No	All operational Hot Mix Plants	Regular activity	NA	Yes	List of Hot Mix Plants and APCS installed	Not required	NA	NA	NA	NA	To be done by unit owner
C&D 1.17	Mandatory installation of PTZ Cameras in Hot mix & ready-mix plants with open access to UPPCB for remote monitoring.	UPPCB /Hot mix plant Agencies	No.	Regular Activity	NA	NA	01	No of hot mix plants having PTZ camera installed and accessed by UPPCB Control room	Not required	NA	NA	NA	NA	To be done by the unit owner
C&D 1.18	New Hot mix plants should be permitted only on LPG fuel. Promotion of fuel conversion to LPG in existing Plants	UPPCB /Hot mix plants Agencies	Nos.	Regular Activity	NA	NA	01	List of Hot Mix Plants using LPG	Not required	NA	NA	NA	NA	To be done by the unit owner
***In case timeline extends to more than one year the annual targets must be fixed.**														
****Mention specific numeric identity to the attachment. Example- Attachment-1**														

VEHICLES

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE1	**Improve and strengthen PUC programme**													
VE1.1	Number of online PUC centres in the city	Transport Department	Number	44	Target Achieved	NA	01	List of PUC centres attached	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE1.2	Regular checking of Vehicular emission and issue of Pollution under Control Certificate (PUC)	Transport Department/ Traffic Police	Number	2500/Month	Regular Activity	NA	NA	Vehicles are being checked by traffic police on regular basis at 43 important crossings all over the city.	Not Required	NA	NA	NA	NA	Transport Dept Funding/Traffic Dept Funding
VE1.3	Auditing and reform of Pollution Under Control (PUC) certification	Transport Department	Number	44/Quarter	Regular Activity	NA	NA	All the PUC centres are regularly checked by technical officers & monitoring is being done regularly.	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE1.4	linking of PUC centres with remote server and eliminate manual intervention in PUC testing.	Transport Department	Number	44	Achieved	NA	NA	List of centres.	Not Required	NA	NA	NA	NA	Transport Dept Funding

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE1.5	Integrate on-board diagnostic (OBD) system fitted in new vehicles with vehicle inspection	Vehicle manufacturing companies/ MoRTH	NA	NA	NA	NA	NA	NA	Not Required	NA	NA	NA	NA	NA
VE1.6	Link PUC certificates with annual vehicle insurance	Transport Department	Yes/No	Issuance of Notification	Achieved	NA	01	Notification copy	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE2	**Vehicle labelling or sticker programme**	Transport Department	Yes/No	Fixing of coloured stickers having name of the registering authority, vehicle's registration number, laser branded permanent identification number and date of vehicle's first registration	Regular Activity	NA	NA	Details of steps for implementation	Not Required	NA	NA	NA	NA	Transport Dept Funding

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE3	**Freight transport**													
VE3.1	Use of off-peak passenger travel times to move freight and restrict the entry of heavy vehicles into cities during the day to continue	Transport Department/ Traffic Police	Yes/No	No entry of heavy vehicles is scheduled for 7:00 AM to 10:00 PM. During this period heavy vehicles are restricted at City entry point Sahjanwa, Nandanagar and Bargadwa.	Regular Activity	NA	01	Details of action against the violating freight vehicles	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE3.2	Provide truck rest areas/parks along national and state highways to prevent entry of trucks into cities during peak hours.	Transport Department/ Nagar Nigam & Development Authorities	05	Proposed parking for non-destined vehicle at city boundaries during day time.	NA	NA	NA	2 rest points constructed by NHAI in Gorakhpur city at NH-21(NEW Name- NH-27), 05 other locations have also been identified by GDA and will	2898.6	-	NA	NA	2898.6	SBM/15th Finance commission

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
								be developed jointly by NHAI/PWD and GDA. Details attached as Annexure I(B).						
VE3.4	Check overloading: Use weigh-in-motion bridges / machines (WIM) and Weigh bridges at entry points to the city to check the payload of commercial vehicles. As per the CMVR, a penalty of 10 times the applicable rate for overloaded vehicles is applicable.	Transport Department/ NHAI/ Road Construction Agencies	1	Achieved	NA	NA	01	131 overloded vehicles passed through Tendua toll plaza during January 2020 to December 2020. 10 times penalty was receovered from 4 vehicles under Central motorvehicles rules,1989.	Not Required	NA	NA	NA	NA	NA

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VE3.5	Define routes, permits, fares, vehicle design and safety standards, and vehicle technology standards for para-transit vehicles.	Transport Department/ Traffic Police	NH and SH	NA	Achieved	NA	NA	NA	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE4	**Clean fuel and fuel Quality**													
VE4.4	Use of Bioethanol in the city/urban transport system/waste to energy.	Transport Department/Nagar Nigam	NA	NA	NA	NA	NA	NA	Not Required	NA	NA	NA	NA	NA
VE5	**Parking Management**													
VE 5.1	Prevent parking of vehicles in the non-designated areas	Traffic Police/ Nagar Nigam	Number	Action Taken against the unauthorized parking	Regular Activity	NA	1	Action Taken Report	Not required	NA	NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE 5.2	Multi-Layer Parking	Nagar Nigam/ Development Authorities	05	Multi-Layer parking proposed	30.06.2024	NA	1	01 No/4200 sqm (for 383 Cars Parking) is Under progress. 5 other multilayer parking locations viz. Near City Mall, Vijay Chauraha, Medical College, Bargadwa police Chowki and Betiyahata Chowk. have been identified in the city limits. Details Attached as **Annexure I (C).**	4321.70 16338.00	4321.70 -	2329.07 NA	1600.00 NA	2721.70 NA	State/ Development Authority fund
VE6	**Strengthening of Public Transportation**													

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE6.1	Regulate the taxi industry	Transport Department	Through trade certificate and permit for issuing such typical vehicles.	NA	NA	NA	Yes	Details on the steps	Not Required	NA	NA	NA	NA	Transport Dept Funding

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE6.7	Steps for promoting battery operated vehicles like E-rickshaw/E-Cart	Transport Department/ Nagar Nigam & Development Authorities	NA	NA	NA	NA	NA	Battery operated E rickshaws has been exempted from registration. Registation banned on Diesel driven auto rickshaw in Gorakhpur city. Only CNG/PNG/Petrol driven autorickshaw has been permitted. Tender has been invited for operation of 27 electric buses. Number of CNG/LPG/petrol driven autorickshaws has been restricted up to 3125 only.	Not Required	NA	NA	NA	NA	MNN Funding

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE8	**Launch Public awareness campaign for air pollution control, vehicle maintenance, minimizing use of personal vehicle, lane discipline, etc.**	transport Department/ Traffic Police	No. of programmes pertaining to pollution control are organised during road safety weeks.	.....	Regular Activity	.....	01	Details of Awareness programmes in different crossings, schools, and other public places are regularly conducted from time to time.	100	NA	NA	NA	10	Transport Dept Funding
VE9	**Periodic calibration test of vehicles emission monitoring instruments**	Transport Department	Yes	NA	NA	NA	NA	Online testing of PUC has been started from September 2019. Transport Commissioner has order for the installation of PUC centres at every vehicle dealer in their workshop Vide order dated 20 November 2020. Calibration of PUC machines	Not Required	NA	NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
								is done once in a year.						
VE10	**To check the calibration of emission monitoring equipments, housed in Emission Testing Centers (ETCs) once in 6 months to know the status of equipments**	Transport Department	Yes	NA	NA	NA	Yes	Details on the test conducted	Not Required	NA	NA	NA	NA	NA
VE11	**Phase out old vehicles and vehicle scrappage policy**	transport Department	Decided by STA/RTA	NA	NA	NA	NA	NA	Not Required	NA	NA	NA	NA	Transport Dept Funding

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VE11.1	Inspection /maintenance to all BSII & BS III	Transport Department	Under process	NA	NA	NA	NA	Inspection of commercial Vehicles is done by RI (Tech) in office as per norms for private vehicles. It is the responsibility of vehicle owner	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE11.2	Restriction on plying and phasing out of 15 years old commercial diesel driven vehicles.	Transport Department	Yes	NA	NA	NA	NA	Action will be taken after receiving the directions from the Head office.	Not Required	NA	NA	NA	NA	Transport Dept Funding
VE11.3	Enforcement of law against visibly polluting vehicles: remove them	Transport Department	757 vehicles in year 2020-21	NA	NA	NA	NA	Details on the drives conducted	Not Required	NA	NA	NA	NA	Transport Dept Funding

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	from road, impose penalty, and launch extensive awareness drive against polluting vehicles.													
VE11.5	To increase fine on vehicle owners (not drivers) where the visible smoke is emitted and noticed.	Transport Department	Yes/No	Rs. 10000/- (fine has been increased up to 10 times)	Achieved	NA	01	As per the Motor Vehicle Act,1989 and amendments from time to time.	Not Required	NA	NA	NA	NA	

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
VE11.7	The restriction on use of two stroke vehicles in phased manner (2-Stroke, 3-stroke)	Tranport Department	Yes/No	Such types of vehicles are eliminated.	Achieved	NA	NA	As per NGT order, use of diesel vehicle older than 10 years and petrol vehicle more than 15 years old is restricted. Registration certificate of Non-Transport Vehicle falling in this category has been suspended. Currently there is no provision for restricting use of vehicle on the basis of engine stroke type	Not Required	NA	NA	NA	NA	Transport Dept Funding

***In case timeline extends to more than one year the annual targets must be fixed.**

****Mention specific numeric identity to the attachment. Example- Attachment-1**

INDUSTRIES

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
IP1	**Industrial air pollution control**													
IP1.1	To intensify monitoring of industries to reduce of emission by the industries.	UPPCB	No.	49	31.12.2021	49	Yes	Total Air polluting industries in Gorakhpur are 49 and their monitoring is being done time to time by this office.	Not Required	NA	NA	NA	NA	NA
IP1.2	Action against non-complying industrial units	UPPCB	No.	05	ongoing	ongoing	Yes	Inspections of industries are being done on regular basis and find the defaulter of the industries action is taken under section 31A of air pollution (Prevention and control) act 1981 as amended by UPPCB	Not Required	NA	NA	NA	NA	NA
IP1.3	Shifting/Closing of Polluting Industries from non-conforming	Department of Infrastructure &	No.	0	31.03.2024	0	Yes	A team shall be constituted by DM along with concerned	Not Required	NA	NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
	to conforming area	Industrial Development/UPPCB/District Administration						departments and ensure the shifting of polluting industries from non-confirming to confirming area up to 31.03.2024							
IP1.5	Auditing for Air pollution measures and Online reporting systems in the industrial sectors namely Slaughter houses, Sugar industries, Textile industries, Distilleries, Steel plant, Pulp & paper industries	UPPCB	No.	49		49	Yes	There are 49 Air polluting industries in Gorakhpur. All 49 industries are installed with air pollution control System for controlling air pollution such as ESP, Wet scrubber, Multicyclone dust collector, bag filters etc. Continuous Emission monitoring system which connects to CPCB or UPPCB server also installed in only 06	Not Required	NA		NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
								units.							
IP1.10	Ensuring installation/Up-gradation and operation of air pollution control devices in industries	UPPCB	No.	24	31.03.2021		Yes	During the emission inventory survey total 49 air polluting industries have been identified. Out of these only 25 industries have APCS installed. The remaining 24 industries having sufficient stack height. Additional APCS not required.	Not Required	NA		NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
IP1.11	Action/closure against defaulting/unauthorized industrial units.	UPPCB	No.	NA	Regular activity	NA	Yes	This is a regular activity to identify the defaulting units and action is taken time to time by the regional office, Gorakhpur. Action is taken against 05 defaulter unit under section 31A of air pollution (Prevention and control) act 1981 as amended by UPPCB	Not Required	NA		NA	NA	NA	NA
IP1.12	Ensuring emission standards in industries	UPPCB	No.	49	ongoing	49	Yes	The Air polluting industries situated in Gorakhpur already installed/up-graded with air pollution control	Not Required	NA		NA	NA	NA	NA

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								devices. All these air polluting industries are monitored by UPPCB time to time							
IP1.14	Measures taken for location specific Emission reduction.	UPPCB	No.	49	Regular activity	49	Yes	Details of locations considered	Not Required	NA		NA	NA	NA	NA
IP1.26	Bank guarantee should be taken for the compliance of conditions imposed in CTO/CTE for control of Environmental Pollution from industries.	UPPCB	Yes	NA	Regular activity	NA	NA	Bank guarantee shall be taken for the compliance of conditions imposed in CTO/CTE for control of Environmental pollution from industries	Not Required	NA		NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
IP1.28	Implementation of SOx and NOx standards notified by MOEF&CC	UPPCB	Yes	NA	Achieved	NA	**Yes**	SOx and NOx standards for industries notified by MoEF& CC notification GSR 96(E) dated 29.01.2018 has been implemented.	Not Required	NA		NA	NA	NA	NA
IP1.29	Prepare and implement local area action plan for pollution hotspots and strict enforcement of air pollution control measures in all	District Administration/ Nagar Nigam/UPPCB/GDA/NHAI/PWD/DIC	Yes	NA	NA	NA	Yes	Implementation for pollution hotspots, a inspection team will be constituted by DM Gorakhpur to have a surveillance on industries and	Not Required	NA		NA	NA	NA	NA

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	industries, including those located in unauthorized areas.							a team along with concerned depts for those industries which located in unauthorized area shall be constituted as soon as possible.							
IP1.30	Assess the number of industrial units that are non-compliant and prepare unit/plant wise action plan for time bound compliance or be shut down.	UPPCB	Yes/ No	Regular activity	NA	NA	Yes	Details on the action undertaken	Not Required						
IP1.32	Industrial units to install water spraying system of internal roads and washing of tyres of vehicles	UPPCB	**Yes**	**Installation of Water spraying system.**	**31.03.2021**	**NA**	**Yes**	NA	Not Required	NIL		NIL	NIL	NIL	Industrial units

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
IP1.33	Monitoring of Cane Kolhus for compliance of CPCB guidelines.	UPPCB	Yes	NA	31.05.2022	NA	NA	Monitoring of cane kolhus for compliance of CPCB guidelines shall be done up to 31.05.2022	Not Required	NA		NA	NA	NA	NA
IP1.34	Support to Cane Kolhus for installation of appropriate Air Pollution Control System	UPPCB/ Cane Department	Yes	NA	NA	NA	NA	To support cane kolhus for installation of appropriate Air Pollution Control System as per CPCB guidelines, a workshop shall be organized with the help of cane dept and initiate the installation of APCS	Not Required	NA		NA	NA	NA	NA
IP1.35	To conduct feasibility study to phase out small boilers in Industrial Clusters in GIDA by centralized steam supply system	UPSIDA, GDA, DIC	Yes		31.12.2021	NA	Yes	TOR of the proposed study	10 Lakhs	-		NA	NA	NA	Own Resources of Firms
IP3	**OCEMS in Industries**														

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IP3.1	There should be provision to use CEMS data as legal evidence and a policy be framed in consultation with Central Pollution Control Board.	CPCB/UPPCB	Yes	NA	31.12.2021	NA	Yes	Yes	Not Required	NA		NA	NA	NA	NA
IP3.5	Monitoring of industrial emission including real time online monitoring through OCEMS (Online Continuous Emission Monitoring System) and live camera feed and to take action against non-complying industrial units	UPPCB	No.	Achieved	Continuous process	NA	yes	OCEMS installed by 06 polluting industries.	Not Required	NA		NA	NA	NA	NA
IP4	**Clean fuel in industries**														

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IP4.1	Introduction and shifting towards cleaner fuels in industries where PNG supply is available	Department of Infrastructure and Industrial Development /UPSIDA/GGIL	No.	49	06 months after the availability of PNG/CNG	NA	NO	Direction has been issued to UPSEIDA to ensure availability of cleaner fuel in Industrial area GIDA by Department of Infrastructure and Industrial Development	Not Required	NA		NA	NA	NA	NA
IP4.2	Conversion to CNG/PNG from wood / coal and other agro and fossil fuels.	Department of Infrastructure and Industrial Development /UPSIDA/GGIL	No.	49	06 months after the availability of PNG/CNG	NA	NO	Direction has been issued to UPSEIDA to ensure availability of cleaner fuel in Industrial area GIDA by Department of Infrastructure and Industrial Development.	Not Required	NA		NA	NA	NA	NA
IP4.4	Establish a protocol for using cleaner fuels & technology in industries	Department of Environment, Forest & Climate Change U.P. & UPPCB	Yes	NA	NA	NA	Yes	Yes	Not Required						

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IP4.5	Restriction on using un-authorised fuels in industries such as rubber, polythene, cotton bags, etc. and other dirty fuels.	UPSIDA/DIC /UPPCB	**Yes**	**NA**	**Achieved**	**NA**	**Yes**	Already restricted on using unauthorised fuels in industries and actions are being taken on defaulters as per norms.	Not Required	**NA**		**NA**	**NA**	**NA**	**UPPCB Fund**
IP4.8	Preparation and implementation of Industrial hotspot action plan	UPPCB, UPSIDA & DI	Yes	3	31.06.2021	NA	Yes	Progress of implementation	Not Required	NA		NA	NA	NA	NA
IP5	**Control of air pollution from Brick kilns**														
IP5.1	Adapting new technologies for Brick kilns	UPPCB	No.	228	Timeline for Zig-Zag technology is not given by CPCB in other than NCR cities.	228	yes	228 brick kilns are situated in Gorakhpur. 78 brick kilns are already converted to Zig Zag.	Not Required	NA		NA	NA	NA	UPPCB Fund

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IP5.2	Identification of brick kilns and their regular monitoring including use of designated fuel and closure of unauthorized units.	UPPCB	Yes	228	Regular activity	228	Yes	Regular monitoring and identification of brick kilns for use of designated fuel is being done by this office time to time and action taken against unauthorized brick kilns.	Not Required	NA		NA	NA	NA	UPPCB Fund
IP5.3	Conversion of natural draft brick kilns to Force/ induced draft.	UPPCB	No	228	Timeline for Zig-Zag technology is not given by CPCB in other than NCR cities.	228	Yes	228 brick kilns are situated in Gorakhpur. Brick Kilns owners will be encouraged to adopt for cleaner technologies.	Not Required	NA		NA	NA	NA	UPPCB Fund

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IP5.4	Closure of unauthorized units by seeking the possibility for shifting of kilns outside corporation limits. This should be replaced as "Closure of brick kilns not conforming the siting guidelines of UP Govt." as shifting is not possible	UPPCB	Nil	Nil	Nil	Nil	Nil	If this type of situation is identified then immediate action shall be initiated.	Not Required	NA		NA	NA	NA	
IP5.5	Prescribe design specifications for improved kilns and ensure compliance checking to know that conversion has actually taken place.	UPPCB	Yes	228	Timeline for Zig-Zag technology is not given by CPCB in other than NCR cities.		Yes	All the officers have been instructed to ensure compliance for checking to know that brick klins actually converted into prescribed design or not. In case of defaulting action shall be taken.	Not Required	NA		NA	NA	NA	UPPCB Fund

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IP5.6	To identify the clusters of brick kilns including upwind & downwind monitoring locations for ambient air quality monitoring.	UPPCB	No.	NA	April. 2021	NA	NA	Piprauli and Jungle Kaudia, in upwind direction and Sardaar nagar, in downwind direction has been identified as major clusters of Brick kilns.	Not Required	NA		NA	NA	NA	
IP5.7	To impose cluster pollution responsibility conditions in the Consent to Operate of brick kilns in the clusters after due consultation with brick kilns operators	UPPCB	No.	NA	Dec.2021	NA	NA	Copy of Direction	Not Required	NA		NA	NA	NA	NA
IP11	**Control of air pollution from generator sets**														
IP11.1	Allow only DG sets meeting emission and design of chimney/ exhaust, acoustic enclosures	UPPCB/ Nagar Nigam/Electrical Safety Department	Yes	Regular activity	NA	NA	Yes	Yes and industries are equiped with DG sets having accoustic enclosure and appropriate	Not Required	NA		NA	NA	NA	Industry resources

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	standards to operate							height of chimneys.							
IP11.2	Curtail use of DG Sets in social events by providing temporary electric connections and uninterrupted power supply	U.P. Power Corporation Ltd.	**Yes**	NA	NA	NA	**Yes**	UPPCL should ensuring availability of 24 hrs power supply to the consumers. It is further to add that on occasion of any social event in Gorakhpur town temporary connection are released on demand of organisers.	Not Required	NA		NA	NA	NA	**PVVNL Funding/ owner funding**
IP12	**Control of air pollution from waste incineration**														

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IP12.2	Implement CEMS for incinerators and provide data on emissions on an open platform	Nagar Nigam/UPPCB/CPCB	No.	**0**	NA	**NA**	**NA**	No incinerator is situated in Gorakhpur and provide the data of emission to CPCB or UPPCB and on an open platform.	Not Required	NA		NA	NA	NA	NA
IP13	**Renewable Energy**														
IP13.2	Identify and target commercial and industrial establishments for installation of roof top solar system	Non-Conventional Energy Development Agency (NEDA)	MW	2 MW	31-03-2025	0.4 MW	No	No	Not Required	NA		NA	NA	NA	Departmental funding
IP13.4	Organise consumer outreach programme for roof top solar programme	Non-Conventional Energy Development Agency (NEDA)	YES	40 NO. SEMINAR/ MEETING TO BE ORGANISED along with Lectures	31-03-2025	8 NO	No	Details on the action undertaken	80 Lacs	-		NA	NA	80 Lacs	World bank Sources.

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
				and Literature, & refreshment to all related targeted groups/consumers.											
IP14	**Accelerate the technological transformation of enterprises and improve their technological innovation capabilities**	NA	NA	NA	NA	NA	NA	NA	Not Required	NA		NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
IP14.1	Establishment of Knowledge Centre for promotion of technological transformation for desulfurization, denitrification, efficient dust removal, volatile organic compound control, diesel engine (vehicle) emission purification, environmental monitoring, and new energy vehicles, smart grids, etc.	UPSIDA, DIC, Industrial Associations, Transport Department	Yes	Establishment of Knowledge Centre with the help of Educational Institute/Consultancy Firms	31-12-2021	NA	NA	MMTU/DDU Gorakhpur University/GIZ	Not Required	NA		NA	NA	NA	Industrial & infrastructure department
IP14.2	Conduct clean production audits on key industries such as Paper & Pulp, Sugar, Dying &Distillery sector, Slaughter	UPPCB/UPSIDA/DIC/Individual Industries	Yes	31.03.2022	NA	NA	NA	Clean production audits on key industries such as Paper & Pulp, Sugar, Dying &Distillery	Not Required	NA		NA	NA	NA	individual industriesd

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
	house							sector, Slaughter house shall be done up to 31.03.2022							
IP14.3	Promote Circular Economy- Encourage the development of industrial clusters, implement circular transformation, promote energy cascade utilization, water recycling, waste exchange and utilization, and land conservation and intensive utilization and build circular industries system. Promote the co-processing of waste in industrial kilns and blast furnaces such as cement and steel. Vigorously develop the	UPPCB/UPSIDA/DIC/Individual Industries	Yes	yes	31.03.2024	NA	NA	With consensus of the concerned department, Circular transformation, energy cascade utilization will be encouraged	Not Required	NA		NA	NA	NA	Industries

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)		Source of Funding
	remanufacturing of mechanical and electrical products and promote the development of the resource recycling industry.														
IP14.4	Vigorously cultivate energy conservation and environmental protection industries	UPPCB/UPSIDA/DIC/Individual Industries	Yes	yes	31.03.2024	NA	NA	Yes	Not Required	NA		NA	NA	NA	NA
***In case timeline extends to more than one year the annual targets must be fixed.**															
****Mention specific numeric identity to the attachment. Example- Attachment-1**															

WASTE AND BIOMASS- DUMPING AND BURNING

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
BB1	**Biomass Burning**													
BB1.1	Regular check and control of burning of municipal solid wastes	Nagar Nigam/Development Authority/ UPPCB	No.	Immediate detection and strict action against cases of burning of MSW	Regular activity	NA	O1	ATR against the cases of illegal burning of MSW	Not Required	NA	NA	NA	NA	NA
BB1.2	Defaulters for open burning to be imposed fines	Nagar Nigam/Development Authority/ UPPCB	Amount of Fine Rs. Lacs	Immediate detection and imposition and realization of fine against cases of burning of MSW	Regular activity	NA	O1	Incident wise details of the fine imposed & realized	Not Required	NA	NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
BB1.3	Identify Garbage burning locations	Nagar Nigam/Development Authority	Number	Geo tagging of garbage burning locations	Regular activity	NA	01	List along with latitude & longitude of Garbage burning locations	Not Required	NA	NA	NA	NA	NA
BB1.4	Prohibition/complete ban on garbage burning.	Nagar Nigam/Development Authority	Yes	Make suitable provisions in the bylaws to prohibit garbage burning	Achieved	NA	NA	Burning of Solid Waste is banned as per the provisions of Rule 4(2) of Solid Waste Management Rules 2016. The garbage burning ban has been incorporated in the MSW Management and Cleanliness bylaws of ULBs	Not Required	NA	NA	NA	NA	
BB1.5	Launch extensive drive against open burning of bio-mass, crop residue, garbage, leaves, etc.	Nagar Nigam/Agriculture Department/District Administration	No.	Immediate detection and strict action against cases of burning of MSW, Crop residue, biomass etc.	Regular activity	NA	01	ATR against the cases of illegal burning of MSW, Crop residue, biomass etc.	Not Required	NA	NA	NA	NA	NA
BB1.6	Construction of advanced waste management Site.	Nagar Nigam	Yes	Establishment of MSW Management Facility	31.03.2022	Finalization of DPR & land acquisitio	01	NA	2500.00	-	NA	NA	NA	State/ SBM/15th Finance commissi

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
						n by 31.03.2021								on/ Nagar Nigam Nidhi.
BB1.7	Regular collection and control of municipal solid wastes.	Nagar Nigam/Development Authority	Yes	70 wards	Regular activity	NA	NA	1-Safai karmchari (out sourcing)-2901.00 2- Diesel/Petrol-797.66 3- Repairing of vehicle- 80.57 4-Store goods-135.58 4- Miscellaneous-281.55	4200.00	-	NA	NA	NA	State/ SBM/15th Finance commission/ Nagar Nigam Nidhi.
BB1.8	Providing Organic Waste Compost machines, decentralization of processing of Waste, dry waste collection centres.	Nagar Nigam/Development Authority	No.	All bulk waste generators	31.03.2022	Identification of bulk waste generators to be done by 31.03.2021	01	List of bulk waste generators doing decentralized waste management	Not required	NA	NA	NA	NA	To be done by Bulk waste generators
BB1.9	Awareness for controlling of burning of agricultural waste and crop residues.	Nagar Nigam/Agriculture Department/District Administration	No.	Regular Activity	NA	NA	01	Details of the awareness drives including dates and images	30	-	NA	NA	NA	State/ULB Funds

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
BB 1.10	No plot should be left open more than 02 years and planting of trees must be mandatory on vacant plots.	Nagar Nigam/GDA/Forest Department	1.Provisions be made in the byelaws 2.Number	1.Provisions be made in the byelaws Regular Activity	31.03.2022	NA	02	No unallotted plot in GDA	Not required	NA	NA	NA	NA	To be done by plot owner
BB 1.12	Mapping of legacy waste and waste dumping sites in the city	Nagar Nigam/Development Authority/ UPPCB	No.	1. Akala Bandh- 1.5 lakh MT 2. Mashera Jungle Hakim no.1- 2.31 lakh MT	Achieved	NA	NA	NA	Not required	NA	NA	NA	NA	-
BB 1.13	Bioremediation / bio-mining of legacy waste	Nagar Nigam/Development Authority	MT of legacy waste	1. Akala Bandh- 1.5 lakh MT 2. Mashera Jungle Hakim no.1- 2.31 lakh MT	31.03.2023	NA	NA	NA	1906.7	-	NA	NA	NA	ULD/State Funding
BB 1.14	Development and implementation of integrated door to door waste collection system with GPS mounted waste collection vehicles and mobile App to	Nagar Nigam/Development Authority	wards	70	Regular activity	NA	NA	NA	250.00	-	NA	NA	NA	State/ SBM/15th Finance commission/ Nagar Nigam Nidhi.

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
	facilitate the households													
BB 1.15	EPR compliance for plastic waste	Nagar Nigam & UPPCB	No. of units/ quantity	02MT/DAY	31.03.2022	NA	NA	NA	Not Required	NA	NA	NA	NA	To be done by brand owners
BB 1.16	Preparation and implementation of Waste Burning hotspot action plan	Nagar Nigam/Development Authority	Yes	02	31.06.2021	NA	NA	NA	Not required	NA	NA	NA	NA	NA
BB2	Ensure segregation of waste at source	Nagar Nigam	No. of wards	70	31.03.2022	NA	NA	NA	Not Required	NA	NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
BB3	Proper collection of Horticulture waste and its disposal following composting-cum gardening approach	Horticulture Department/Nagar Nigam/GDA	No	All parks and Green areas in the city	Regular Activity	NA	NA	NA	Not required	NA	NA	NA	NA	NA
BB4	Recycling plants for dry waste.	Nagar Nigam	No. of plants	1	31.03.2022	NA	01	Recycling plant for dry waste will be established along with MSW plant.	500.00	-	NA	NA	NA	State/ SBM/15th Finance commission/ Nagar Nigam Nidhi.
BB 10.2	Adopt roadmap for zero landfill policy to promote decentralized waste segregation, reuse and recycling	Nagar Nigam/GDA	Text	Implementation of plan for decentralized waste segregation, reuse and recycling for zero landfill	31.03.2022	NA	NA	NA	Not Required	NA	NA	NA	NA	NA

Action Point Code	Action Point	Department/ Agency	Field type	Total Target	Target Date (Timeline)	*Annual Target	**Attachment No.	Attachment Contents	Total Fund required (Rs. Lakh)	Total Funds Allocated (Rs. Lakh)	Funds released (Rs. Lakh)	Funds Utilized (Rs. Lakh)	Additional Funds Required (Rs. Lakh)	Source of Funding
BB11	Fire crackers—regulate to control their usage	District Administration/Police	Text	1. No of defaulters fined 2. No. of awareness camps organized	Regular Activity	NA	NA	NA	10	-	NA	NA	NA	District Funds
DF1	**Domestic Fuel**													
DF1.1	Increasing the LPG connections in low-income strata.	Food & Civil Supply Department	No	Total Households - 1,11,837 LPG Connections -84,996 Target-26841	31.03.2022	NA	Yes	79405 LPG connection has been already distributed against 1, 11,837.	NA	NA	NA	NA	NA	Central Govt.
DF1.2	Ensuring promotion and use of cleaner fuel (i.e., LPG) instead of coal fired chula s or fire-woods in the hotels and open spaces	Food & Civil Supply Department/Nagar Nigam/District Administration	No	Regular Activity	NA	NA	NA	NA	Not Required	NA	NA	NA	NA	NA

AIR QUALITY DATA

Action Code	Action Point	Field type	Attachment	Attachment Contents
AQ1.1	Monthly averages for PM2.5 (In µg/m3)	Number (12)	No	
AQ1.2	Monthly averages for PM10 (In µg/m3)	Number (12)	No	
AQ1.3	Monthly averages for SO2 (In µg/m3)	Number (12)	No	
AQ1.4	Monthly averages for NO2 (In µg/m3)	Number (12)	No	
AQ1.5	Annual averages for PM2.5 (In µg/m3)	Number (1)	Yes	Discussed under heading "Status of Air Quality and its trend in Gorakhpur City"
AQ1.6	Annual averages for PM10 (In µg/m3)	Number (1)	Yes	Discussed under heading "Status of Air Quality and its trend in Gorakhpur City"
AQ1.7	Annual averages for SO2 (In µg/m3)	Number (1)	Yes	Discussed under heading "Status of Air Quality and its trend in Gorakhpur City"
AQ1.8	Annual averages for NO2 (In µg/m3)	Number (1)	Yes	Discussed under heading "Status of Air Quality and its trend in Gorakhpur City"
AQ1.9	Monthly Meteorological Data		Yes	Windrose diagram attached on Page 184

a) *Proposed Locations & Budget for development of Parking space for Non destined Vehicles -Annexure I(A)*

(i) Pipraich Road (1.0 Acre Land)	
Land Cost 4046.80 Sqmt. @ 12,000.00 Per Sqmt=	485.62 Lacs
Construction Cost 4046.80 Sqm.@ 2325.20 Per Sqmt=	94.10 Lacs
	579.72 Lacs
(ii) Maharajgang Road (1.0 Acre Land)	
Land Cost 4046.80 Sqmt. @ 12,000.00 Per Sqmt=	485.62 Lacs
Construction Cost 4046.80 Sqm. @ 2325.20 Per Sqm=	94.10 Lacs
	579.72 Lacs
(iil) Deoria Road (1.0 Acre Land)	
Land Cost 4046.80 Sqmt. @ 12,000.00 Per Sqmt=	485.62 Lacs
Construction Cost 4046.80 Sqm. @ 2325.20 Per Sqm=	94.10 Lacs
	579.72 Lacs
(iv) Sonoli Road (1.0 Acre Land)	
Land Cost 4046.80 Sqmt @ 12,000.00 Per Sqmt=	485.62 Lacs
Construction Cost 4046.80 Sqm. @ 2325.20 Per Sqm=	94.10 Lacs
	579.72 Lacs
(v) Hata/Kushi Nagar Road (1.0 Acre Land)	
Land Cost 4046.80 Sqmt. @ 12,000.00 Per Sqmt=	485.62 Lacs
Construction Cost 4046.80 Sqm. @ 2325.20 Per Sqm=	94.10 Lacs
	579.72 Lacs
Grand Total- (1 to 5)	**Rs. 2,898.60 Lacs**

Land Rate of all 05 Roads are approximate Actual land Rate can be taken from P.W.D.

(b) Proposed locations & Budget for development of Multi-layer Car parking in Gorakhpur City -Annexure I(B)

S. No.	Location of Proposed Parking	Capacity of Parking	Estimated Cost (Rs in Lac)
1	Multilevel Parking near City Mall	350	4300.00
2	Multilevel Parking near Vijay Chauraha in front of United Cinema.	280	3440.00
3	Multilevel Parking near Medical College.	300	3685.00
4	Multilevel Parking near Bargadwa Police Chauki.	250	3070.00
5	Multilevel Parking near Betiyahata Chauk	150	1843.00

(c) Proposed budget for Installation of Fountain at various locations in Gorakhpur City-Annexure I(C)

S.No.	Location of Fountain	Fountain Present (Yes/No)	Cost of construction (If Fountain is not available) (Rs in Lac)
1	Ghantaghar	No	12.00
2	Townhall kachahri chauraha	No	15.00
3	University Student Union Building	No	10.00
4	University North	No	15.00
5	University South	No	15.00
6	Mohaddipur Chauraha	No	30.00
7	Malgodam Tiraha	No	25.00
8	Asuran Chauk	No	40.00
9	Golghar Chauraha	No	10.00
10	Transport Nagar Chauraha	No	30.00

xv. ANNEXURE- II

Plantation Scheme based on wind pattern of Gorakhpur city by Miyawaki Method

Plantation Scheme based on wind pattern of Gorakhpur City

U.P. Pollution Control Board prepared air action plans for Gorakhpur city of Uttar Pradesh. The Action Plans comprises of 06 Major categories as given below:-

a. Vehicle Emission Control

b. Suspension of Road Dust and Fugitive Emission Control

c. Control of Emissions form Biomass/ Crop residue/ Garbage/ Municipal Solid Waste burning

d. Control of Industrial Emissions

e. Control of Air Pollution from constructions and demolition activities.

f. Other Steps to Control Air Pollution.

The main action points of this plan to mitigate pollution are to prepare plan for creation of green buffers along the traffic corridors and Plantation of specific types of species of plants which are helpful in pollution control and develop the tree plantation by Miyawaki forest for mitigation of air pollution based upon location of pollution sources and Wind rose data.

MIYAWAKI FOREST DEVELOPMENT:

The 'Miyawaki Method' is a unique technique to grow forests. Under the approach, dozens of native species are planted in the same area, close to each other which ensures that the plants receive sunlight only from the top and grow upwards than sideways. It requires very little space in which plants grow ten times faster and the forest becomes maintenance-free in approx three years.

Training program to develop Miyawaki Forest is given http://www.upecp.in or scan the QR-code given bellow:

CLIMATE OF THE CITY:

Being on the North- Eastern part of Uttar Pradesh, Gorakhpur city situated in the subtropical continental part of the Saryu Par Plain. The climate is sub-humid to humid and is influenced to some extent by the proximity of the north and the existence of Terai swamps.

The cold season from around the end of November to February is followed by the summer, from March to around middle of June. The period of mid June to September constitutes the south west monsoon season October and November form the post monsoon season. On an average there has been a rainfall of 1393.1 mm. In district normally maximum and minimum temperature varies between 44.10° C to 5°C respectively. The monsoon and the post monsoon seasons the relative humidity are high ranging between 70% and 85%.

SOIL PROFILE:

Gorakhpur district lies between 26°15' and 27°06' North latitude and 83°06' and 83°45' East longitude in Ghaghra- Gandak Doad which is a part of vast Gangetic Plain. It is situated on the banks of the Rapti River. According to soil profile of the district are mainly transported i.e. alluvial soil, comprising sand, silt and clay in varying proportions and rich in humus. The alluvial soil of the districts is subdivided into older alluvial soil and younger alluvial soil. The older alluvial soil occupies high land and younger alluvial soils are restricted to marginal tract of Rapti and Ghaghra rivers and both are fertile.

Alluvial Plain

1. Deep, loamy soils and slightly eroded.
2. Deep, loamy soils and slightly eroded associated with silty soils.
3. Deep, fine soils moderately saline and sodicity associated with loamy soils, slightly eroded.
4. Deep, loamy soils, moderate salinity and sodicity associated with loamy soils with moderate salinity and strong sodicity.
5. Deep, silty soils associated with loamy soils slightly eroded.

Older Alluvial Plain

1. Deep, loamy soils and slightly eroded associated with stratified loamy soils slightly eroded.

EXISTING FOREST COVER:

There is a net increase of 0.0 sq.km has been observed in the State compared to the previous assessment which can be attributed to plantation and conservation. Forest outside Green wash areas have seen a considerable increase. The latest Forest Survey of India (FSI) state of the forest report shows that the overall forest cover of Gorakhpur district has increased — from 2.38% in 2019 to 2017.

According to the FSI report, all trees with canopy density of over 10%, having an extent of more than one hectare and falling on forest, private, community or institutional land, are reflected in the assessment report. Barring the change in geographical areas, the so-called "increase" in forest cover has raised concerns among environmentalists as the forest department sets itself a high plantation target each year and claims a 80% to 90% survival rate of saplings. According to 2019 assessment the forest area of Gorakhpur and its nearby district are given below:

District Name	Geographical Area (sq.km)	2019 Assessment (sq.km)				%GA	Change wrt 2017	Scrub
		V. Dense Forest	M. Dense Forest	Open Forest	Total			
Gorakhpur	3,321	28.00	23.00	28.00	79.00	2.38	0.0	0.0

(Source- The State of Forest Report, 2019, Forest Survey of India)

SENSITIVE AREAS OF THE CITY:

Kushmi Forest:

Forests have a considerable influence on the economy and development of the district, though they are far less extensive than was formerly the case. Kushmi forest is a dense forest-covered with Sal trees. The forest is situated at a distance of 9.0 Kms from Gorakhpur Railway station and is just beside the Air force Station There is a religious-picnic spot named Budhia Mai in the thick green forest. The chief produce of the forest is sal (shorea robusta) in the shape of both timber and fuel besides fodder and other forest produce. They reduce soil erosion and thereby increase fertility of the soil. The forest assets like Banyan, Bhalk, Bamboo, Shisham, Neem and Mango trees are found in the district. Cutting and felling of trees has taken place in the district and retrieved land is being used for agriculture purposes. The wood so obtained from the trees is used for fuel purposes.

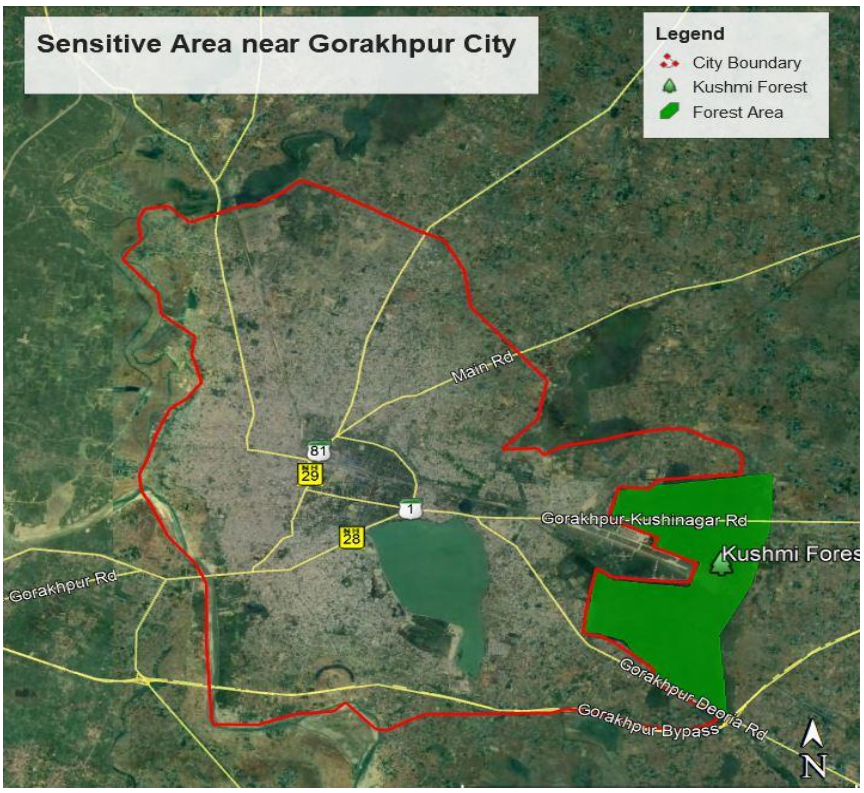


Figure 64: Location of Kushmi Forest

WINDFLOW PATTERN- WINDROSE:

The windrose for the four seasons have been plotted which indicate that the predominant wind direction is blowing from West North West, North-West, West, East North East, East and East South East direction. The wind pattern is very helpful in siting the locations preferable for plantation so that they may act as barriers to air pollution in the downwind direction.

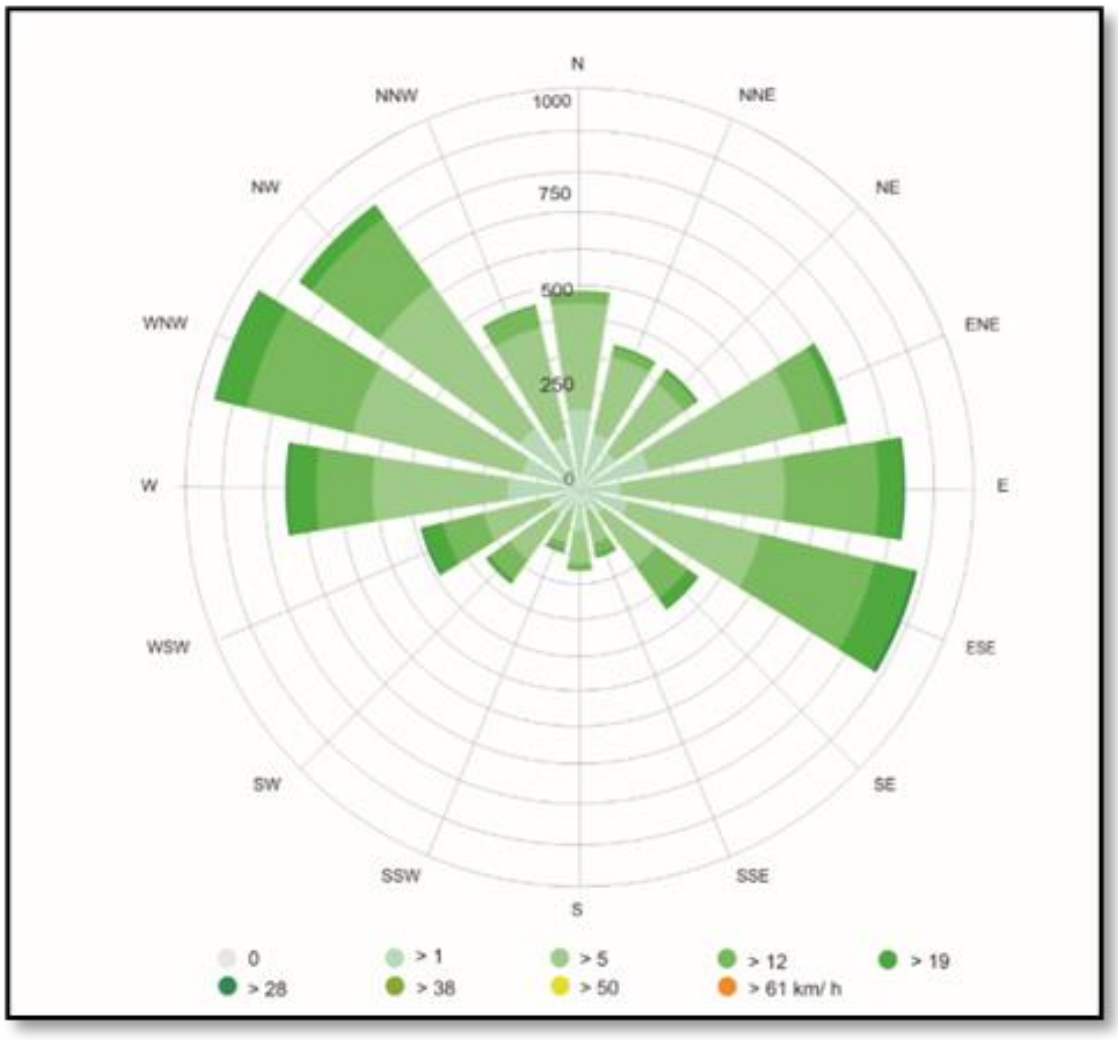
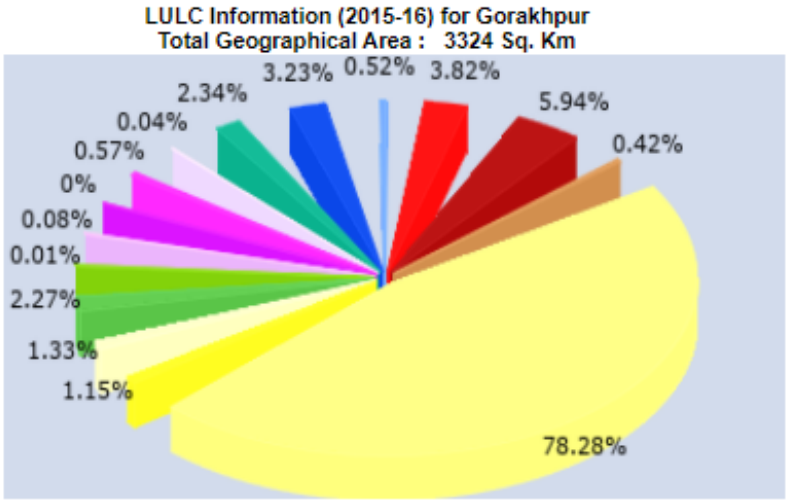


Figure 3: Yearly Wind rose Pattern of Gorakhpur City



LULC Class	Area (Sq.Km)	LULC Class	Area (Sq.Km)
Builtup,Urban	126.82	Builtup,Rural	197.47
Builtup,Mining	14.12	Agriculture,Crop land	2602.09
Agriculture,Plantation	38.28	Agriculture,Fallow	44.24
Forest,Deciduous	75.61	Forest,Forest Plantation	0.46
Barren/unculturable/ Wastelands, Salt Affected land	2.56	Barren/unculturable/ Wastelands, Gullied/Ravinous Land	0.09
Barren/unculturable/ Wastelands, Scrub land	18.8	Barren/unculturable/ Wastelands, Sandy area	1.49
Wetlands/Water Bodies, Inland Wetland	77.65	Wetlands/Water Bodies, River/Stream/canals	107.2
Wetlands/Water Bodies, Reservoir/Lakes/Ponds	17.12		

Figure 4: LULC for Gorakhpur

Description of Land use/Land cover distribution of Gorakhpur

Category	Agriculture				Barren/uncultivable/wastelands			Built up			Forest			Wetlands/water bodies		
	Crop	Current Shifting	Fallow	Plantation	Gullied/ Ravinous	Salt affected	Sandy	Scrub	Mining	Urban	Rural	Deciduous	Forest Plantation	Inland wetlands	River/ Streams/	Water bodies
Area (in sq. km)	2602.09	0.0	44.24	38.28	0.09	2.56	1.49	18.80	14.12	126.82	197.47	75.61	0.46	77.65	107.20	17.12

(Source-https://bhuvan-app1.nrsc.gov.in/2dresources/thematic/LULC502/MAP/UP.pdf)

As per the district wise distribution of Land use/Land cover of Uttar Pradesh data(2015-2016) available in **Bhuvan- Indian Geo Platform of ISRO,** for Gorakhpur there is 26.02.09 sq. km land as crop land out of total geographical area of the district and 44.24 sq.km land is Fallow Land and 38.28 sq.km is already under Plantation, which should be maintained. There is also 18.80 sq.km land left as Scrub land which comes under wasteland category. There is Forest land also available in the district as forest plantation which is 0.46 sq.km and deciduous which is 78.61 sq.km out of total geographical area. Therefore, Barren/uncultivable/waste land available in the upwind and downwind directions of the wind shall be identified for developing green belt to curb the rising level of air pollutants in the city.

TREE PLANTATION STRATEGY:

Objectives of Tree Plantation Strategy

- ✓ Climatic amelioration
- ✓ Check in air & noise pollution
- ✓ Check in soil erosion and reduce water logging
- ✓ Moderating the effect of wind and incoming radiation
- ✓ Aesthetics, shade and ornamentation.

Actions which can be taken in account to curb the emission of dust and other particulate matter in the district:

- Proposal for speeding up the process of developing green belt around the Construction sites of townships and Buildings being constructed towards prominent downwind direction of wind as they have already obtained EC from SEAC/SEIAA and to also produce the 6-monthly Compliance report.
- Development of green belt around the existing brick kiln sites and other air polluting sources located within the city.
- Development of green belt around the outskirts of existing park, Parking areas, Market areas etc.
- Proposal for developing wind break between residential and industrial area.
- Other places which found suitable for proposing plantation- Near GIDA industrial area, along the Gorakhpur- Sonauli Road, along the Railway Tracks and bus stations or other places of the District.
- Plantation of Trees on the flood plain zone to check the soil erosion at the time of floods and enhance the riparian vegetation along with the small ponds and marshy areas found for their

restoration of rejuvenation. List of marshy areas to be rejuvenated by turning them into green spaces is given in this report.

- Unauthorized dump sites to be cleared of the wastes and then after restoring the quality of soil and making it fit for plantation should be turned green. List is attached here in this report
- Abandoned brick kiln sites should be turned green after getting clearance of its ownership and permission from the owner.
- To identify the proposed developments plan for the city like URBAN AND RURAL PLANNING DEPARTMENT, UTTAR PRADESH has developed Master Plan- 2001-2021 for Gorakhpur City which is given below. This Master plan will help in identifying the available places for proposing plantation scheme as to avoid any contradiction in both the schemes.

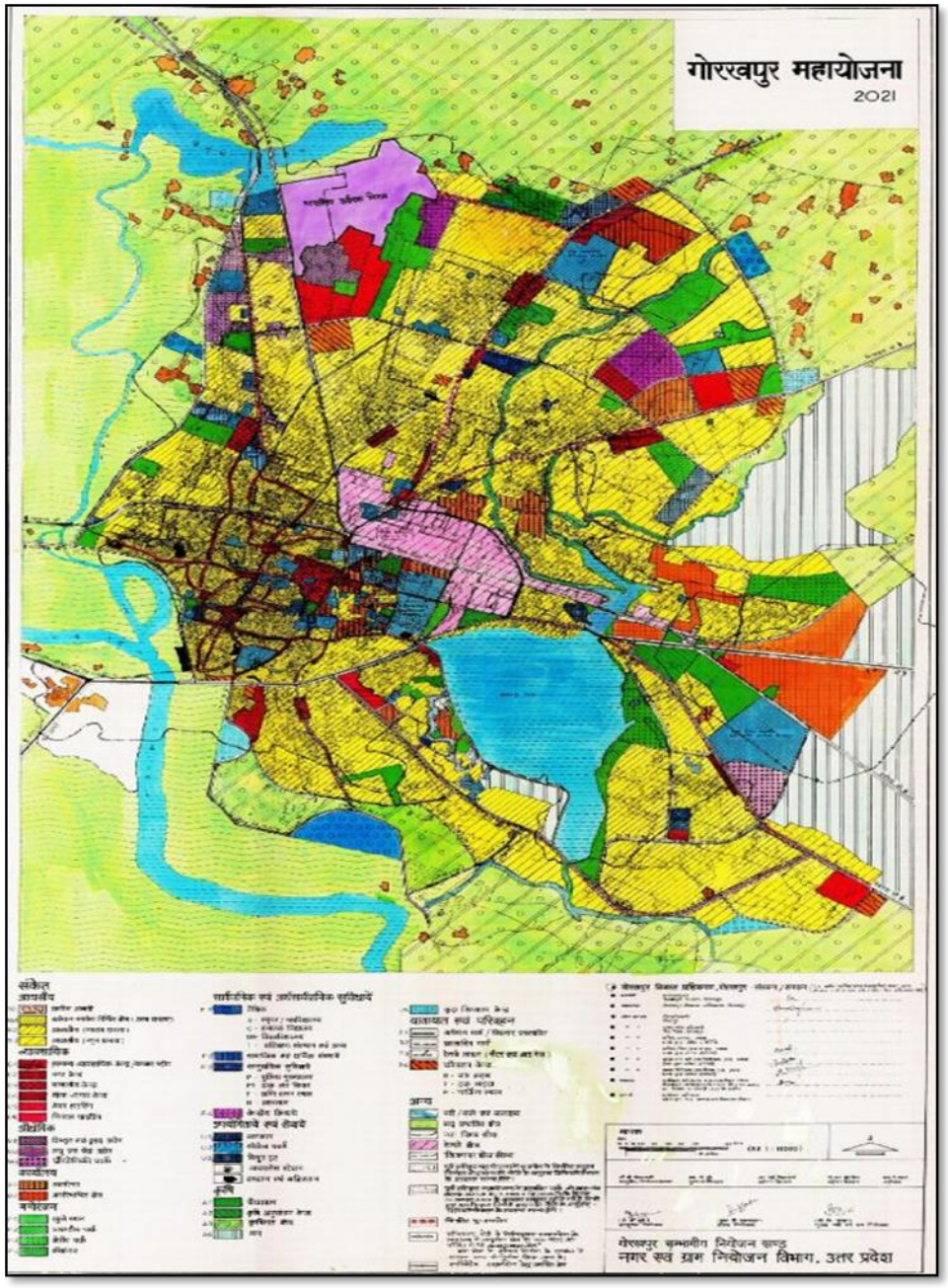


Figure 5: Master Plan for Gorakhpur City

Slum and squatter settlements in Gorakhpur are growing at alarming rates due to increased infrastructure development. The general composition of majority of slums comprises of scheduled tribes, scheduled caste, and other backward classes, forming the weaker section of the society. From habitation point of view, slums located in the low lying areas, along open drains/nallah, tank beds and hazardous/toxic sites are susceptible to inundation, and other forms of disasters.

Gorakhpur-being one of the most significant industrial cities of the state. It has slum population of 49,268 which is 7.32% of total population of the Gorakhpur city population that accounts for 6,

73,446. From amenities view, slums do not have access drinking water sources and households lack connectivity to storm water drainage system and with no underground sewer system, even not a proper facility of cooking requirements hence they rely on biomass/coal burning to cook their food which should be replaced with the supply of LPG.

City Population	Slum Population	% of slum population to city population
673446	49268	7.32%

(*Source: Census 2011, RAY Primary Survey, 2011*)

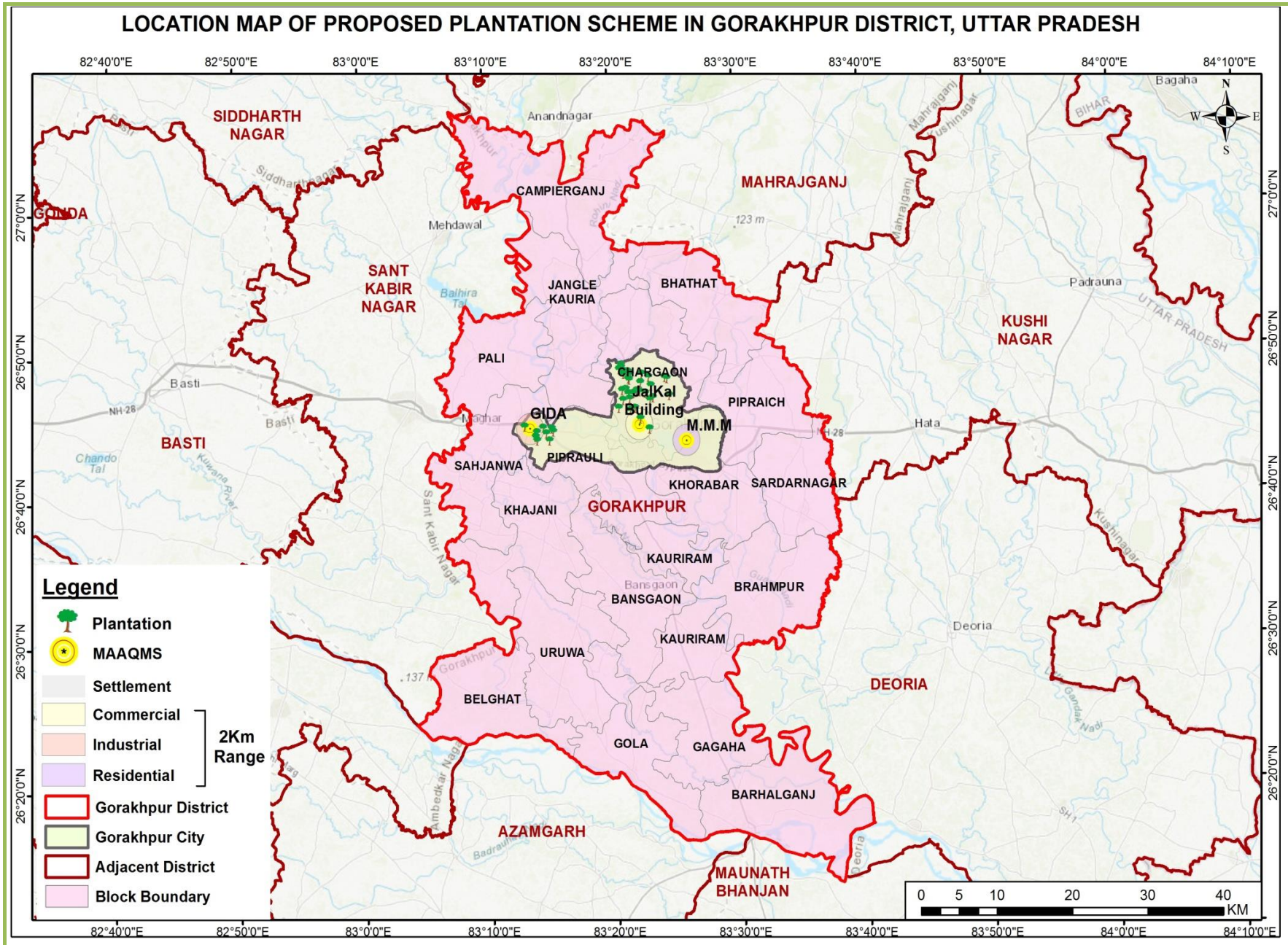


Figure 6: Proposed Plantation on Potential sites located on the outskirts and within the Gorakhpur District

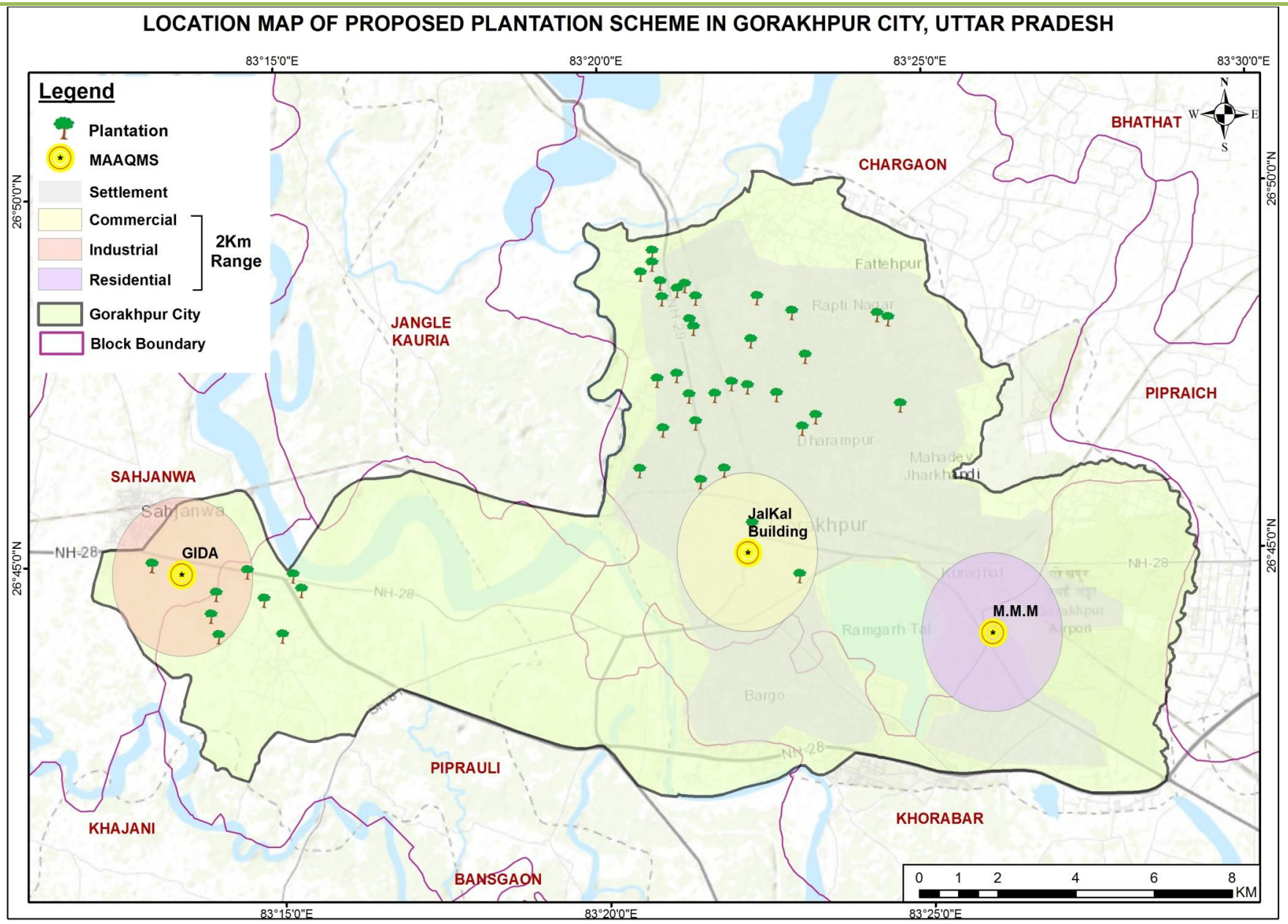


Figure 7: Proposed Plantation on Potential sites located on the outskirts and within the Gorakhpur City

Following sites have been identified on the basis prominent upwind and downwind wind flow pattern on which plantation is proposed to curb the rising level of PM_{10} in Gorakhpur. In addition to these sites, following the direction prominent wind flow pattern, sites will be identified within the city between the habitation to create small oxygen pockets which will also help in lowering the rising level of pollutants being emitted from the major congestion points of the city.

Sites identified for proposing Plantation towards Upwind and Downwind directions

Prominent Wind Direction **West North West, North-West, West, East North East, East and East South East**				
SNo.	**Identified Site**	**Latitude**	**Longitude**	**Area (In Hectares)**
1.	Near NooruddinChak	26°49'8.80"N	83°20'48.26"E	5.26
2.	Near NooruddinChak	26°48'59.16"N	83°20'48.05"E	
3.	Near NooruddinChak	26°48'51.28"N	83°20'37.15"E	
4.	Near NooruddinChak	26°48'37.39"N	83°21'10.95"E	0.91
5.	Near NooruddinChak	26°48'43.76"N	83°20'55.23"E	
6.	Near Vikas Nagar	26°48'30.83"N	83°21'27.75"E	1.23
7.	Near Vikas Nagar	26°48'41.27"N	83°21'17.91"E	
8.	Near Bargadwa	26°48'30.80"N	83°20'56.59"E	6.17
9.	Near Vistar Colony	26°48'12.21"N	83°21'21.66"E	0.62
10	Near Vistar Colony	26°48'6.10"N	83°21'25.24"E	
11	Rajendra Nagar	26°47'27.65"N	83°21'8.92"E	1.23
12	Rajendra Nagar	26°47'10.82"N	83°21'19.94"E	
13	Rajendra Nagar	26°47'24.07"N	83°20'50.66"E	
14	Rajendra Nagar	26°46'48.64"N	83°21'25.77"E	

15	Rajendra Nagar	26°46'43.45"N	83°20'55.23"E	
16	Near SardaKunj	26°47'20.35"N	83°21'59.74"E	0.91
17	Near SardaKunj	26°47'17.33"N	83°22'14.32"E	
18	Near SinchaiVibhag Colony	26°47'11.05"N	83°21'43.98"E	0.30
19	Near Fertilizer Colony	26°48'30.10"N	83°22'24.65"E	6.17
20	Near Surajkund Colony	26°46'10.60"N	83°20'33.05"E	1.53
21	Near adityanagar	26°46'0.63"N	83°21'29.24"E	0.62
22	Near Ramjanki Nagar	26°47'10.54"N	83°22'41.12"E	1.23
23	Near Lajpat Nagar	26°46'9.45"N	83°21'51.29"E	0.91
24	B Colony Shahpur	26°46'42.76"N	83°23'4.34"E	0.62
25	Siva Puram	26°46'51.90"N	83°23'16.89"E	1.23
26	Near Narayan Colony	26°48'14.32"N	83°24'15.63"E	0.91
27	Near Narayan Colony	26°48'10.79"N	83°24'25.34"E	
28	Bank Colony	26°47'0.12"N	83°24'35.35"E	0.30
29	Gayatripuram Nakaha No-1	26°47'55.00"N	83°22'18.16"E	3.09
30	Milinium City Kareem Nagar	26°48'17.48"N	83°22'56.71"E	6.17
31	Rapti Nagar Fattepur	26°47'41.31"N	83°23'08.25"E	1.23
Total Area				**40.64**

Non- Prominent Wind Direction

(North North West to North East Section and West South West to South East Section)

SNo.	**Identified Site**	**Latitudes**	**Longitudes**	**Area (In Hectares)**
1.	Near Basharatpur	26°45'24.76"N	83°22'16.27"E	3.09
2.	Near Paidleganj	26°44'42.32"N	83°22'59.37"E	3.09
Total Area				**6.18**

As per the locations identified towards the prominent wind directions given above in the table, total area proposed for plantation and maintenance of the vegetation in prominent wind direction is approximately 40.64 ha similarly towards non prominent wind directions is approximately 6.18 ha which comes upto the total of **46.82 ha**.

Proposing Plantation around GIDA

Above given is the list of abandoned GIDA sites which could be considered for plantation as this city has high demands of other activities these pockets of place should be considered for creating oxygen pockets.

S No.	Industrial Area	Latitudes	Longitudes	Area (acres)
1.	Near GIDA	26°44'49.60"N	83°15'10.72"E	2.47
2.	Near GIDA	26°44'37.73"N	83°15'18.23"E	17.24
3.	Near GIDA	26°44'53.47"N	83°14'28.39"E	0.62
4.	Near GIDA	26°44'35.60"N	83°13'59.13"E	0.62
5.	Near GIDA	26°44'17.83"N	83°13'54.23"E	0.62
6.	Near GIDA	26° 44.561'N	83° 15.051'E	0.62
7.	Near GIDA	26° 45.012'N	83° 13.649'E	2.47
8.	Near GIDA	26° 45.363'N	83° 13.471'E	2.47
Total				27.13

As plants are universal sink for air pollutants, they trap the carbon dioxide and store it within them as reserve food material. Plants being the initial acceptors of air pollutants act as a scavenger to the pollutants. Leaves provide surface area for impingement, absorption and adsorption of air pollutants as well settlement for dust particles in the atmosphere equally. Few plants are sensitive to certain air pollutants while others are tolerant. The plants sensitive to pollutants act as pollution indicators while the plants tolerant to pollutants act as sink. While selecting the species for pollution control the following are the important characteristics that should be considered. Plants should be evergreen, large leaved, rough bark, indigenous, ecologically compatible, low water requirement, minimum care, high absorption of pollutants, resistant pollutants, agro-

climatic suitability, height and spread, canopy architecture, growth rate and habit (straight undivided trunk), aesthetic effect (foliage, conspicuous and attractive flower colour), pollution tolerance and dust scavenging capacity. Hence, plantation needs to be done on haul routes to curb air pollution in respect to dust emission.

Selection of Plants for Greenbelts:

Main limitation for plants to function as scavenger of pollutants are- Plants interaction to air pollutants, sensitivity to pollutants, climatic conditions and soil characteristics. While making choice of plants species for plantation in green belts, due consideration has to be given to the natural factor of bio-climate. Character of plants mainly considered for affecting absorption of pollutant gases and removal of dust particle are as follows:

Major Pollutants	Varieties of Trees	Varieties of Bushes
Particulate Matter	*Cassia siamea* (Kassod tree), Siris, Chitwan, Kadamb, Neem, Sheesham, Mahua, Amaltas, Ficus (Peepal and Banyan)	Kadi Patta, Croton, Tecoma stans, Cassia glauca, Dhak
Sulphur oxides	Siris, Arroo, Chitwan, Kadamb, Neem, Bamboo, Mahuli, Semal, Mahua, Tamarind, Ficus	Amla, Dhak, Subabool,
Nitrogen oxides	Chilbil, *Mangifera indica* (aam), Siris, Mahua, Jamun, Neem, Sheesham	Mahuli, Subabool, Dhak,

For absorption of gases:

- Tolerance towards pollutants in question, at concentration, that are not too high to be instantaneously lethal
- Longer duration of foliage
- Freely exposed foliage
- Adequate height of crown

- Openness of foliage in canopy
- Big leaves (long and broad laminar surface)
- Large number of stomatal apertures

For Removal of Suspended Particular matter:

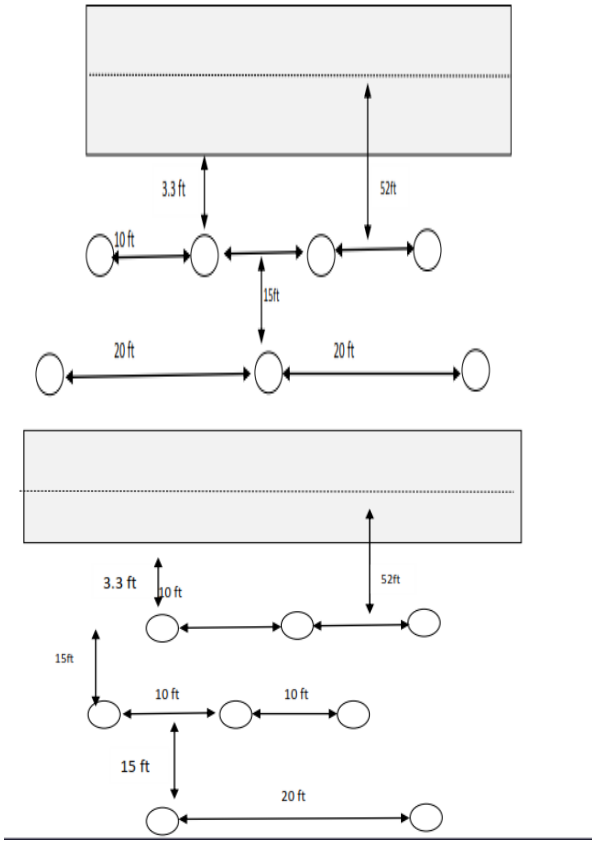
- Height and spread of crown.
- Leaves supported on firm petiole
- Abundance of surface on bark and foliage
- Roughness of bark
- Abundance of axillaries hairs
- Hairs or scales on laminar surface
- Protected Stomata

Selection of Plants for Greenbelts:

The main limitation for plants to function as scavenger of pollutants are, plant's interaction to air pollutants, sensitivity to pollutants, climatic conditions and soil characteristics. While making choice of plants species for plantation in green belts, due consideration has to be given to the natural factor of bio-climate. Character of plants mainly considered for affecting absorption of pollutant gases and removal of dust particle are as follows.

a. **Plantation pattern:**

- The first row along the highways will be of small to medium size ornamental trees
- Subsequent rows depending on the availability of width will comprise of ornamental and/or shade bearing species of medium height more than those in the first row.
- In rural sections the last row shall always be shade bearing tall trees.
- Plantation shall be done in a staggered (zigzag) manner.



(Option 1) Two-row Plantation

(Option 2) Three-row Plantation

Plantation pattern

Specification	I row	II row	III row
Spacing between plant to plant	10 ft	10 ft	20 ft
Canopy Shape & Size	Cylindrical/oblong with small CSA	Round/oblong with medium CSA	Spreading with medium CSA
Spacing between rows	-	15 ft	15 ft
Size of the pits	60 X 60 X 60 cm	60 X 60 X 60 cm	60 X 60 X 60 cm
Height of the plant	1.5 m to 2 m	More than 2m	More than 3m

To develop a plantation matrix various characteristics of plant species are taken into considerations like tolerance factor, ecologically compatible, growth rate of plant species, canopy surface area, leaf area, stomatal index, canopy shape, flowering seasonality and utility etc. and score obtained by varieties of species of trees and bushes naturally found in that region. The species which scored high are preferred over the species scored less for the plantation to curb air pollution

Matrix for plant selection

S.No.	Characteristic	Score	Remarks
1.	Tolerance/stressed	1/0	Any species which have shown tolerance for primary pollutants of vehicular emission will be rated tolerant and given a fixed score of 1 mark and sensitive species are given 0 mark.
2.	Evergreen	1/0.5/0	Evergreen tree/shrubs have been given 1 marks, semi deciduous have been given 0.5 marks and deciduous have got 0 mark.
3.	Growth rate	1/0.5/0	Growth rate of trees/ shrubs have been classified in to three categories. Fast- 1 mark for the trees which grow in a very short span of time. Quick 0.5 mark for the trees which grow in a very short span of time. Slow-0 mark for the trees which grow in a very short span of time.
4.	Canopy surface	1	Trees/ shrubs with highest canopy surface have been given 1 mark and others have been rated relative to the tree

			/shrubs with highest CS.
5.	Leaf area	1	Trees/ shrubs with highest leaf area have been given 1 mark and others have been rated relative to the tree /shrubs with highest LA.
6.	Stomatal index.	1	Trees/ shrubs with highest stomatal index have been given 1 mark and others have been rated relative to the tree /shrubs with highest SI.
7.	Canopy shape- Spreading/Round /oblong/Flat crown/Conical	1/0.75/0.5/0.25/0	Spreading-1 mark Round -0.75 mark Oblong-0.5 mark Flat crown-0.25 mark Conical-0 mark
8.	Flowering seasonality	0.5	Tree/shrubs having the round year flowering season have been given 0.5 marks and others have been rated relative to them.
9.	Utility	1	Trees with highest recorded uses have been given 1 mark and others have been rated relative to the tree /shrubs with highest uses.
10.	Total	8.5	

Recommended Pattern of Plantation for the congested streets:

As these congested streets have a local scenario due to emission of pollutants from vehicle exhausts which could not escape concrete lanes and narrow streets and causes deterioration in the local air quality. Hence, low hedges/ green barriers which have an

impermeable core are recommended between the traffic lanes and the footpath along with the isolated trees every here and there.

Recommended Plantation Species for Gorakhpur City:

List of Tree Species for Plantation

S. No.	Common Name	Botanical Name	S. No.	Common Name	Botanical Name
1.	Siris	*Albizia lebbeck*	19.	Subabul	*Leucaena leucocephala*
2.	Amaltas	*Cassia fistula*	20.	Eucalyptus	*Eucalyptus globulus*
3.	Ber	*Ziziphus mauritiana*	21.	Desi Babool	*Acacia nilotica*
4.	Neem	*Azadirachta indica*	22.	Mango	*Mangifera indica*
5.	Pepal	*Ficus religiosa*	23.	Casuarina	*Casuarina equisetifolia*
6.	Guava	*Psidium guajava*	24.	Jamun	*Syzygium cumini*
7.	Amla	*Phyllanthus emblica*	25.	Sheesham	*Dalbergia sissoo*
8.	Tamarind	*Tamarindus indica*	26.	Pakad	*Ficus virens*
9.	Sahajan	*Moringa oleifera*	27.	Chitwan	*Alstonia scholaris*
10.	Gulmohar	*Delonix regia*	28.	Gular	*Ficus racemosa*
11.	Sagwan	*Tectona grandis*	29.	Bottlebrushes	*Callistemon*

12.	Shahtoot	*Morus*	30.	Mahua	*Madhuca longifolia*
13.	Kanji	*Millettia pinnata*	31.	Kadam	*Neolamarckia cadamba*
14.	Bakayan	*Melia azedarach*	32.	Bahera	*Terminalia bellirica*
15.	Jungle jalebi	*Pithecellobium dulce*	33.	Amla	*Phyllanthus emblica*
16.	Banyan	*Ficus benghalensis*	34.	Jamun	*Syzygium cumini*
17.	Ashoka	*Saraca asoca*	35.	Semal	*Bombax Ceiba*
18.	Arjun	*Terminalia arjuna*			

List of Shrub Species for Plantation

S. No.	Common Name	Botanical Name	S. No.	Common Name	Botanical Name
1.	Bougainvillea	*Bougainvillea glabra*	6.	Molshree	*Mimusops elengi*
2.	Madar	*Calotropis gigantea*	7.	Chandni	*Tabernaemontana divaricate*
3.	Chakotra	*Citrus maxima*	8.	Harshringar	*Nyctanthes arbortristis*
4.	Kaner	*Cascabela thevetia*	9.	Kunth	*Tecoma stans*
5.	Gudhal	*Hibiscus*	10.	Nimbu	*Citrus limon*

Plants experience physiological changes before getting damaged when the leaves are exposed to air pollutants. The tolerant species are preferred over the sensitive species for plantation. To analyze the species, various variables are used like Air Pollution Tolerance Index (APTI) which is based on biochemical parameters, Anticipated Performance Index (API) which is based on biological and socio-economic aspect of a plant. The carbon trapping and dust accumulating potential also varies from species to species.

APTI score of different trees and their efficacy in Pollution control.

S.No.	Botanical Name	Family	Common Name	APTI	Effective in Control
1.	*Cassia siamea*	Caesalpiniodeae	Kassod tree	10.41	Dust
2.	*Albizia lebbeck*	Fabaceae	Siris tree	15.9	Air pollution
3.	*Alstonia scholaris*	Apocynaceae	Chitwan tree (Blackboard tree)	6.6	Dust
4.	*Neolamarckia cadamba*	Rubiaceae	Kadamb tree (Burflower tree)	15.5	Dust
5.	*Azadirachta indica*	Meliaceae	Neem tree	18.73	Dust, air pollution and Noise pollution
6.	*Dalbergia sissoo*	Papilionaceae	Sheesham	16.59	Air pollution Noise pollution
7.	*Madhuca indica*	Sapotaceae	Mahua	22.57	Air pollution
8.	*Mangifera indica*	Anacardiaceae	Mango	20.80	Air pollution

9.	***Bougainvillea spectabilis***	**Nyctaginaceae**	**Booganbel**	**20.32**	**Air pollution**
10	***Nerium indicum***	**Apocynaceae**	**Kaner**	**18.94**	**Air pollution**
11	***Ficus benghalensis***	**Moraceae**	**Banyan**	**15.92**	**Air pollution, noise pollution**
12	***Ficus religiosa***	**Moraceae**	**Peepal**	**12.41**	**Air pollution, noise pollution**

Significance of Plantation in city:

According to the UN World Health Organization (WHO), about 90% of the global population living in cities in 2014 was exposed to particulate matter that exceeded the WHO air quality guidelines. The UN agency estimates that outdoor air pollution caused three million premature deaths in 2012, with the vast majority occurring in low- to middle-income nations.

The WHO Health Statistics 2016 says air pollution is "caused by inefficient energy production, distribution and use, especially in the industrial, transportation and building sectors, and by poor waste management". It adds that transport systems based primarily on individual motorized transport can lead to further deterioration in air quality. As everyone within an urban area breathes the same air, the pollution does not discriminate - both rich and poor are exposed to the dangers. But, it adds, people living near the source or busy roads are more exposed and more affected. The WHO says that the air quality in many cities is not monitored, making it difficult to get an accurate understanding of the global impact of air pollution. However, planting trees in an urban setting is not without potential pitfalls. One is regarding the flow of air in heavily polluted streets, particularly ones with large volumes of traffic. Thick canopies can limit the circulation of air, trapping the poor quality of air at low levels, where people breathe but if plantation done in a manner that instead of restricting the air flow it will facilitate

the movement of air and also reduce the concentration of pollutants, that should be encouraged.

Trees help by removing (sequestering) CO_2 from the atmosphere during photosynthesis to form carbohydrates that are used in plant structure/function and return oxygen back into the atmosphere as a byproduct. Roughly half of the greenhouse effect is caused by CO_2. Therefore, trees act as carbon sinks, alleviating the greenhouse effect. On average, one acre of new forest can sequester about 2.5 tons of carbon annually. Young trees absorb CO_2 at a rate of 5.9kg per tree each year. Trees reach their most productive stage of carbon storage at about 10 years at which point they are estimated to absorb 21.8kg of CO_2 per year.

Trees also reduce the greenhouse effect by shading houses and office buildings. This reduces the need for air conditioning by up to 30 percent which in turn reduces the amount of fossil fuels burned to produce electricity. The combination of CO_2 removal from the atmosphere, carbon storage in wood and the cooling effect makes trees extremely efficient tools in fighting the greenhouse effect. Planting trees remains one of the most cost-effective means of drawing excess CO_2 from the atmosphere. Especially, the urban vegetation plays a multitude of different roles in the urban environment as they provide shade, absorb and store carbon dioxide, mitigate the urban heat island effect, affect noise hindrance, enrich the urban biodiversity etc. in addition, trees and urban vegetation play a great role in enhancing the aesthetical and emotional value.

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