



Training Module
for
District Nodal Officers

AIR POLLUTION RELATED ILLNESSES

National Programme on Climate Change and Human Health

National Centre for Disease Control
Directorate General of Health Services
Ministry of Health and Family Welfare

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National Programme
on Climate Change
and Human Health



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Executive Summary

The manual is meant for the capacity building of the district programme officials under NPCCHH on air pollution related illnesses. This will help them to understand what the priority activities to do and how these activities are to work out in achieving the intended five key objectives as outlined under the programme on the subject.

The programme officers will be sensitised that air pollution is regarded as a critical environmental hazard recognized globally as the single largest environmental risk to human health and a main avoidable cause of death and disability. Tackling air pollution and its health impact is a great challenge in our country because of multiplicity of sources and prevailing meteorology and requiring multi-sectoral approaches both the health and non-health sectors. Health sector mostly deals on the adaptation concerns where the non-health sectors work for the mitigation role in addressing the air pollution.

The capacity-building programme will also introduce on air quality information, its forecasting and integration to health sector, its exposure and its health impacts, health issues of short and long-term diseases, and surveillance. Understanding of ways to strengthen the health system adapted to air pollution and health issues.

The training will help the DNO develop health action plans suitable to the region and tackle their respective district's health issues related to air pollution and its exposure. This will highlight the roles and responsibilities of district health system and its coordination with the state and national level.

The document will have on the hands training on ways to constitute district level multi sectoral task force, its meeting conduction, creating mass awareness plans and actions through different Information, Education & Communication (IEC) tools. It will also focus on the capacity building approaches for the health professionals, community health workers, and community members through guidelines and training modules. Such mechanisms support the knowledge enrichment of the DNOs and others and give them the required tools and techniques for community outreach. It also outlines the roles and responsibilities of programme officers, health professionals, and workers in the health sector.

With this DNO training programme in the country, it is expected to provide the foundation for India's response to the health impacts of air pollution. The training is flexible to accommodate emerging information on the subject and evolve strategies accordingly in future and a resilient health sector to address air pollution related illnesses under NPCCHH.

Acknowledgement

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The National Centre for Disease Control (NCDC) under the Ministry of Health and Family Welfare through United Nations Environmental Programme (UNEP) has brought out this document on Strengthening Capacity at the District Level on Air Pollution & Human Health. This is a guidance training module developed by the undersigned under the leaderships and supervision of Prof (Dr.) Atul Goel, Director General Directorate General of Health Services, MoHFW, Shri Lav Agarwal, Additional secretary, MoHFW, Dr. Sujeet Kumar Singh, Principal Advisor, NCDC, Dr. Aakash Shrivastava, Head of the NPCCHH division at NCDC.

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The programme is very grateful to all those who have contributed successfully in bringing up the present training module meant for the DNOs on air pollution related illnesses to support the officials for developing health action plans at the district level achieving NPCCHH key objectives to address challenges in the health sector at the district level.

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1. INTRODUCTION ON AIR POLLUTION

Learning Objectives:

1. Understanding the basics of air pollution- its system, forms and types, key pollutants, sources and indoor (household) air pollution
2. Relationship between Air Pollution and Climate Change

Air pollution problem can be depicted as a system consisting of three basic components (Figure 1.1):

(i) emission sources; (ii) atmosphere; and (iii) receptors.

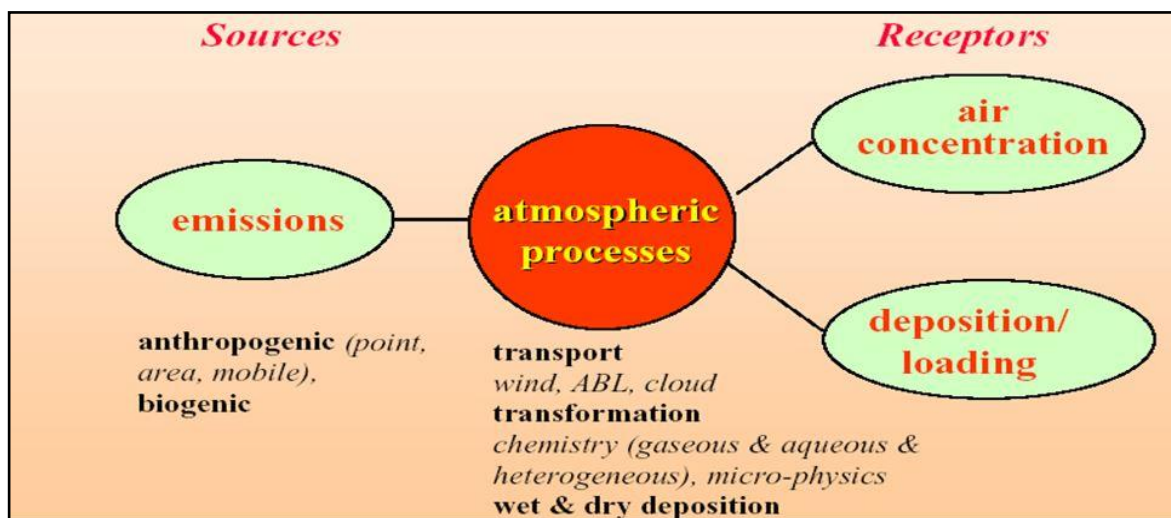


Figure 1.1: Air Pollution System (ABL: Atmospheric Boundary Layer)

The air pollution problem begins with emission sources, which can be anthropogenic or natural. Anthropogenic sources include industrial establishments, domestic cooking, space heating and automobiles. Natural sources of air pollution include volcanic eruptions, forest fires, desert storms and biogenic emissions. Anthropogenic sources are generally predominant over natural sources and by far the most important to air pollution since these sources occur in the close vicinity to where we live. The critical aspect of these sources is their strengths in emission quantities and height of release. Atmospheric processes are responsible for the transportation, mixing, and physical and chemical transformation of pollutants. The wind speed and direction decide how quickly the pollutants will be dispersed and what will be the direction of impact. The vertical temperature profile of the atmosphere decides the vertical mixing and turbulence. The third component receptor (e.g., humans, ecology, buildings) is the one that receives the harmful impacts of air pollution. The impact on living receptors can be short-term to life-threatening, whereas other effects could be economic losses. The ultimate aim of a study of this system is to answer the question: 'What the optimum way to prevent/minimize the impact of air pollution on the receptor is.'

Air Pollution and its various forms and types

Although pollution in the atmosphere can stay in all three forms - gaseous, liquid and solid, physical forms generally considered for all pollutants are particulate (including mist) and gaseous. These two forms are described below in Table 1.1.

Table 1.1: Atmospheric forms of the pollutants

Particulate	Gases
Small discrete masses of solid or liquid matter	Widely separated molecules in rapid motion lack definite shape and volume
Example: dust, smoke, mist, etc.	Examples: carbon monoxide, Sulphur dioxide, hydrocarbon vapours, etc.

Air pollutants are also classified as primary or secondary based on their characteristics at the time of emissions and the physical/chemical changes they undergo while in the atmosphere (Table 1.2).

Table 1.2: Primary and secondary air pollutants

Primary Pollutants	Secondary Pollutants
Emitted into the atmosphere directly from the identifiable sources	Undergo chemical changes in the atmosphere as a result of reactions among two or more pollutants
Present in the same chemical form as at the time of emission from the sources. Example: SO ₂ , NO, NO ₂ , CO	Examples: NO ₂ , H ₂ SO ₄ , O ₃

Key Air Pollutants

The key primary air pollutants are particulate matter (PM), black carbon (BC), Sulphur oxides (SO₂), nitrogen oxides (NO_x) (including nitrogen monoxide and nitrogen dioxide, NO₂), ammonia (NH₃), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), including benzene, and certain metals and polycyclic aromatic hydrocarbons, including benzo[a]pyrene (BaP). The important secondary air pollutants are PM, ozone (O₃), NO₂ and several oxidized volatile organic compounds (VOCs). Key precursor gases for secondary PM are Sulphur dioxide (SO₂), NO_x, NH₃ and VOCs.

At the same time, reductions in emissions do not always automatically result in similar falls in concentrations. There are complex links between air pollutant emissions and air quality. These include emission heights, chemical transformations, reactions to sunlight, additional natural and hemispheric contributions and the impact of weather and topography.

Ground-level (tropospheric) ozone is not directly emitted into the atmosphere. Instead, it forms in the atmosphere from a chain of chemical reactions following emissions of certain precursor gases: NO_x , carbon monoxide (CO), and volatile organic compounds (VOCs). Ground-level ozone is formed from chemical reactions in the presence of sunlight, following emissions of precursor gases, mainly NO_x , NMVOCs, CO and CH_4 .

Nitrogen oxides are emitted from industrial facilities and the road transport sector during fuel combustion. NO_x is a group of gases comprising nitrogen monoxide (NO) and nitrogen dioxide (NO_2). NO makes up the majority of NO_x emissions. NO_x contributes to the formation of ozone and particulate matter.

Particulate matter (PM)

Suspended Particulate Matter (SPM) is a subset of particulate matter, which comprises particles with sizes less than $50\mu\text{m}$ and are likely to remain suspended in the atmosphere for a long time. The health effect of SPM is a function of particle size. Particulate matter enters the body through the respiratory system. The respiratory system has several levels of defense against invasion by foreign materials. Large particles are filtered from the air stream by hair in the nasal passage and trapped by the mucus lining in the nasal cavity. Fine particles (less than $2.5\mu\text{m}$ in diameter) reach deep into the respiratory system, where oxygen transfer occurs. Figure 1.2 presents the human respiratory system and the mechanisms of particulate deposition. There are typically three particle size ranges considered in the atmosphere. These ranges represent main PM size types and typical sources of particulate (Figure 1.2).

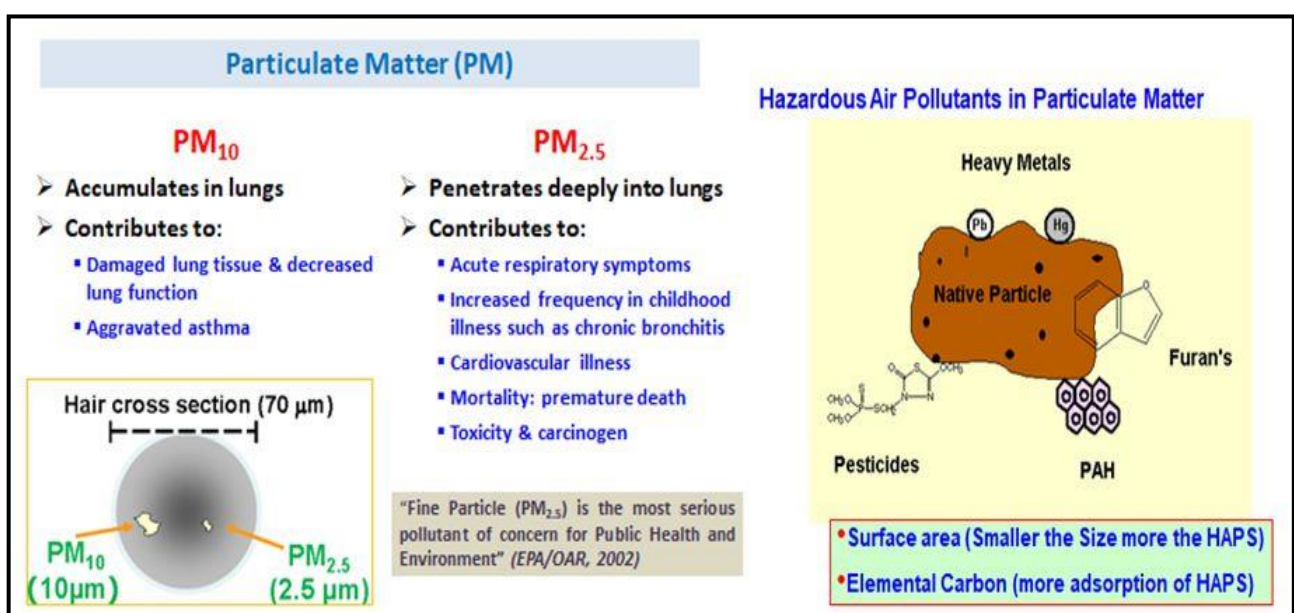


Figure 1.2: Typical aerosol size distributions (Brune, 2019)

Sulphur dioxide is formed and emitted by the combustion of fossil fuels (mainly coal and oil) primarily for electricity generation. High concentrations of SO₂ are associated with multiple health and environmental effects. The highest concentrations of SO₂ have been recorded in the vicinity of extensive industrial facilities. SO₂ emissions are a critical environmental issue because they are a significant precursor to ambient PM_{2.5} concentrations.

Benzo(a)pyrene is a polycyclic aromatic hydrocarbon (PAH) found in fine PM. Its origin is the incomplete combustion of various fuels. The primary sources of BaP in Europe are domestic home-heating, in particular, wood and coal-burning, waste-burning, coke and steel production, and road traffic. Other sources include outdoor fires.

Major sources of air pollution in the country are –

- i. **Ambient (outdoor) air pollution** is from both anthropogenic and natural.
 - a) Industrial emissions (through fossil fuel burning/ process and fugitive emission)
 - b) vehicular exhaust
 - c) re-suspension of road dust, construction and demolition activities,
 - d) refuse burning (garbage, horticulture wastes, crop residues etc.)
 - e) use of solid fuels for cooking and burning of firecrackers etc.
- ii. **Household (Indoor) air pollution** is caused by burning biomass such as
 - a) wood, coal, dung, kerosene in chulhas or fireplaces for cooking, lighting and heating purposes.
 - b) Others such as
 - by burning mosquito coils, incense sticks, cigarettes, bidis,
 - use of sprays, solvents, and fumes from chemicals used in building interiors etc.
- iii. **Sick Building Syndrome (SBS)**: Building occupants experience acute health and comfort effects which appear to be linked to time spent in a building, but no specific illness or cause can be identified is called Sick Building Syndrome (SBS).
 - a) The complaints may be localized in a particular room or zone, or may be widespread throughout the building.
 - b) The major sources are inadequate ventilation, chemical and biological contaminants (molds and fungi) from indoor sources or outdoor sources, dust, smoke, fumes, fabric fibres, bright or flickering lights and problems with cleaning and layout

Every day we see chimneys from various industries emitting smoke and other pollutants in the atmosphere. Different types of industries emit different types of pollutants and in multiple quantities. Combustion of any type causes pollution as combustion is generally incomplete and produces harmful exhaust products.

Figure 1.3 show sources of air pollution and Figure 1.4 show the Source-Pollutant Matrix. Industrial and other air pollution sources are summarized below in Figure 1.5.



Figure 1.3: Sources of Air Pollution

- 1 – Ammonia and methane emissions from agricultural activities.
- 2 – SO_x from energy production and distribution
- 3 – Natural phenomena, including volcanic eruptions
- 4 – Waste landfill, coal mining
- 5 – NO_x emission from road transport
- 6 – Fuel combustion from households, etc.

Domestic sources of air pollution include residential heating and cooking using fossil fuels. Although small in quantity, this source is significant from an air pollution point of view. Almost all emissions of particulate matter from domestic sources using wood and coal are in the respirable size fraction (<2.5 μ m) and the highest concentration is likely to occur in residential neighborhoods. Often ignored, the non-point sources are significant as they are mostly somewhat hidden. Emissions from loading/unloading, open storage or other types of crushing, open refuse burning, unpaved roads, agriculture activities (such as spreading of Pesticides) and construction and building demolition activities constitute the non-point sources. These sources can generally be controlled employing better housekeeping and enclosing areas where these emissions occur.

Source	Pollutant						
	PM	SO ₂	NO _x	CO	HC	Fluoride	Lead
A. Industrial							
Power plant (coal)	++++	+++	+++	-	-	-	-
Sulphuric acid	-	++++	-	-	-	-	-
Super phosphate	+++	-	-	-	-	++++	-
Cement	++++	+	+++	+	-	-	-
Carbon black	+++	++	++	++++	++	-	-
Oil refinery	+	++++	+++	+	+++	-	-
Aluminium	+++	++	++	+	++	++++	-
Cooper and zinc	+++	++++	++	-	-	-	-
Iron and Steel	++++	++++	++++	+++	++++	++	-
Brick kilns	+++	+++	+++	++	+	++	-
B. Vehicular							
Petrol-driven	-	+	++	++++	++++	-	++++
Diesel-driven	++	+++	++++	+	+	-	-
C. Domestic							
Coal	++	++	++	++	++	-	-
Wood	++	++	+	++	++	-	-
Biogas	-	-	+	+	-	-	-
LPG	-	-	+-	-	-	-	-

Figure 1.4: Source of air pollutants showing Pollutant Matrix

'+' indicates emission strength and '-' Indicates absence or near absence

Abbreviation: PM- Particulate matter, SO₂ - Sulfur dioxide, NO_x - Oxides of Nitrogen, CO- Carbon monoxide, HC - Hydrocarbon

The mobile sources refer to automobiles' emissions, which include cars, buses, trucks, tempos, three and two-wheelers, motor cycles, steam and diesel-driven locomotives, air crafts and ships. The mobile source is one of the largest sources of air pollution in our urban centers.

Indoor Air Pollution

Indoor air pollution is dust, dirt, or gases in the air inside buildings such as homes or workplaces that could be harmful to breathe in. Poor indoor air quality has been linked to lung diseases like asthma, COPD and lung cancer. It has also been linked to an increased risk of heart disease and stroke. The principal sources of indoor air pollution are: combustion inside a building (solid biofuel, incense sticks), tobacco smoking, building material, and bioaerosols (fungi and moulds) (Figure 1.5). Although radon, asbestos, pesticides, heavy metals, volatile organic matter, are present in indoor air, tobacco smoke and the combustion products of biomass fuels are important sources in India. The incomplete combustion products of biomass fuels include particulate matter, carbon monoxide, polyaromatic hydrocarbons, formaldehyde, etc., which adversely affect health. The combustion of coal results in harmful emissions of air pollutants like oxides of sulfur, arsenic, and fluorine. Pollutants such as aldehydes, volatile, and semi volatile organic compounds are produced from resins, waxes, polishing materials, paints, cosmetics, and binders. Lastly, biological pollutants like

dust mites, moulds, pollen, and infectious agents produced in stagnant water, mattresses, carpets, and humidifiers also pollute indoor air (Zhang & Smith, 2003).



Figure 1.5: Sources of Indoor air pollution

Relationship between Climate Change and Air Pollutants

Key Greenhouse gases impacting climate change are carbon dioxide, methane, nitrous oxide, fluorinated compounds, and ozone. The greenhouse effect is illustrated in Figure 1.6.

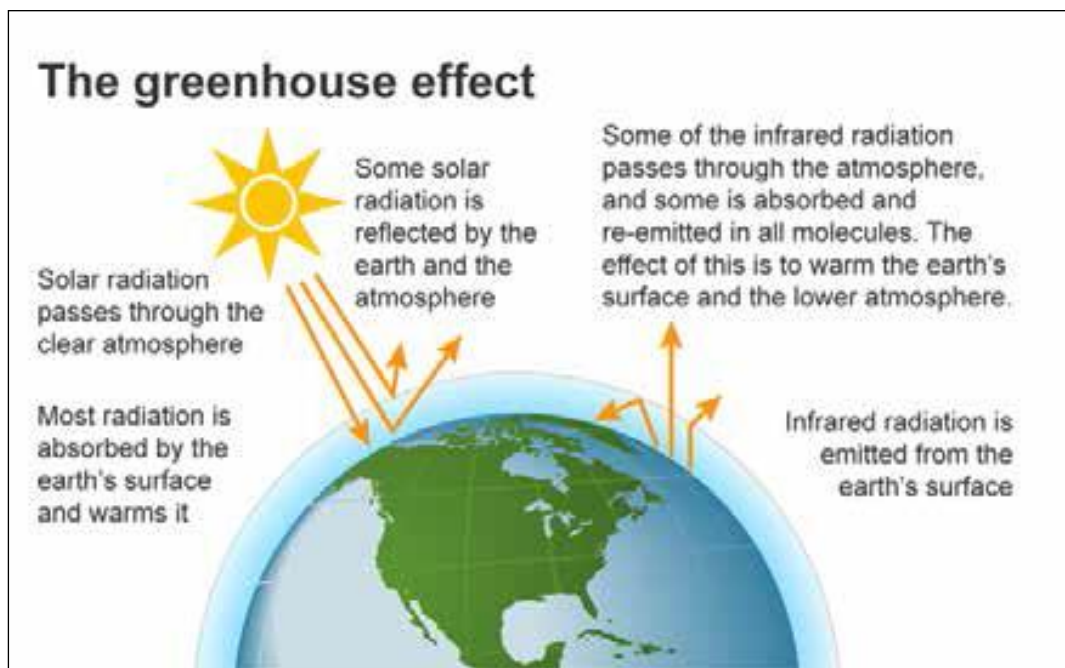


Figure 1.6: Green House Effect

Several air pollutants are also climate forcing agents. Tropospheric O₃ and PM are short lived air pollutants affecting the climate. O₃ in the troposphere warms the climate, while the different components of PM can have either climate warming or cooling effects. Black carbon, a constituent of PM, is generated from combustion and contributes to global warming while other PM components such as Ammonium, Sulphate, and Nitrate have a cooling effect on the Earth's atmosphere.

Climate change can impact air pollution by changing the sources of air pollutants and affecting meteorology that is involved in generating and removing air pollutants. Hence, air pollution and climate change should be considered as two sides of the same coin. Therefore, air quality and climate change should be tackled together by using policies and measures developed through an integrated approach. These integrated policies would help avoid the negative impacts of climate on air quality, and vice versa. Examples of climate policies that have negatively impacted air quality were the subsidization of diesel (with lower CO₂ but higher PM and NO_x emissions) and the increased use of biomass. In addition to changing weather patterns, climate change may also change the transport, dispersion, deposition, and formation of air pollution in the atmosphere. Increasing temperature will also increase the emissions of biogenic volatile organic compounds (VOCs).

Short-Lived Climate Pollutants

Short-Lived Climate Pollutants (SLCPs) are powerful climate forcers that remain in the atmosphere for a much shorter period than carbon dioxide (CO₂), yet their potential to warm the atmosphere which can be many times greater than CO₂ on a molecule per molecule basis. Certain short-lived climate pollutants are also dangerous air pollutants that have harmful effects on people, ecosystems, and agricultural productivity.

The SLCPs black carbon, methane, tropospheric ozone, and hydro fluorocarbons (Figure 1.7) are the most important contributors to the man-made global greenhouse effect after CO₂ which is responsible for up to 45% of current global warming. If no action to reduce emissions of these pollutants is taken in the coming decades, they are expected to account for as much as half of the warming caused by human activity.

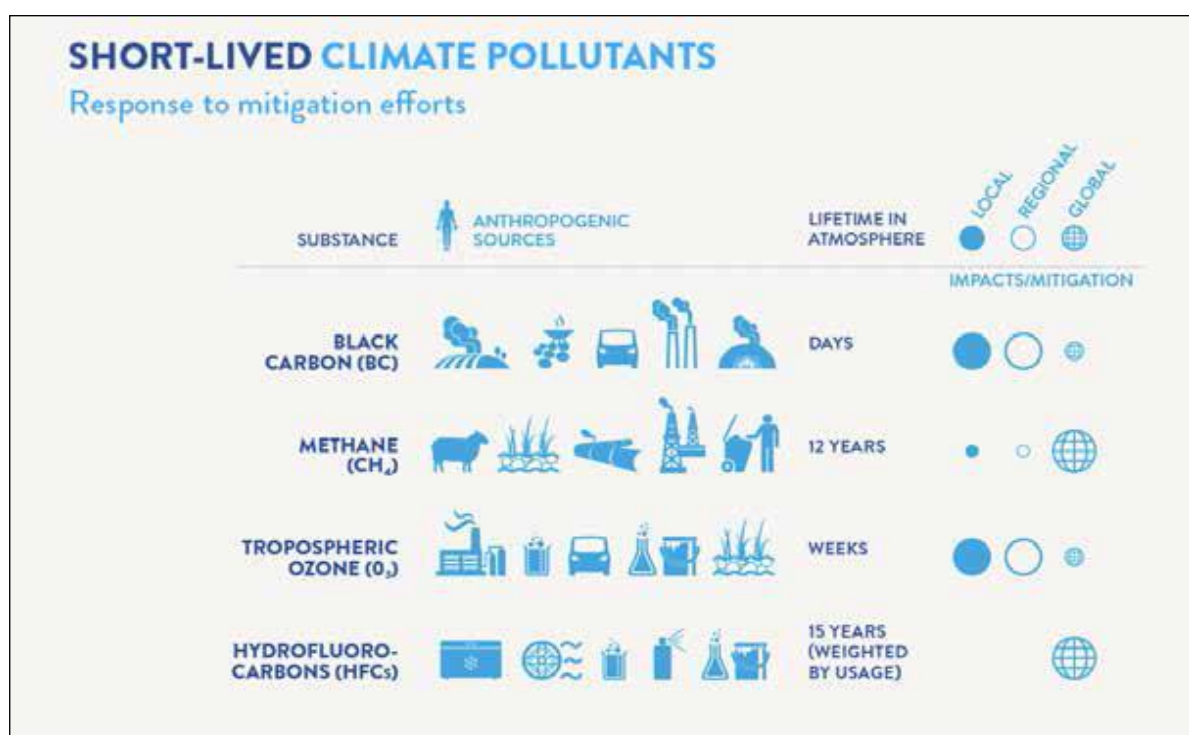


Figure 1.7: Short-Lived Climate Pollutants (source: coalition.org)

Air pollution related illness is therefore considered as one of the priority climate sensitive health issues under NPCCHH. Health sector needs to understand its intricate relationship between climate change and air pollution and negative impact on human health.

Other non-health sectors working on mitigating both issues may be coordinated to enhance mechanisms to address both together if we are to reduce the health effects.

2. NATIONAL CLEAN AIR PROGRAMME - MECHANISM TO ADDRESS AIR POLLUTION

Learning Objectives:

1. To understand National Clean Air Programme as the National Mechanism to address the issues of air pollution in the country
2. To understand the coordinating mechanism with MoEFCC and the concerned ministries to mitigate air pollution
3. To understand how NCAP can play a role in the programme at the district level

National Clean Air Programme (NCAP) under Ministry of Environment, Forest and Climate Change (Nodal Ministry to address air pollution in India) is a long-term, time-bound, national level strategy to tackle the air pollution problem across the country. It is done in a comprehensive manner with targets to achieve 20% to 30% reduction in Particulate Matter concentrations by 2024 keeping 2017 as the base year for the comparison of concentration. Under NCAP, 122 non-attainment cities have been identified across the country based on the Air Quality data from 2014-2018.

Goals:

To meet the prescribed annual average ambient air quality standards at all locations in the country in a stipulated timeframe (long-term)

Objectives:

1. To ensure stringent implementation of mitigation measures for prevention, control and abatement of air pollution
2. To augment and evolve effective and proficient ambient air quality monitoring network across the country for ensuring a comprehensive and reliable database
3. 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.

The table below shows the mitigation measures undertaken by different stakeholders under the NCAP for air pollution. The action points summarise the actions that can be taken by the respective authority bodies to minimise exposure to air pollution in the country.

There are about seven key stakeholders identified to address air pollution under MoEFCC in the country and these are briefly mentioned at Table 2.1

Sectoral Interventions	Name of Sector Involved	Key Action points
Road dust, Construction and Demolition	Ministry of Environment, Forest and Climate Change (MoEFCC)	1. <i>Introducing mechanical sweepers on the basis of feasibility study in cities.</i> 2. <i>Evolve SOP for addressing the specific issue of disposal of collected dust from mechanical sweeping, taking into consideration all the above cited factors.</i> 3. <i>Stringent implementation of C&D Rules, 2016, and Dust Mitigation notification, 2018, of Government of India.</i> 4. <i>Wall-to-wall paving of roads to be mandated.</i> 5. <i>Stringent control of dust from construction activities using enclosures, fogging machines, and barriers.</i> 6. <i>Greening and landscaping of all the major arterial roads and national highways after identification of major polluting stretches.</i> 7. <i>Maintenance and repair of roads on priority.</i> 8. <i>Sewage treatment plant-treated water sprinkling system along the roads and at intersecting road junctions and spraying of water twice a day before peak hours</i>
Power Sector Emissions	Power and Natural Gas Regulatory Board, Ministry of Power and Natural Gas (MoPNG)	1. <i>Stringent compliance by all TPPs with respect to the emission norms according to the timelines upto December 2022 and as per the action plan prescribed in the direction dated December 2017 issued under EPA 1986</i> 2. <i>CGD network distribution shall be taken up on priority within the country emphasizing on 102 non-attainment cities</i> 3. <i>There is need for optimizing the use of the existing power plants by prioritizing capacity utilization of natural gas/ clean fuel- based thermal power plants</i> 4. <i>Phasing out older coal-based power plants and converting specific coal-based power plants to natural gas</i> 5. <i>Emphasis on improved power reliability in urban areas to eliminate the operation of DG sets</i> 6. <i>Emphasizing the expansion of renewable power initiatives prioritizing the use of existing framework of NAPCC in non- attainment cities</i> 7. <i>Need to explore the possibility of Flyash utilization in extensive way in 102 non-attainment cities</i>
Industrial Emissions	Central/State Pollution Control Boards	1. <i>Introduction of gaseous fuels and enforcement of new and stringent SO₂/ NO_x/PM_{2.5} standards for industries using solid fuels</i> 2. <i>Stricter enforcement of standards in large industries through continuous monitoring</i> 3. <i>Full enforcement of zig-zag brick technology in brick kilns</i> 4. <i>Elimination of DG set usage by provision of 24x7</i>

Sectoral Interventions	Name of Sector Involved	Key Action points
		<i>electricity</i> 5. <i>Control by innovative end of pipe control technologies</i> 6. <i>Evolve standards and norms for in-use DG sets below 800 KW category</i> 7. <i>For DG Sets already operational, ensure usage of either of the two options:</i> (a) <i>use of retrofitted emission control equipment having a minimum specified PM capturing efficiency of at least 70%, type approved by one of the 5 CPCB recognized labs; or</i> (b) <i>shifting to gas-based generators by employing new gas-based generators or retrofitting the existing DG sets for partial gas usage</i> 8. <i>Utilize the Gujarat case study for a compelling case for other states to adopt third-party audits for polluting industries for enhancing implementation (States)</i>
Transport Sector Emissions	MoEFCC, MoPNG	<i>Green Mobility:</i> 1. <i>Stringent implementation of National Biofuel Policy with respect to ethanol and biodiesel blending target of 20% and 5%, respectively by 2030</i> 2. <i>City action plans to review the extension of MRT in cities/towns.</i> 3. <i>Improvement and strengthening of inspection and maintenance system for vehicles through extension of I&C centres</i> 4. <i>Stringent implementation of PUC certificate through regular inspection and monitoring</i> 5. <i>Fleet modernization and retro-fitment programmes with control devices</i> 6. <i>Reducing real-world emissions by congestion management</i> 7. <i>Review the Green Corridor Project and feasibility of its extension with reference to 102 cities</i> 8. <i>To review the scaling up of Pilot project of MoPNG for introducing CNG in 2-wheelers and ensure timely implementation.</i> 9. <i>Scaling up of R&D on use of Hydrogen as transport fuel</i> <i>E-mobility:</i> 1. <i>Formulation of a national-, state-, and city-specific action plan for e-mobility</i> 2. <i>Rapid augmentation of charging infrastructure in the country focusing on 102 cities</i> 3. <i>Central government offices fleets older than 15 years to be shifted to electric vehicles</i>

Sectoral Interventions	Name of Sector Involved	Key Action points
		4. Government-run buses for public transport, private buses, and 3-wheelers to be converted to EVs 5. Gradual transition to e-mobility in the 2-wheeler sector. 6. Specific allocations for creating a venture capital fund 6. Investment in R&D and pilots focusing on the indigenization of battery manufacturing, cheap alternate resource to lithium and cobalt, resource efficiency associated with a circular economy, re-use and recycling for lithium batteries, etc.
Agricultural Emissions	Ministry of Agriculture	1. Evaluate the status of implementation of the above scheme in the states and impact on reduction of air pollution in Delhi and the NCR. 2. Evaluate the socio-economic feasibility for implementation of ex-situ options like production of Prali-Char, biochar, pellets, briquettes, bio-CNG, bioethanol, etc., as ex-situ solutions for management of crop residue burning especially with NPB in place. 3. Extending the initiatives for addressing the issue of crop residue burning from the NCR to other part of the country and from paddy to sugarcane and other crops. 4. Coordination with ISRO for regular availability of Remote Sensing Monitoring data for crop burning by the farmers. 5. Evolve plan for management of agricultural emissions from fertilizers and livestock waste on the basis of strong R&D. The R&D for the purpose to be supported. 6. Implement plan for management of agricultural emissions 7. The capacity-building initiatives for Krishi Vigyan Kendra (KVK) shall be strengthened.
Emissions from Unsustainable waste management practices	Ministry of Housing and Urban Affairs	1. Use the smart cities framework to launch the NCAP in the 43 smart cities falling in the list of 102 non-attainment cities. 2. Transform our centralised waste disposal infrastructure to a sustainable decentralized system in 102 cities 3. Source segregation into dry and wet waste to be made mandatory through involvement of municipalities and the RWA. 4. Mandatory Training and capacity building of municipalities and the RWA. 5. Transitioning towards a zero-waste pathway through an integrated solid waste management strategy, including targeting waste prevention, recycling, composting, energy recovery, treatment, and disposal. 6. Waste reduction schemes such as 'polluters pay' principle, recycling projects, composting,

Sectoral Interventions	Name of Sector Involved	Key Action points
		<i>biomethanation, RDF plants and co-processing to be supported under an integrated solid waste management strategy.</i> <i>7. Construction of decentralized composting plant, biomethanation plant and C&D waste plants</i> <i>8. Deployment of fixed compactor and doing away with dhalaos</i> <i>9. Focus on training municipalities and SPCBs to be on national and international technology for integrated waste management options.</i> <i>10. In line with the National Biofuel Policy, promote technologies which can convert waste/plastic, MSW to energy resulting in reduction of traditional fuel use.</i> <i>11. Stringent implementation and monitoring for extended producer responsibility for e-waste and plastic waste.</i> <i>12. Strict implementation of existing six waste management's rules on solid, Hazardous, Electronic, Bio-medical, Plastics and C&D waste.</i> <i>13. The Swachh Bharat Mission and National Mission on Sustainable Habitat to be used as a platform to push the objectives under this sector.</i>
Indoor Air Pollution Management	Ministry of Housing and Urban Affairs	<i>1. Building specific guidelines and protocols on monitoring and management of indoor air pollution</i> <i>2. Extend PMUY in 102 cities/towns and the associated village areas</i> <i>3. Guidelines and provisions for building designs that define proper ventilation, clean cooking, and living areas to maintain healthy air quality inside the house to be integrated with the Pradhan Mantri Awas Yojana (PMAY).</i>

The programme officials including the District Nodal Officers can refer the table to understand the engaging departments in the mitigation measures of air pollution. The DNOs can engage with these concerned departments for coordination of public awareness campaigns. These departments can also be the part of District level multi sectoral task force under NPCCHH to develop a District Health Action Plans on Air Pollution.

3. AIR QUALITY INFORMATION AND ITS HEALTH SIGNIFICANCE

Learning Objectives

1. CPCB/ SPCB as the agency to provide information of air quality information and air quality monitoring centres in the country
2. Air quality information is required for surveillance purposes and health care facilities under NPCCHH
3. DNOs to coordinate with the agency at district to obtain the report and use the reports for health purposes

To avoid complexities in understanding the data and for its effective communication and educate public on status of air pollution and its related health perspectives, Central Pollution Control Board has launched the mechanism of publishing Air Quality Index (AQI) depicted in easily understandable six (6) Colour code categories with their likely health impacts as

- i. Good
- ii. Satisfactory
- iii. Moderately polluted
- iv. Poor
- v. Very Poor
- vi. Severe

AQI Considerations and its significance

- Air pollutants measured by real time analysers at Continuous Ambient Air Quality Monitoring Stations (CAAQMS)
 - First calculate moving averages of last 24 hours for individual pollutant
 - Then, the AQI sub-index for a particular pollutant is calculated and finally, the highest sub-index is declared as AQI of that day of the area or location.
- AQI value never indicates synergistic status of air pollution or impact of air pollution on health; rather it indicates about most problematic air pollutant

Worsening of Air Quality Index (higher AQI value) especially of 'poor to severe' in an area may result in increase in morbidity and mortality among those who are exposed to it particularly vulnerable populations like children, elderly, underlying medical conditions etc.

Therefore, a general health advisory related to AQI is issued by CPCB with AQI bulletin as in table below-

Table 3.1: AQI levels, Health effects and Certain Protective Health Measures			
Air Quality Index (AQI)# (Pollution level)	Possible Health Consequences	Advice for	
		General Population	Vulnerable Population*
Good (0-50)	Low risk	No special precautions	No special precautions
Satisfactory (51-100)	Minor breathing discomfort in vulnerable population*	No special precautions	Do less prolonged or strenuous outdoor physical exertion
Moderate (101-200)	Breathing or other health related discomfort in vulnerable population*	Do less prolonged or strenuous outdoor physical exertion	Avoid prolonged or strenuous outdoor physical exertion
Poor (201-300)	Breathing discomfort in healthy people on prolonged exposure Breathing or other health related discomfort in vulnerable population* on short exposure	Avoid outdoor physical exertion	Avoid outdoor physical activities
Very Poor (301-400)	Respiratory illness in healthy people on prolonged exposure Pronounced respiratory or other illnesses in vulnerable population* on short exposure	Avoid outdoor physical activities, especially during morning and late evening hours	Remain indoors and keep activity levels low
Severe (401- 500)	Respiratory illness in healthy people on prolonged exposure Serious respiratory or other illnesses in vulnerable population* on short exposure	Avoid outdoor physical activities	Remain indoors and keep activity levels low

Sameer app from CPCB is a mobile app which can provide the city level hourly update of the National Air Quality Index (AQI) published by Central Pollution Control Board. Health Officials and general public may download it for use to get information of the air quality level in their respective areas.

Web-based AQI Dissemination: The AQI system should have web-based AQI dissemination, which should be designed for online calculation and display of nationwide AQI. The website should render a quick, simple and elegant response to an AQI query. The website's other features should include reporting pollutant responsible for index, pollutants exceeding the standards, and health effects.

The AQI query is answered by navigating on the map and clicking on the air quality station, which renders AQI at that station with sub-indices. The website for national AQI is https://app.cpcbcr.com/AQI_India/ (Figure 3.2) and is reported as shown in Figure 3.3. In addition, a website can also render menu-based AQI by searching through states and cities from the dropdown menu.

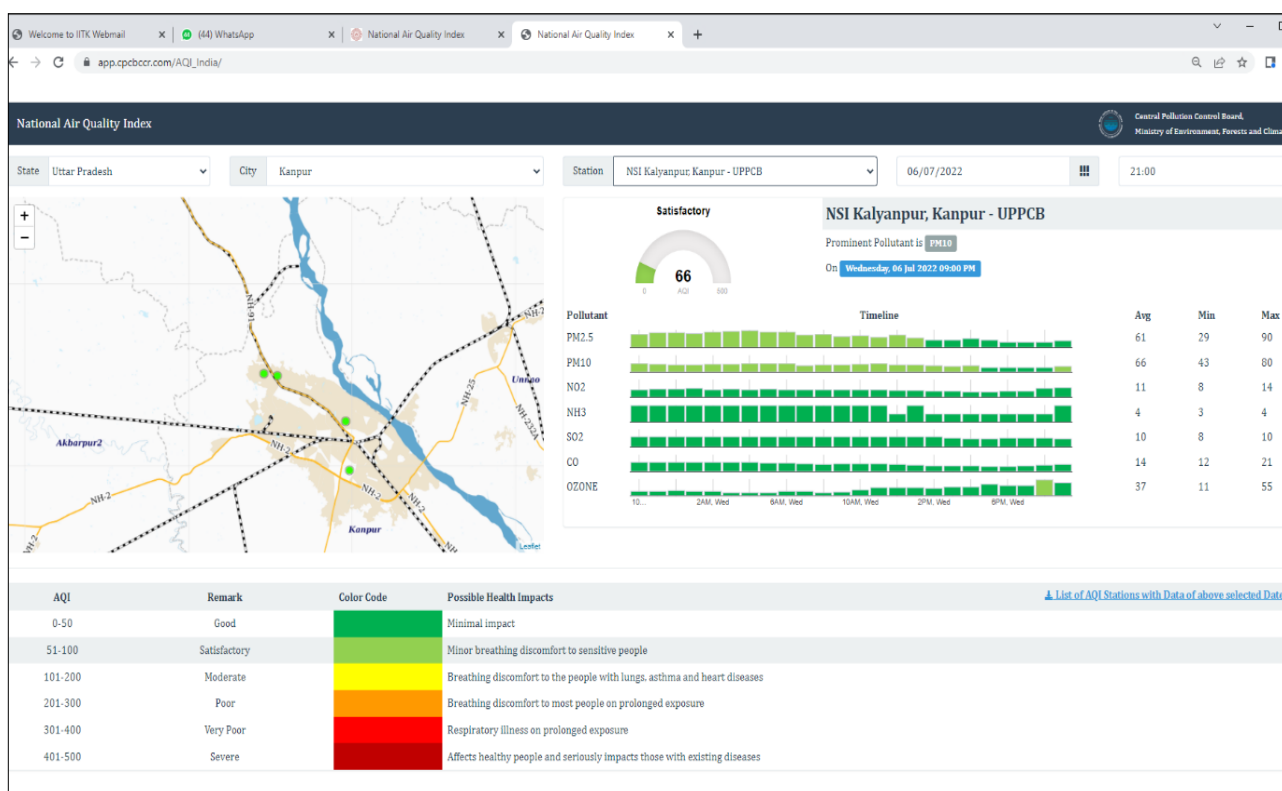


Figure 3.2: CPCB Website for AQI information and dissemination



Air Quality Index on Jul 07, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
1	Agartala	Good	34	PM _{2.5} , PM ₁₀	2
2	Agra	Satisfactory	69	PM _{2.5} , PM ₁₀	6
3	Ahmedabad	Satisfactory	78	CO, NO ₂ , PM ₁₀	6
4	Aizawl	Satisfactory	60	O ₃	1
5	Ajmer	Moderate	110	PM ₁₀	1
6	Alwar	Satisfactory	59	PM ₁₀	1
7	Amaravati	Good	27	O ₃	1
8	Ambala	Satisfactory	68	PM _{2.5}	1
9	Amritsar	Moderate	117	PM _{2.5}	1
10	Ankleshwar	Good	50	CO	1
11	Araria	Good	48	O ₃	1
12	Arrah	Satisfactory	67	PM ₁₀	1

Figure 3.3: AQI Bulletin issued by Central Pollution Control Board
(https://cpcb.nic.in/upload/Downloads/AQI_Bulletin_20220707.pdf)

Air pollutants can travel long distances and can transform into other pollutants which may be more harmful than the parent pollutant. It is important to introduce the concept of airshed management of air pollution and help understand how PM_{2.5} is formed, how it travels and how it impacts health. An animated video (Beyond Boundaries – Understanding Airsheds and PM_{2.5}) produced by the World Bank introduces the complex concepts of secondary pollutants and airshed-based control of air pollution as in Figure 3.4.



Figure 3.4: Beyond Boundaries – Understanding Airsheds and PM_{2.5}
(link to video: <https://www.worldbank.org/en/news/video/2021/11/01/beyond-boundaries-understanding-airsheds-and-pm2-5>)

4. AIR QUALITY EARLY WARNING SYSTEM (AQEWS) UNDER IMD IN INDIA

Learning Objectives:

1. IMD is the nodal agency to provide air quality forecast in the country
2. DNOs to coordinate the information received from IMD for the purposes of health sector in preparedness and response mechanisms under NPCCHH

Air quality, weather and climate, and human health are closely linked. These interdependencies are becoming more evident and health professionals ever more reliant on meteorological and climate services to help anticipate and manage the health risks of poor air quality. Air pollution is still a widespread problem in the India, with large population exposed to levels of air pollution that exceed health-based ambient air quality standards. Air Quality Forecasts, if they are reliable and sufficiently accurate, can play an important role as part of an air quality management system.

Under the auspices of Ministry of Earth Sciences, India Meteorological Department (IMD) and Indian Institute of Tropical Meteorology (IITM) have commissioned Air Quality Early Warning System (AQEWS) for India. Advanced high-resolution Air Quality Early Warning System is operational specifically for Delhi-NCR. The high-level objective of AQEWS is: “to enable and provide air quality forecasting and information services in a harmonized and standardized way tailored to the needs of society and pollution control authorities”. Presently, main focus is on megacities and large urban complexes as they have large number of pollution sources and large populations at risk.

The aim is to develop strategies to help megacities deal with weather, climate and environmental problems, improve related services; enhance environmental monitoring and modelling capabilities; and generate useful case studies to help understand air pollution, health and climate connections in different types of megacities.

Air Quality Modelling Framework

The AQEWS has three main modelling system (i) System for Integrated modelLling of Atmospheric composition (SILAM) for India (ii) Weather Research Forecast with Chemistry (WRF-Chem) for India (iii) ENvironmental information FUsion SERvice (ENFUSER) for Delhi. Air quality forecast model SILAM provides forecast at 3 km resolution for next 4-days over Indian region. A very high-resolution city scale model ENFUSER for Delhi also has been operationalized to identify the air pollution hotspots and pollution upto street level. Integrated WRF-Chem provides air quality forecast at 10km grid resolution for 10 days in advance over Indian domain and 400-meter resolution for 3-days in advance for NCR-Delhi. The models consider the latest land use land cover (LULC) change

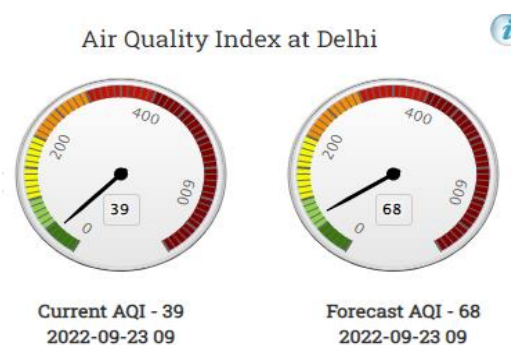
information over Delhi, background aerosols and pollutants. The post-harvest burning of paddy-crop residue in the neighboring states and transported dust significantly affects the air quality. The system also provides the contribution from long range transport of dust and particulate matter from stubble burning. WRF-Chem and SILAM models have been extensively validated against observations. AQEWS has been further extended with a 'Decision Support System (DSS)' for air-quality management in Delhi. The DSS runs with a horizontal grid spacing of 10 km and generates the forecasts and decision-support information for the next five days. DSS provides quantitative information about (i) the contribution of emissions from 8 different sectors from Delhi and the surrounding 19 districts to the air quality in Delhi, (ii) the contribution from biomass-burning activities in the neighbouring states to the degradation of air quality in Delhi, and (iv) the effects of possible emission source-level interventions on the forecast severe air-quality event in Delhi. The AQEWS system also provides the near real time observations of air quality over Delhi-NCR region and Fire Counts & Aerosol Optical Depth (AOD) over India retrieved from different Satellite observations.

The forecasters will typically use the output from several different models in combination with local knowledge and experience to produce the prediction as accurate as possible. The final forecast is made available in terms of Air Quality Index so that appropriate health advisories can be issued depending on severity of the pollution levels.

How to access the Air Quality Forecast

The air quality forecast spatial plots are available for the Indian region. The air quality forecasts products are available at <https://ews.tropmet.res.in> and <https://mausam.imd.gov.in>. Climate and weather – wind, temperature, precipitation and other meteorological factors – play a key role in the poor air quality that populations face. The AQEWS system also provides the weather forecast over NCR-Delhi regions.

The AQ forecast is also available for some specific cities (Pune, Mumbai, Bengaluru, Kolkata, Varanasi, Lucknow, Kanpur, Ludhiana, Ahmedabad, Hyderabad, Visakhapatnam, Chennai, Coimbatore, Bhubaneswar, Ranchi Patna, Raipur etc.).



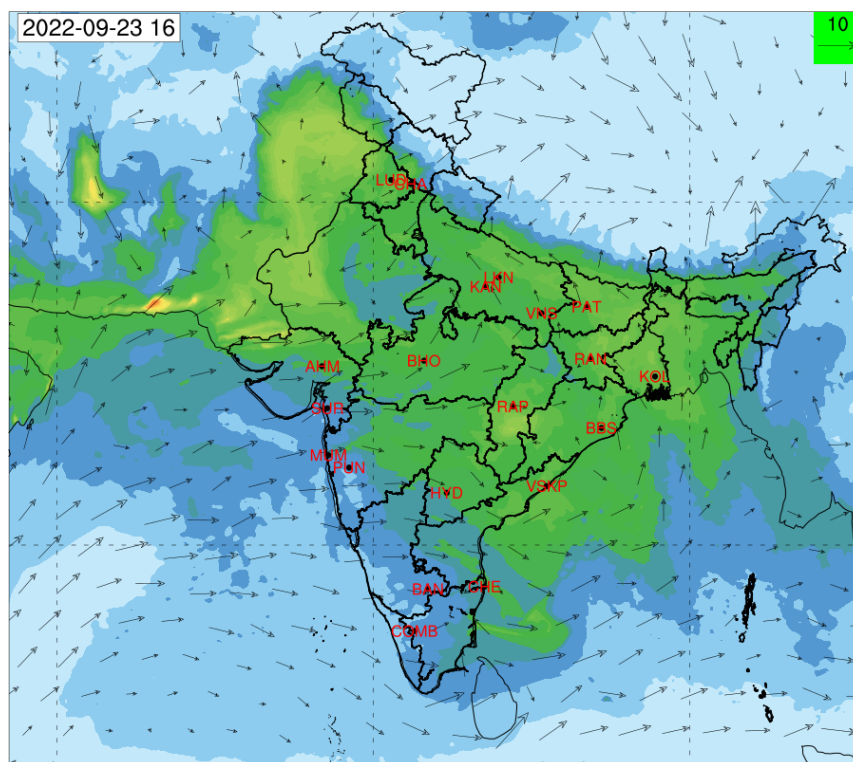


Figure 4.1: Air quality forecast of Delhi by IMD

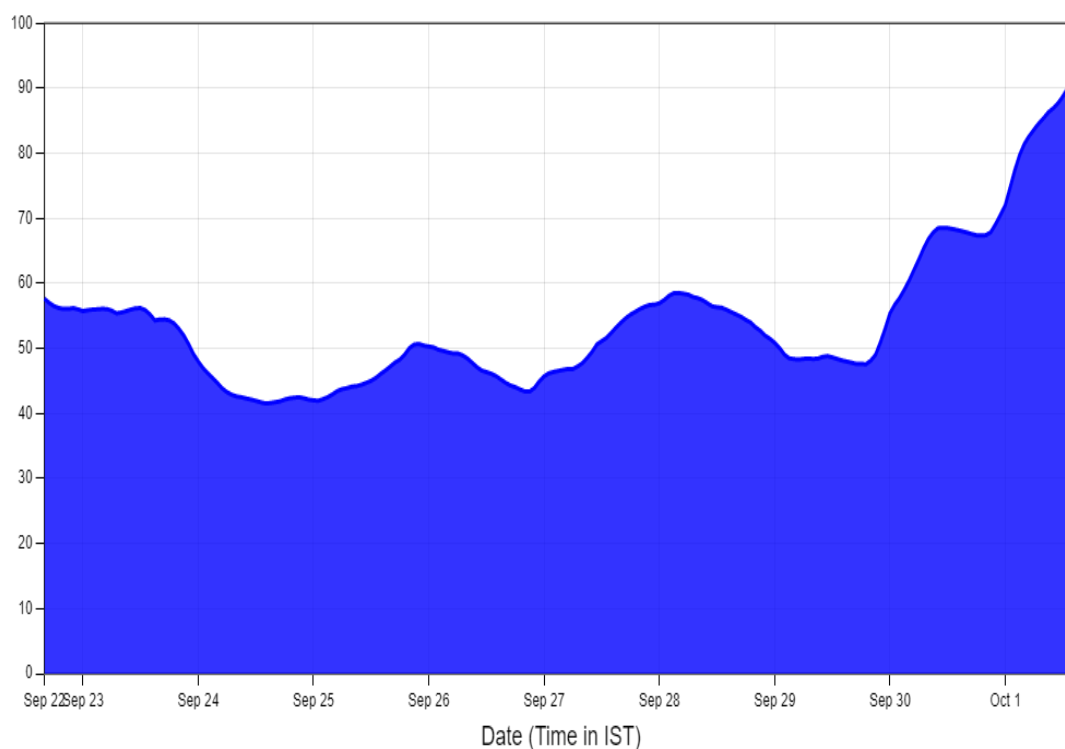


Figure 4.2: Air Quality Index forecast (PM_{2.5}) for Delhi

The air quality forecasts reported for cities by IMD will be shared to all the state programme officials in the respective state Email id and these informations may be a useful tool for preparedness and response mechanisms in the health sector like health advisory issuance.

Programme officials are to monitor the AQ forecasts regularly which are available for the respective areas at present. Depending on severity of the pollution levels in their respective areas, the officers are to take up appropriate health related actions including issuance of health advisory to increase the awareness level of the public on the Do's and Don'ts IEC messages in the social media and other media channels. These are the acts required to protect, prevent and control the health issues which may arise when people are exposed to air pollution

5. HEALTH EFFECTS OF AIR POLLUTANTS

Learning Objectives:

- 1. To understand the health effects of air pollution*
- 2. To understand the signs and symptoms of short term and long-term health effects of air pollution*
- 3. To describe the probable mechanisms causing air pollution related illnesses*

Air pollution is considered as the single largest environmental health threat globally, is known to have association with health impacts. A recent ICMR study reported on disease burden, deaths etc. attributed to air pollution among the Indians showed the following findings –

In India (2019), 1.7 million Deaths (18% of the total deaths) were attributable to air pollution

- i. Chronic Obstructive Pulmonary Disease (32.5%)
- ii. Ischemic heart disease (29.2%)
- iii. Stroke (16.2%)
- iv. Lower respiratory infections (11.2%)

Air pollution attributed to 11.5% of the total DALYs (Disability-Adjusted Life Year) in India (2019) as shown below-

- i. 39.5% from lung diseases COPD (22.7%)
- ii. Lower respiratory infections (15.5%)
- iii. Lung cancer (1.3%);
- iv. Other DALYs Ischemic heart disease (24.9%) Stroke (13.7%)
- v. Diabetes (5.5%)
- vi. Neonatal disorders (14.5%)
- vii. Cataract (1.5%)

Health impacts of air pollution depend on the level of pollution and exposure duration. The individuals' vulnerability to the health impacts of pollution can also differ based on demographic factors and predisposing health conditions.

- i. Short-term high-level exposures can result in acute health reactions with involvement of various human organs and patients may present with certain suggestive symptoms like irritation of eyes, nose, throat and skin, cough, breathing difficulty, wheezing, chest discomfort, chest pain, headache, giddiness, limb weakness, facial deviation etc. Vulnerable groups can experience more severe effects such as lower respiratory tract inflammation and

infection, exacerbation of asthma, bronchitis or exacerbation of chronic illnesses such as chronic obstructive pulmonary disease (Respiratory System), ischaemic heart diseases (CVS), and cerebrovascular strokes (CNS) etc. The Figure 5.1 shows various health effects attributed due to air pollution.

- ii. Long term exposures to even lower level of air pollution can result in chronic illnesses of respiratory and cardiovascular systems, lung cancer and premature deaths. These are shown in the Figure 5.1 as below -

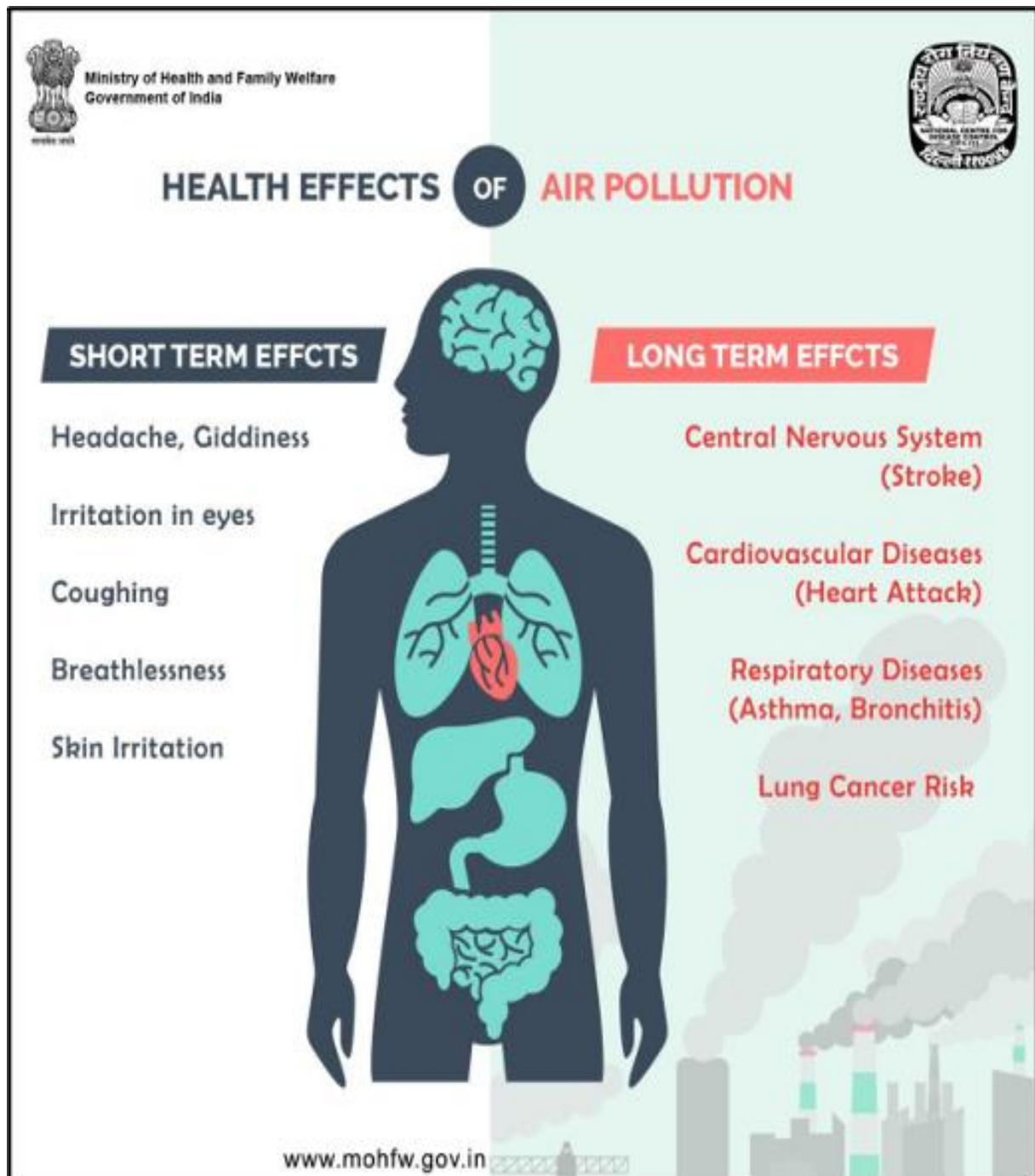


Figure 5.1: Health effects of air pollution

The table 5.1 shows health effects due to short- and long-term exposures of air pollution (WHO)

Table 5.1 showing health effects attributed to short term and long-term exposure to air pollution	
Health Effects attributed to short-term exposure to air pollution	Health Effects attributed to long-term exposure to air pollution
1. Respiratory & cardiovascular hospital admissions 2. Respiratory & cardiovascular emergency department visits 3. Respiratory & cardiovascular primary care visits 4. Use of respiratory & cardiovascular medications 5. Days of restricted activity 6. Work absenteeism 7. School absenteeism 8. Daily mortality	1. Acute symptoms (wheezing, coughing, phlegm production, respiratory infections) 2. Chronic respiratory disease incidence & prevalence (asthma, COPD, chronic pathological changes) 3. Chronic changes in physiologic functions 4. Chronic cardiovascular diseases 5. Intrauterine growth restriction (low birth weight at term, intrauterine growth retardation, small for gestational age) 6. Physiological changes (e.g. lung function) 7. Lung cancer 8. Mortality due to cardiovascular & respiratory disease

Vulnerable Population to health effects of air pollution(Figure 5.2)

- Age group: Children particularly under 5 years and old age groups**
- Pregnant women:** Exposure during pregnancy may have consequences for child in womb.
- Predisposed health conditions:** Those with pre-existing illnesses of respiratory cardiovascular and cerebrovascular systems are at higher risk
- Low socio-economic conditions:** Those with poor nutritional status; those living in poor housing, using fossil fuels for cooking, heating/ lighting purposes are at risk.
- Outdoor working groups:** Those with possibility of prolonged exposures such as traffic policemen, traffic volunteers, construction workers, road sweepers, rickshaw pullers, auto-rickshaw drivers, roadside vendors, and others working outdoors in air polluted settings, labours working near boilers or furnace smelters, miners etc. are at higher risk.
- Besides, women with burning biomass for cooking, and sweeping dust are vulnerable on account of their household work.



Figure 5.2: Vulnerable Population for air pollution

Defense Mechanism of Respiratory system against air pollution

Respiratory system is one of the crucial pathways through which PM in the ambient air gets into the body. The body responds to particulate pollution with the same multi-layered defense system that it uses to defend itself against other foreign materials such as bacteria and viruses: by attempting to prevent access and then by trying to rid the body of the foreign matter. The first important level is the barrier of cells and fluids that the foreign material must get through before it enters the body's tissue. Fluid secretions, such as mucus lining the airways and ciliated cells, are essential elements of this system.

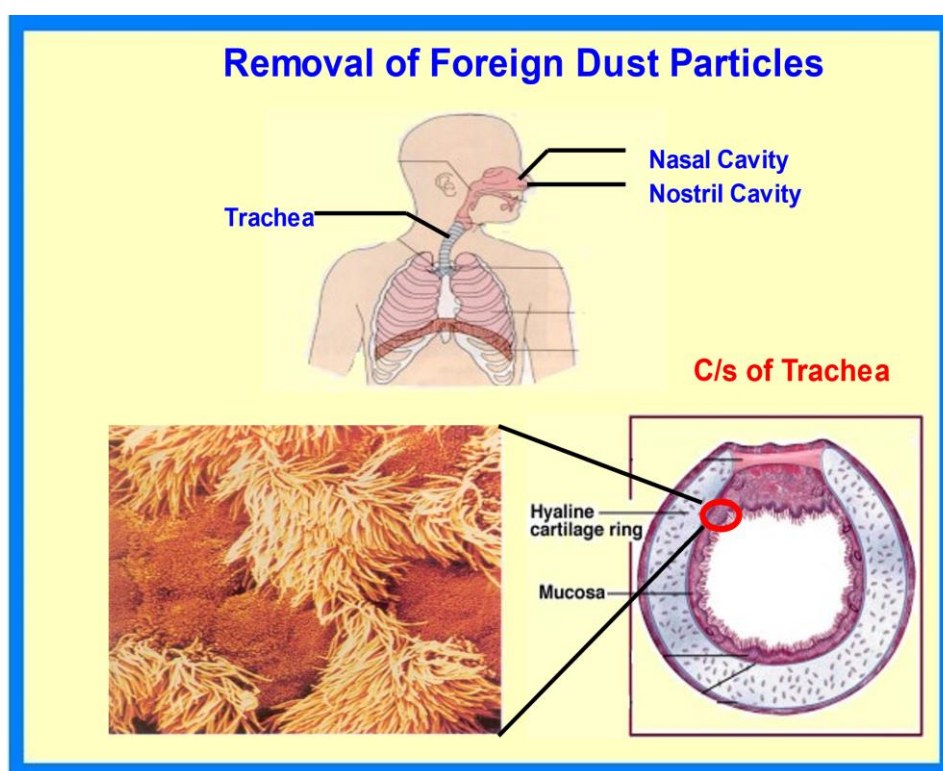
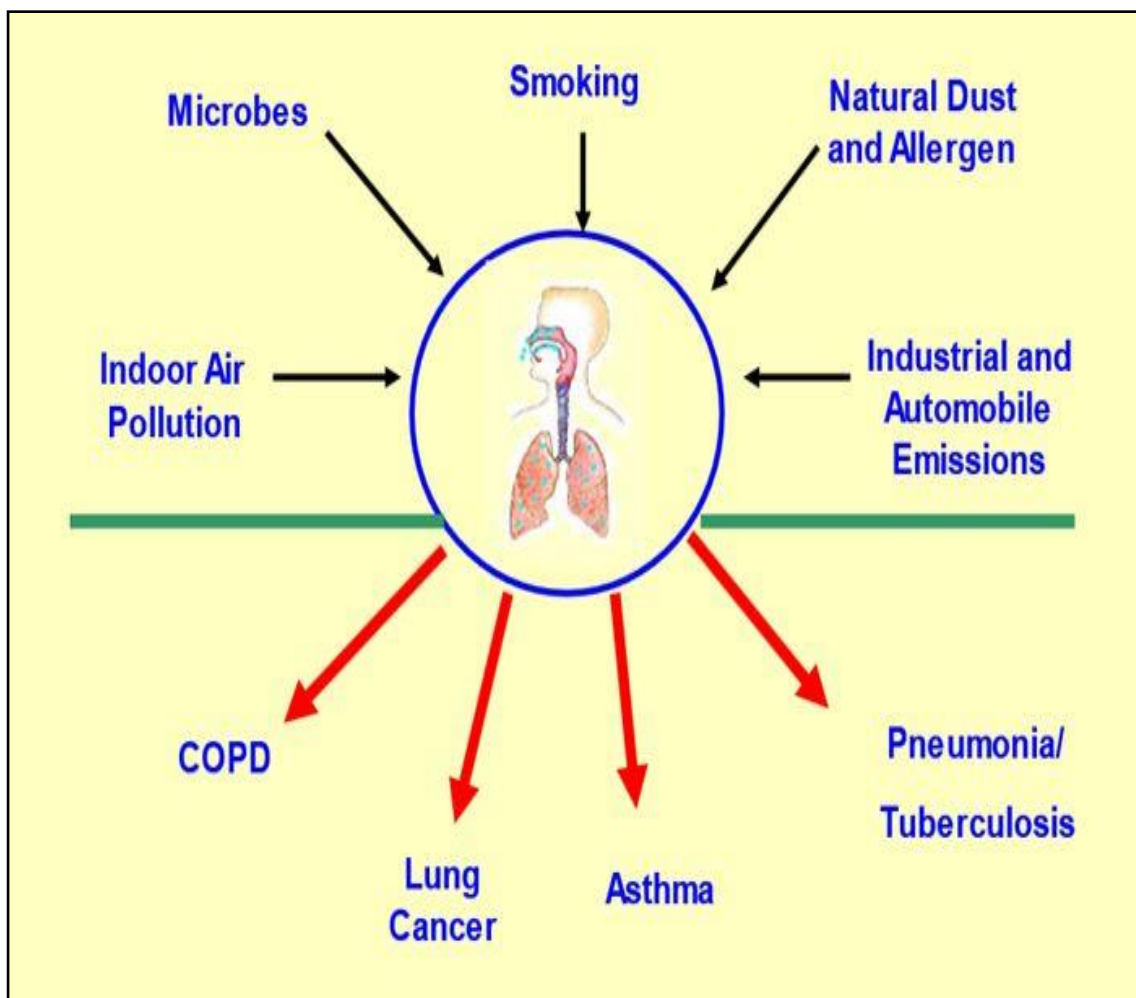


Figure 5.3: Defense mechanism of the body against foreign material

The immediate effect can be visualized by decreased lung function capacity. One potential consequence is that increased exposure to particulates may reduce the capacity to defend against microorganisms. The inflammatory response in the airways stimulates the liver to secrete a set of molecules known as acute phase reactants. This molecule, which includes C-reactive protein and fibrinogen, appears in the circulation within 6 to 24 hours. Fibrinogen binds the platelets and contributes to their aggregation, resulting in multiple effects throughout the cardiovascular system, including an enhanced blood clot ability. Ultra-fine particles may physically move out of the airways and rapidly into the bloodstream to trigger effects at distant sites. Deposition of particles in the

airways can stimulate nerve cells which in turn changes the breathing pattern, heart rate and heart rate variability may also occur (HEI). A diagrammatic presentation showing common sources of particulate matters and some examples of health effects is depicted in the figure 5.4 as follows-

Figure 5.4: Sources and Health Effects of Particulate matter



6. ROLE OF DNO UNDER NPCCHH AND ITS RELATION TO KEY PROGRAMME OFFICIALS

DNO under NPCCHH play a key role in the implementation of programme activities on the ground at the district level.

A brief understanding of the background of NPCCHH at various levels showing linkages of key Institutional mechanisms and functionaries and their roles and responsibilities are depicted as a snapshot in the Figure 6.1 as below.

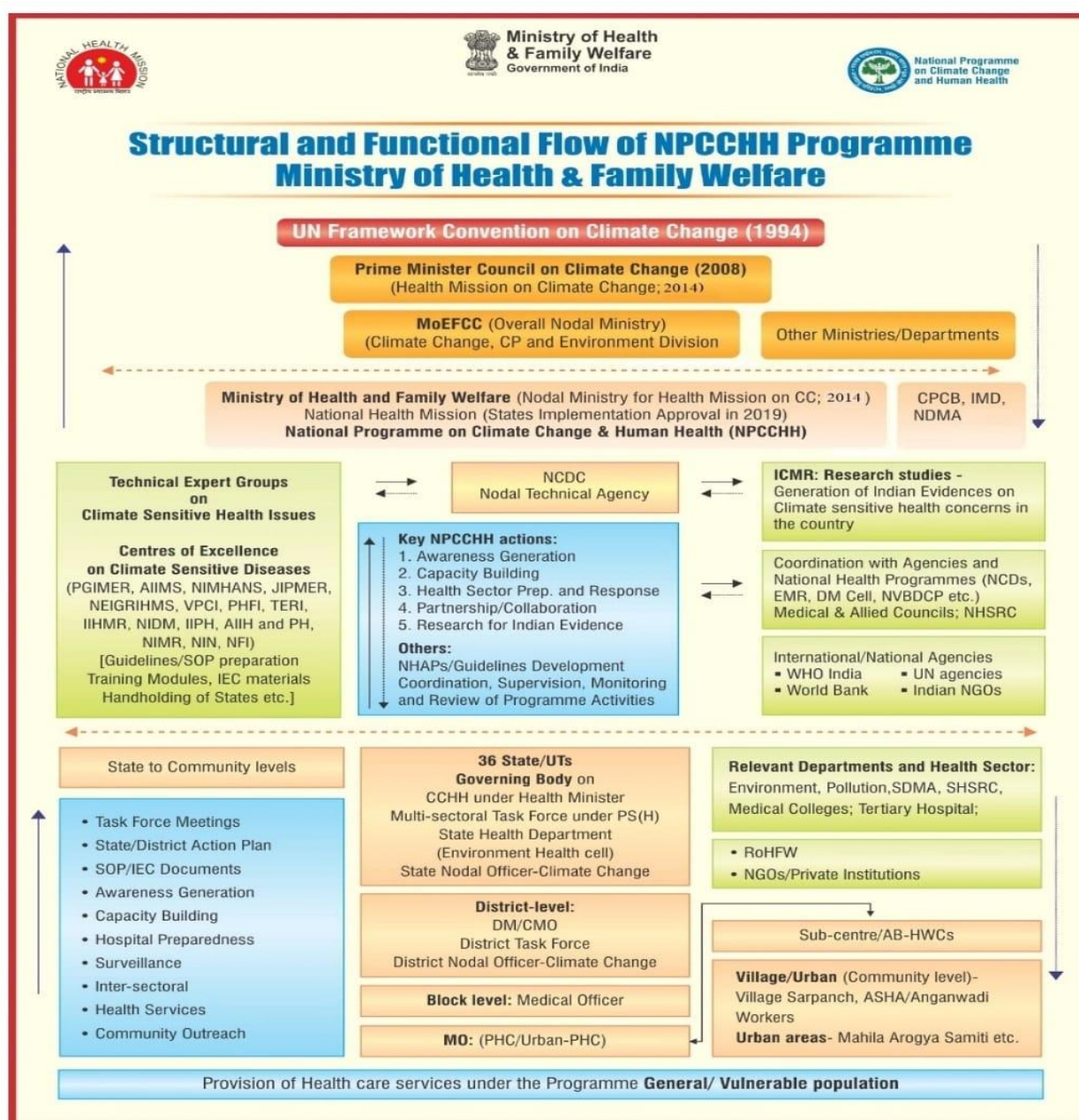
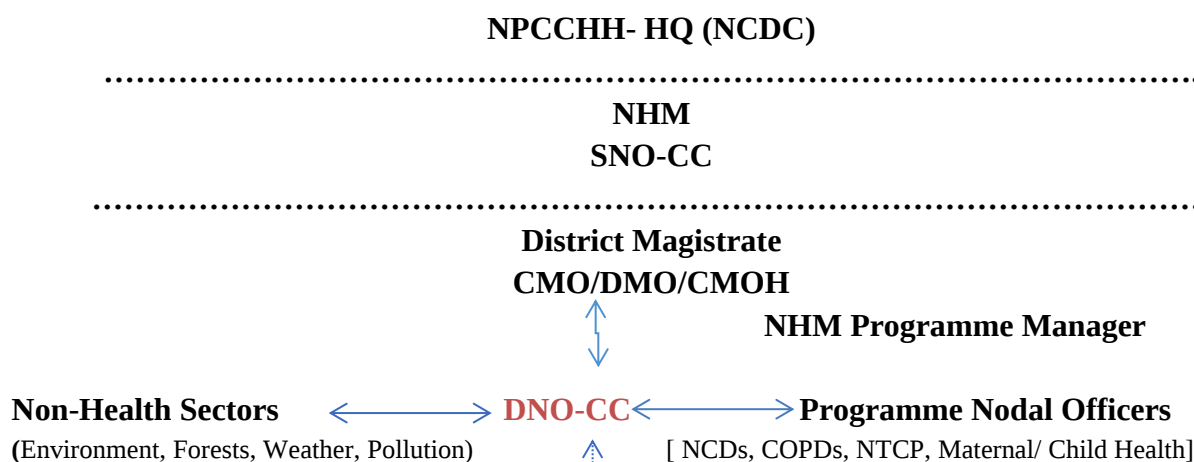


Figure 6.1: Structural and Functional Mechanisms of NPCCHH

DNO as a key functional programme implementing officer under NPCCHH is detailed below-

Structural and Functional Flow of NPCCHH at district level



Key objectives of NPCCHH Climate Sensitive Diseases (Air Pollution related Illnesses)

1. Awareness Generation among all relevant key stakeholders and populations
2. Capacity Building of health professionals and workers
3. Health sector preparedness and responses mechanisms
4. Partnership role with Government/ Non-Government Sectors
5. Any local evidences on the subject area

Main Tasks for DNO at the district level are as follows-

1. District Task Force Meetings to draft action plan with support from experts/officials concerned
2. HAP on Air pollution related Illnesses drafting/finalisation
3. Situational analysis of the subject (Vulnerability level, Resources availability, Hotspots Identification to prioritise actions; Action plans)
4. IEC dissemination/Campaign plan/Health Advisory Issuance
5. Training Calendar development and its conduction
6. Strengthening Surveillance on air pollution related Illness
7. Air Quality Forecast Coordination
8. Air quality Information coordination c Pollution Control Board and HCFs
9. Health care Service provisions at HCFs (OPDs, Emergency, Referral mechanism, Logistics/Equipments, Medications etc)
10. Emergency Health Action Plans (When AQI level is very high)
11. Reporting, Supervision, Monitoring, Coordination

Implementation of the priority activities at two broad levels in the district-

- i. Health care facilities (DH.SDH.CHC.PHC.WCs) and
- ii. Community level

Roles and responsibilities of the District Nodal Officer (DNO)

District Nodal Officer, to be precise, plans, executes and monitors this Health Adaptation Plan. Therefore, some of their key roles and responsibilities will be defined as such.

Planning and Coordination under NPCCHH

- a) To constitute District Level Task Force and its meeting conduction for development of action plan for Air Pollution and related health illnesses at the district level
- b) To draft and finalize district health adaptation plan
- c) To undertake situational analysis including burden, risk, vulnerability assessment, health system preparedness assessment, stakeholder analysis regarding air pollution and health at the district level

Implementation of the priority activities under NPCCHH

- a) To ensure implementation of district health adaptation plan
- b) To implement risk reduction strategies under NPCCHH
- c) To strengthen health system by
 - i. Identifying hot spot sites in coordination with (CPCB/ SPCB/ SAFAR or NCAP)
 - ii. Capacity building of human resource including professionals from medical colleges, staff working under state government and NHM, community health workers such as ASHAs, AWWs
 - iii. To fill gaps identified during health system preparedness assessment
- d) To advocate for air pollution related illnesses with policy makers with policy briefs, regular presentations
- e) To draft and disseminate information on air pollution related illnesses through various means such as IEC materials, audio/visual aids
- f) To timely disseminate health advisories in case of poor or worse air quality to all concerned stakeholders such as vulnerable population groups, individuals, health professionals
- g) To establish surveillance framework for timely data sharing

Monitoring of programme related activities under NPCCHH

- a) To ensure implementation of risk reduction strategies in coordination with other health and non-health air pollution related programmes
- b) To ensure AQI Monitors information and its report sharing to health sector in the district - (CPCB/ SPCB/ SAFAR or NCAP)
- c) To ensure air quality forecast information from IMD are shared to health sector
- d) To ensure timely data sharing with multi sectoral coordination activities with all relevant stakeholders

7. DEVELOPMENT OF DISTRICT HEALTH ADAPTATION PLAN ON AIR POLLUTION RELATED

Learning Objectives:

1. Understanding health sector's role to address air pollution at the district level
2. Exercises to develop DAP on air pollution related illnesses under NPCCHH

A climate resilient health system is to withstand or minimise adverse health effects due to climate change including that of air pollution for all citizens across the country.

The District Health Adaptation Plan on air pollution related illnesses is a mechanism developed to support health system to be resilient against the air pollution related illnesses at the district level. The plan will include various mechanisms to address the key five NPCCHH objectives focusing on this climate sensitive health issue. This will be briefly mentioned in the following and can adopt the broad strategies as in the Figure 7.1.

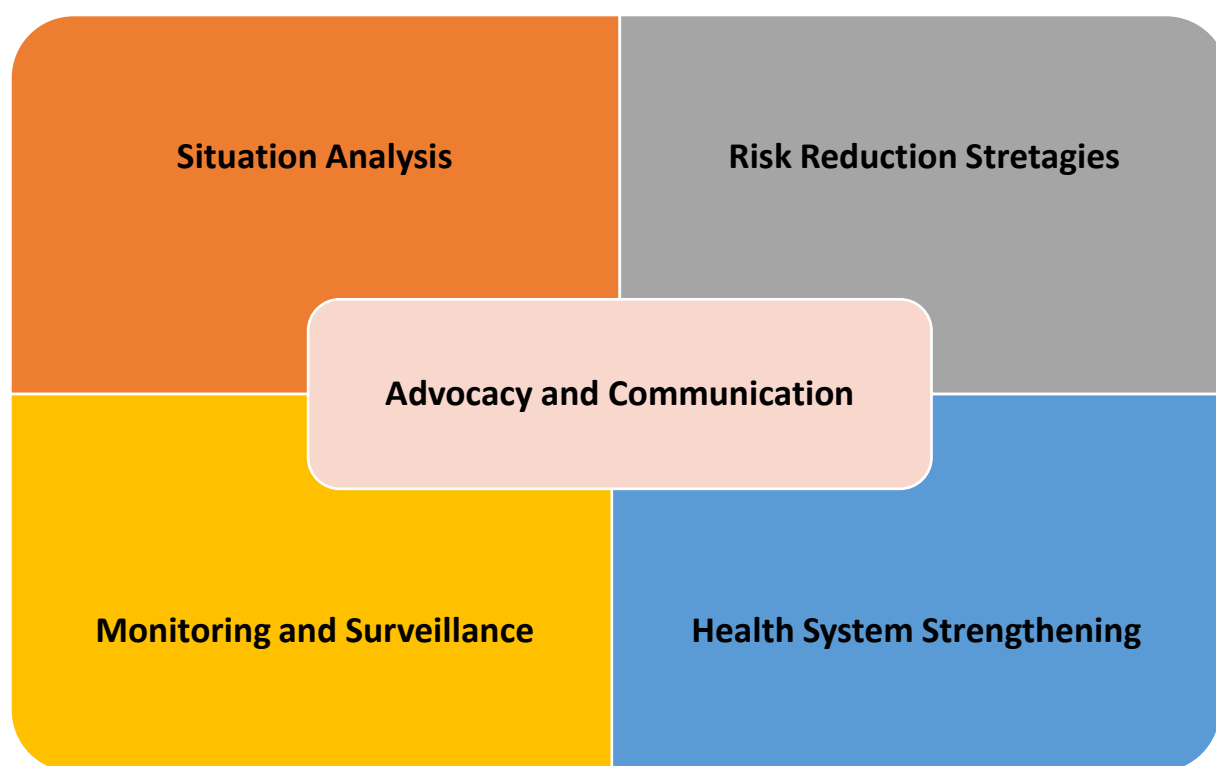


Figure 7.1: Pillars of District Health Adaptation Plan

The following mechanisms mentioned below will help the DNOs to understand and support in developing action plans for DHAP on the subject to address issues at the district level as key action points and their work out at district level will be of utmost importance.

I. Constitution of District level multi-sectoral Task Force on Climate Change & Human Health and its meeting conductions for DHAP drafting and approval

The district level task force is to be constituted with the District Magistrate as the chairman and DNO CC as the member secretary and if constituted, it is to be put in the action plan document. The mandate of the task force is to provide policy actions of the concerned health issue at the district level and prioritize health related activities and its resource mobilizations.

The members of the task force shall include stakeholders from other relevant departments (health and Non-health to support in developing the health action plans and its execution in partnerships) which could support policy actions and its implementation at the district level.

The meeting of the district task force shall preferably be done quarterly, and additional meetings can be done if necessary as per the advice of the Chair. Minutes preparation, follow up and review of the actions taken with the key partners to address the concern are key actions for DNOs.

No. of meetings done in the last year - _____

Minutes preparation, follow up and review and action taken reports.....

DNOs may coordinate with the SNOs and work as per guidelines in the SAPCHH.

A sample Table 7.1 is shared for the constitution of the Task Force and its constituent members and DNOs are to work out to constitute it in consultation with CMO and the approval of the District Magistrate.

Table 7.1- District level Multi-Sectoral Task Force on Climate Change & Human Health			
S.no	Position	Designation	Name and details
1.	Chairman	DM	
2.	Co-Chairman	CMOH	
3.	Member Secretary	DNO-CC	
4.	Pollution control Board	Member	
5.	Meteorological Department	Member	
6.	Municipality Department	Member	
7.	Transport Department Energy/ Power Department	Member	

8.	Education Department	Member	
9.	Nodal Officer NPCDCS	Member	
10.	Nodal Officer Tobacco Control Programme	Member	
11.	Nodal Officer Maternal & Health Division	Member	
12.	Medical Colleges	Member	
13.	NGOs (WHO/ UN Agencies)	Member	
14.	Other relevant Institutes		

II. Situation Analysis of air pollution and health at the district level

Situation analysis will require regular understanding of the air pollution level in the district/city including the urban areas and rural background impacted from cooking, heating and lighting purposes. It may require to look into the reports of air quality levels in the areas in previous years. It may find out hotspot areas having sources of air pollution like power plant, construction sites, traffic contributions, industries etc. impacting the people in the neighborhood. Its influence from nearby surroundings. The analysis also requires mapping of burden, risk, resources, materials, and finances. This also includes assessment of burden of diseases due to air pollution in the district as part of routine health related surveys and health system reporting.

a. Health Burden, Risk and Vulnerability Mapping

With respect to air pollution related illnesses, certain populations are more vulnerable. They may be focused during situation analysis. Similar exercise may be done by DNO with the help of other small surveys such as Non-Communicable Diseases (NCDs) Risk Factor Survey, STEPS survey (refer to WHO document). Care must be taken not to duplicate activities. These activities are already mandated for District Nodal Officer/ District Co-coordinating Officer for NCDs. These can also be done in collaboration with medical colleges.

Guidance in vulnerability mapping specific to air pollution and its related health effects is given at Annexure 1. After vulnerability assessment at block level, respective district can be categorized as high, medium, and low vulnerability for air pollution related health effects. The indicators given in annexure 2 are indicative.

Allocate a cumulative grade to your district - High, Moderate, Low depending on the total number of grades district is allocated as per the Table 7.1

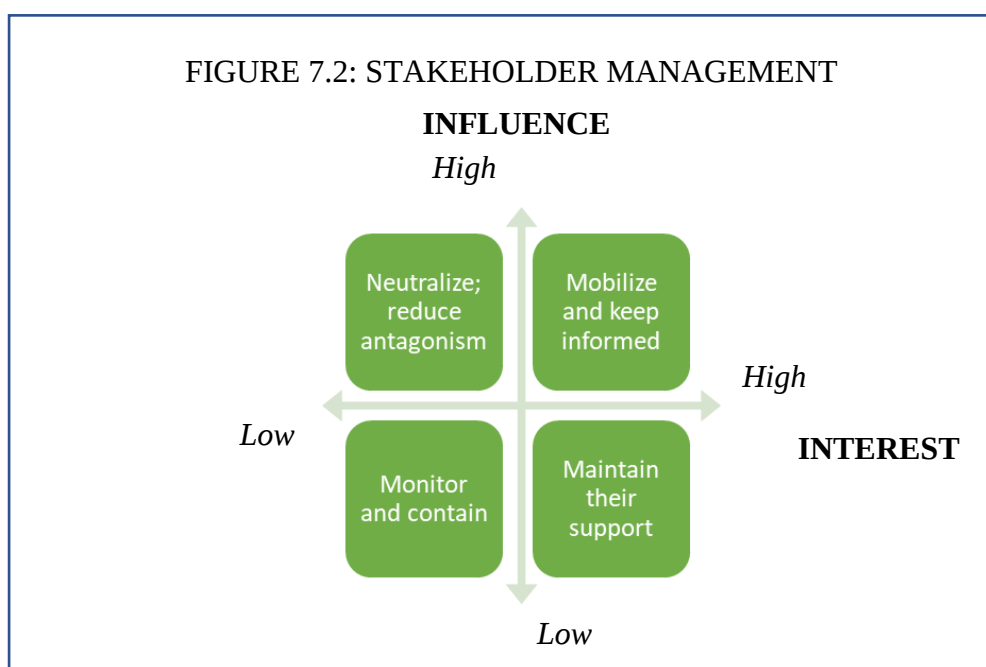
Table 7.2: Cumulative grade for the district

Sl.No.	Total Number of Grades	Overall Grade
1.	Maximum number of indicators allocated Grade Very High	Very High
2.	Maximum number of indicators allocated Grade High	High
3.	Maximum number of indicators allocated Grade Moderate	Moderate
4.	Maximum number of indicators allocated Grade Low	Low

b. Stakeholder analysis:

Stakeholder analysis is a process of identifying the individuals or groups that are likely to affect or be affected by your activities. They need to be sorted according to their impact on the action and the impact the action will have on them. A good stakeholder analysis can help you in mapping out and establishing appropriate level of communication with your stakeholders and their involvement in your action plan.

For example, a well-done stakeholder analysis lends the logic to the district nodal officer to formulate communication strategy. All stakeholders that affect or are affected by DNO's activities should be listed. A non-exhaustive list of stakeholders is mentioned at (Annexure 3) for reference. Each



stakeholder mapped needs to be considered as a separate entity to identify their influence and interest (Influence-Interest Grid in Figure 7.2) in context of air pollution related diseases. Plotting them in

the grid will help DNO define roles and responsibilities of all stakeholders as well as formulate an effective communication strategy.

The following four types of influences based on interest may be observed as below-

1. High Influence – High Interest people: These are the people you must fully engage and make the greatest efforts with. For example, local leader, sarpanch, political leader, school principal, head of NGO, etc.
2. High Influence – Low Interest people: provide sufficient information to these people to ensure that they are up to date but not overwhelmed with data. For example, media
3. Low Influence – High Interest people: keep these people adequately informed, talk to them to ensure that no major issues arise.
4. Low Influence - Low Interest people: provide these people with minimal communication to prevent boredom. Example: other departmental members, teams unaffected by the change

c. Resource Mapping to address the subject

Health System Preparedness Assessment can be conducted to identify gaps in functioning of a resilient health system. It is an exercise conducted to determine the status of preparedness of a health system to counteract impact of air pollution on health. This assessment forms the baseline and identifies gaps that need to be addressed to help prepare/ make the health system more resilient with rising air pollution and changing climate.

This assessment will involve mapping availability of trained HRs, infrastructure, essential medicines and equipments and logistics.

Availability of trained HR may be assessed by referring to Indian Public Health Standards for primary and secondary level of care facilities. This may be combined with programme specific manpower mandated by the Ministry of Health and Family Welfare, Government of India. This information may be tabulated as per below format. A few staff cadres have been mentioned in the Table 7.5 as an example and it is not in any way exhaustive in nature. This information may also be found with the nodal officer in-charge of human resources in the district under National Health Mission. It is also annually collected and shared at state level while drafting Programme Implementation Plan.

III. Awareness generation through targeted IEC for key stakeholders particularly the Vulnerable

Awareness generation is a key objective under NPCCHH.

DNO is to assess the awareness generation level on the subject in the district and to target key stakeholders through IEC materials, media channels appropriate for the district and the people. The nodal officer is to assess IEC materials requirements, local languages requirements and IEC materials available at national and state level.

District must enlist the available materials, types and develop plans to disseminate them (materials, time and months, durations, areas) to the public such as in local channels. The following points may be considered during its planning and action development-

A. IEC materials availability

- Posters, GIFs, Audio-Video Spots, Social media messages (Prototypes at NCDC website)
- Locally translated/ created IEC materials
- IEC messages
- Social Media Messages

B. IEC dissemination plans (Figure 7.3)

- Timing: For example-
 - i. Winter months (Sept.-Oct to Feb.-March)
 - ii. Pre and Post Diwali
 - iii. Stubble Burning Days
 - iv. SMOG (Smoke + Fog)- Fog admix with polluted air (Hazardous to health)
 - v. International Day of Clean Air for blue skies (7th September) every year
 - vi. International Days related to Environment and Health
- Channels for disseminations-
 - i. Social media - Twitter, Facebook, Instagram, You Tube, WhatsApp
 - ii. Posters, Wall paintings, Street plays/ Nukkad Natak
 - iii. Radio Television channels (AIR, Doordarshan, FM channels)
 - iv. Public means of transport vehicles- Bus etc.
 - v. Competitions (Painting, Quiz, Debates, Symposium)
 - vi. Key Public Officials and Senior officials
 - vii. Experts and Panel discussion

Table 7.3: Dissemination Plan for IEC materials

S.no	IEC Material	Languages	IEC Dissemination action Plan		
1.	Posters	English	Materials	Media channels/Time	Areas
		Hindi			
		Local Languages			
2.	Audio IEC	English			
		Hindi			
		Local Languages			
3.	Video IEC	English			
		Hindi			
		Local Languages			
4.	Public health Advisory issues	English			
		Hindi			
		Local Languages			
5.	Others	English			
		Hindi			
		Local Languages			
6.	Campaign for Clean Air like <i>Clean Air for Blue Skies</i> (7 th Sept.)				

IV. Capacity building of the health sector

Capacity building requires mapping healthcare facilities available in the system, mapping human resources including health workers, training needs, training plans and providing training the HRs. It also requires strengthening logistic supports- medications, equipments and ambulances for referral mechanisms. Required training modules availability for the MOs, Paramedics, CHOs, Community Health Workers, Surveillance Nodal Officers etc. are to be assessed by DNO and are as follows-

Mapping the Health Care Facilities in the District

Each type health care facility has to be listed by the district and they should be mapped with the vulnerable areas and population.

Table 7.4 showing the number of HCFs in the district		
Name of the District:Blocks (number).....		
Health Care Facilities	Block (1, 2, 3...)	Total Number of HCFs in district
DH		
SDH		
CHC		
PHC		
WCs		
Medical College		
Others		

Strength of Human Resources in the Health sector in the District:

The Human resources available at each level has to be filled as given below Table 7.5 as below-

Category	Facility (SC / PHC / CHC/ DH)	Sanctioned [B]	In-Place [C]	Filled Posts % [D] = (C / B) *100
Staff Nurses				
Medical Officers				
Pediatrician				
Cardiologist				

Ophthalmic Assistant				
Gynaecologist				
Epidemiologist				
Physician				
CHOs				
Community workers				

Training Calendar plans for HRs at the district level

A detailed training calendar has to be planned by the district for air pollution related illnesses in particular.

Table 7.6 showing District Level Training Plan / Calendar for NPCCHH (Air Pollution related Illnesses)				
		Total Number of Officers/Staffs for training	No. of Officers/Staffs who received training	No. of Officers/Staffs who require training
I.	Medical Officers			
II.	Nursing Officers			
III.	Paramedical Officers			
IV.	Community level Health worker			
V.	Surveillance Nodal Officers			

Focus area for Training activities

- 1) Burden, risk factors, vulnerability assessment of air pollution related illnesses in the district
- 2) Risk factors (Transport, construction, presence of industry, green cover, use of biomass cooking fuels, vulnerable, health risk factors)
- 3) Health effects and Sign and Symptoms
- 4) **Information** availability of air pollution parameters from Pollution control board/IMD for the district
- 5) Strengthening of health care system as per NPCCHH objectives
- 6) Health response mechanisms at HCFs and Community level
- 7) Communication and advocacy

V. Surveillance establishment and its reporting on Air Pollution related Illness in the District

Districts can refer the operational guideline on surveillance of air pollution related illnesses available on the website for establishing sentinel surveillance on air pollution.

NPCCHH programme officials at the District level are –

- a. To establish and expand sentinel surveillance on air pollution related illnesses in the state particularly NCAP cities.
- b. About (3-4) sentinel hospitals/ city including hospital nodal officers to identify
- c. Each sentinel hospital to report regarding daily air pollution related illness cases attending the emergency department to DNO-CC regularly/ timely.
- d. Each DNO to monitor reports from sentinel sites; analyse statistics of illnesses related to air pollution and share to the State and Central level for timely actions.

(Details in the SOP of Surveillance on air pollution related illnesses:

<https://ncdc.gov.in/WriteReadData/l892s/33115111771669018502.pdf>)

DNOs are to work out the following table 7.7

Table 7.7 showing status of the Sentinel surveillance on air pollution related illnesses					
Sl. No.	Name of Sentinel Hospital Identified	Surveillance Nodal Officers Particulars	Training Done for Surveillance Nodal Officers – Yes/No	Digital Mode	Manual Mode
1.					
2.					
3.					
4.					

VI. Health sector response mechanisms to address the issue

Healthcare facilities strengthening require health officials and Staffs orientation on the issues and availability of the healthcare service provisions and support system in HCFs to address health issues-

- i. Patient care service areas
 - a) OPD services (mainly General OPDs, Medicine, Paediatrics, Respiratory Medicine, Cardiology and Neurology etc.)
 - b) Emergency services
 - c) Referral Services
 - d) Ambulance services
 - e) Outreach services
- i. Medications availability- acute respiratory/ cardiovascular/ cerebrovascular etc.
- ii. Diagnostic/ Laboratory Services
- iii. Medical equipments like oxygen supply, nebulizers, ventilators
- iv. Hospital beds, Stretchers, Wheelchairs, Ambulances availability

Health Sector Response Action Plans must also be in place to address during high level of air pollution such as particularly during post-Diwali, Stubble burning and winter days/ months (SMOG) etc. at the District.

VII. Air Quality information for the Health Sector:

Programme officials to keep a check on the daily air quality data in the cities particularly NCAP cities and these are available at CPCB website or State Pollution Control Board. Sameer App. can also be used for obtaining the information as in Table 7.8

- i. State/District may coordinate with pollution control board for developing a system of availing such air quality information in health sector regularly.
- ii. The same air quality data may preferably be made available to health facilities (WCs, PHCs, CHCs, SDHs and DHs and others) for health-related actions
- iii. Based on the air quality data, healthcare facilities may strengthen appropriate healthcare service provisions to address health issues arising in their respective area and also, for the outreach activities at the community level.
- iv. This information is also for use in surveillance on air pollution related illnesses and use in healthcare facilities.

Table 7.8 - AQI Monitoring Centres for the city in district and its information details if possible		
Locations/ Cities where AQI monitoring centres in district	Sources from CPCB website/ SAFAR/ State pollution control board	Type of measurement: Manual/ Automatic (preferably)

VIII. Air Quality Forecasting and Early warning system from IMD

The programme officers are to coordinate with IMD for air quality forecast data or from its website (IMD). The availability, method and frequency of sharing needs to be determined by the district in consensus with the relevant IMD officers at the district level. Availability of air quality forecasts for cities in the districts are to be noted and if available to use the information for public.

This information will be helpful for advisory issuance and preparedness.

IX. Inter-sectoral Co-ordination with key health and non-health sectors to address the issue

The stakeholders are coordinated to support one another in addressing the issue -

1. Information sharing in areas to support one another
2. Campaigning together for public awareness generation/capacity building
3. As a member of the task force to draft and develop the action plans
4. Both Non-Health and Health sectors like relevant National Health programmes which can help to address air pollution related illnesses like NCDs, Maternal and Child health etc.

Table 7.9 showing Health and Non-Health sectors for intersectoral coordination	
Department	Name and details of relevant persons at district level
Environment & Forest Department	

Pollution Control Board	
Public Works Department	
Agriculture	
PWD	
Medical Colleges (Allopathy/ AYUSH)	
Women and Child Development	
Petroleum and Natural Gas	
Road transport, highways	
Panchayati Raj	
Nodal officers of health programmes	

X. Monitoring and supervision activities of the implementation of the programme at various levels in the district (block level, facility levels, community levels); programme priorities, budget allocations, expenditures, tasks completions, resources allocations and mobilizations.

XI. Reporting mechanisms from the district to be in place for the state and central level of the programme on the health-related activities conducted at the district level like task force constituted and meetings conducted, action plans drafted, the surveillance report, any best practices conducted during eventful campaigns, budget and financing expenditure of programme related.

ANNEXURES:

Annexure 1: Status of different Indicators at the District level

Situational Analysis		
Domain	Specific action	Current Status
Leadership and Governance	Air Pollution and health focal points designated within the department of health and department of environment, science, and technology, with specific programme of action and budget allocated.	
	District level strategy on health and air pollution is developed	
	District level strategy on health and air pollution implemented	
	Responsibilities of various stakeholders identified by Department of Health	
	Health representations in District/ City Clean Air Plan	
	Communication strategy developed for advocacy and communication related to air pollution and its health impact for capacity building of various stakeholders	
	District Level Committee formed for stakeholder engagement	
Health Workforce Development	Conduction of training courses on air pollution and related health topics targeting health personnel	
	Contingency plans for the deployment of sufficient health personnel in case of acute shocks, such as severe air quality, increased incidence of exacerbated breathing issues. seasons for allergic reactions, harvesting season, developed at the district level	
Vulnerability Assessment	Assessment and availability of baseline rates, and air pollution sensitivity of health conditions, allowing selection of priority risks, and continuous monitoring of changing risk conditions and health status	
	Identification of most vulnerable or high-risk population in the district	
	Execution of health impact assessment of any mitigation strategy/ plan/ activity	
Health system capacity assessment	Baselines on existing human resources, technical and health service delivery capacity established, with identification of weaknesses.	
	Recommendations made for addressing gaps and building health systems capacity	
Adaptation capacity	Plan developed for prioritization of allocation of resources as per vulnerability assessment	
	Review mechanism established	
Integrated risk monitoring and early warning	Mechanism for tracking/mapping geographic and seasonal distribution of health risks and outcomes established	
	Early warning systems for sever air quality and its related health effects established	
Air pollution related health effects research	Access to, and linkage of, data on meteorological information, health determinants and outcomes enabled	
	Multidisciplinary research partnerships, knowledge management networks and rosters of local experts established.	
Management of environmental determinants of health	Integrated monitoring systems allowing collection and analysis of data on environmental hazards, socioeconomic factors and health outcomes exist	
Air pollution/ Climate informed health programmes	Air Pollution/ Climate actions identified in the PIP	
Emergency preparedness and management	Mitigation measures to be carried out in the emergency situation such as severe air quality, harvesting season, etc. in the district are well identified	
	Existence of plan/ strategy for community participation in case of emergency situation such as severe air quality, harvesting season, etc.	
Air Pollution/ Climate health financing	Budget allocation related to Air Pollution/ Climate actions in the annual PIPs	

Annexure 2: Indicators for vulnerability assessment

Vulnerability assessment					
	Vulnerability Level				Source of Information
Indicator	Very High	High	Moderate	Low	
Reports of Industry in District violating Emission standards	Data not Available	Reported		Not Reported	Central/ State Pollution Control Board (who has given industry consent to operate in the area)
Air Quality zone (SAFAR)/ (SAMEER)	Data not Available	Very Poor/ Severe	Moderate	Good/ Satisfactory	Indian Meteorological Department, CPCB Website / Applications SAFAR, SAMEER
Plantation target met for increasing Green Cover (Tree cover + Forest cover)	Data not Available	No		Yes	Forest Department
Reports of crop residue burning	Data not Available	Reported		Not Reported	Agriculture Department
Households using solid fuel/ Biomass fuel for cooking (%)	Data not Available	> 35 %	25 – 10 %	< 10 %	Latest NFHS District Fact Sheets
Current Alcohol use in adults (%)	Data not Available	> 35 %	25 – 10 %	< 10 %	District level estimates, Local surveys, studies
Current Tobacco use In adults (%)	Data not Available	> 35 %	25 – 10 %	< 10 %	District level estimates, Local surveys, studies
Prevalence of COPD/ Asthma in adult (%)	Data not Available	> 5%	2% – 5%	< 2%	District level estimates, Local surveys, studies
Hospitalizations for LRI (Under five Children/ elderly) (%)	Data not Available	> 5%	2% – 5%	< 2%	IDSP Surveillance data
Proportion of Chronic Renal Failure on dialysis (%)	Data not Available	> 5%	2% – 5%	< 2%	District level estimates, Local surveys, studies
Prevalence of Hypertension in adults (%)	Data not Available	> 10%	5% – 10%	< 5%	District level estimates, Local surveys, studies
Health system preparedness	Very Poor	Poor	Fair	Good	District Programme Management Unit
Prevalence of Obesity in adults (%)	Data not Available	> 10%	5% – 10%	< 5%	District level estimates, Local surveys, studies

Annexure 3: Stakeholders which may be relevant to air pollution related Illnesses

Stakeholders related to Healthcare and Public Health Management of Air Pollution related Illnesses

- Medical Associations like Indian Medical Association, Indian Public Health Association
- Medical Colleges and private hospitals
- District officers in-charge of other programmes of national importance
- Non-Government Organizations working on air pollution related health effects like Lung Care Foundation
- Medical Commissions and health related councils

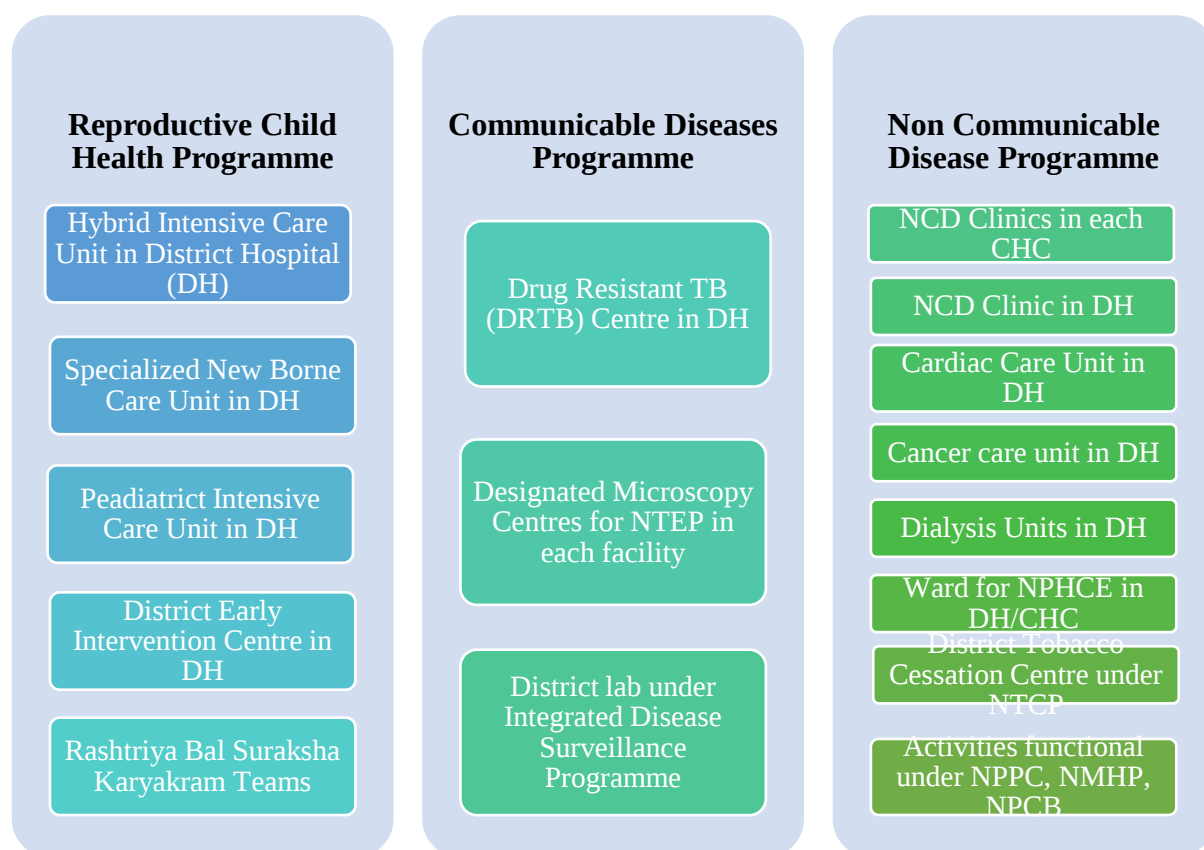
Stakeholders related to Air Pollution Management

- Industrial Association
- Non Government Organizations working on Air Pollution
- Municipal Corporation
- Department of Food, Civil Supplies and Consumer Affairs
- Department of Industry
- District Pollution Control Board
- Department of Urban Development
- State Housing Board
- Development Authority
- PWD
- National Highway Authority
- State Highway/Roads Authority
- State Forest Department
- State Transport Department
- City Transport Services
- Metro Corporations
- Railways
- Private/ PSU players such as hotels, restaurants, oil companies (Indian Oil, HP, etc), Construction Companies
- Department of Rural Development
- Panchayati Raj Institutions
- Department of Education

Ultimate Stakeholders

- Private citizens who drive/ own vehicles requiring fuel
- Private citizens with jobs requiring high exposure to air pollution or those using public transport

Annexure 4: Health Programmes which may be of relevance to the subject



Annexure 5. Some examples to show the essential medicines and technologies list for management of cardio-pulmonary disorders at Primary Care level

Medicines	Technologies
Thiazide diuretic	Thermometer
Calcium channel blocker (amlodipine)	Stethoscope
Beta-blocker	Blood pressure measurement device
Angiotensin converting enzyme inhibitor	Measurement tape
Statin	Weighing machine
Isosorbide dinitrate	Spacers for inhalers
Glyceryl trinitrate	Peak flow meter
Furosemide	Nebulizer
Salbutamol	Pulse oximeter
Ipratropium	Blood cholesterol assay
Amoxicillin	Lipid profile
Hydrocortisone (inj)	Serum creatinine assay
Epinephrine	Troponin test strips
Heparin	Urine microalbuminuria test strips
Diazepam	Electrocardiograph
Magnesium sulphate	Defibrillator
Promethazine	
Dextrose infusion	
Glucose injectable solution	
Prednisolone	
Inhaled Budesonide	
Inhaled Tiotropium	
Aspirin	
Codeine	
Morphine	
Penicillin	
Erythromycin	
Sodium chloride infusion	
Oxygen	
Digoxin tablets/Inj	
Potassium chloride	
Antiarrhythmics	

Annexure 6: Mapping of Data Outcomes

Sl.No.	Activity	Indicators for Monitoring	Frequency of Reporting	Reported to	Key Output
1	Stakeholder Analysis	Number of Stakeholder Engagement Activities completed at district level	Annually	DNO, NPCCHH	Stakeholder Analysis Report
2	Health System Preparedness Assessment	Number of Health System Preparedness Assessment activities completed at district level	Annually	DNO, NPCCHH DNO, NPCDCS DNO, RCH DNO, IDSP DNO, TB	Health System Preparedness Analysis Report
3	Vulnerability Assessment	Number of Vulnerability Assessment activities completed at district level	Annually	DNO, NPCCHH	Vulnerability Assessment Report
4	Communication Strategy	Number of Communication Strategies finalized at district level	Annually	DNO, NPCCHH DNO, NPCDCS DNO, RCH DNO, IDSP DNO, TB	Communication Strategy Document with draft IEC materials in local language
5	Standard Operating Protocols	Number of SOPs finalized for public health management of each grade of Air Quality Index	Annually	DNO, NPCCHH DNO, NPCDCS DNO, RCH DNO, IDSP DNO, TB	Document on SOP for each Grade of Air Quality Index
6.1	Air Pollution and related Illnesses Management	Number of documents on Standard Treatment Guidelines for Air pollution related illnesses for different levels of health system	Annually	DNO, NPCCHH DNO, NPCDCS DNO, RCH DNO, IDSP DNO, TB	Standard Treatment Guidelines available in all facilities
7.1	Capacity Building of Health Workforce	Percentage of District Nodal Officers, District Programme officers trained regarding Air Pollution and related illnesses	Quarterly	DNO, NPCCHH DNO, NPCDCS DNO, RCH	District Annual Report Proceedings/ Report of Capacity Building Workshop
7.2		Percentage of Medical Officers trained regarding Air Pollution and related illnesses		DNO, IDSP	
7.3		Percentage of CHOs, ANMs, ASHAs trained regarding Air Pollution and related illnesses		DNO, TB	
7.4		Percentage of PRIs trained regarding Air Pollution and related illnesses		DNO, CPHC	
8.1	Improving Availability of Supplies and Materials	Percentage of facilities reported stock outs of EDL	Quarterly	DNO, NPCCHH DNO, NPCDCS DNO, RCH DNO, TB DNO, CPHC	Reports on Indented medicines/equipment
8.2		Percentage of facilities reported non-functional/ non-availability of essential health technologies			

Sl.No.	Activity	Indicators for Monitoring	Frequency of Reporting	Reported to	Key Output
9.1	Improving Finance Management	Expenditure reported for funds approved for Air pollution and related illnesses activities	Quarterly	DNO, NPCCHH	Quarterly Reports on Financial Progress
9.2		Expenditure reported for funds approved for multisectoral coordination under Air Pollution and related illnesses management			
9.3		Expenditure reported for funds approved for Capacity Building under Air pollution and related illnesses management			
9.4		Expenditure reported for funds approved for IEC and printing Air Pollution and related illnesses management			
10.1	Availability of Information on Prevalence of NCD risk factors	Percentage of facilities reporting Prevalence of Tobacco	Once in 3 years	DNO, NPCDCS	District level Surveys
10.2		Percentage of facilities reporting Prevalence of obesity			Grading of Vulnerability Level in Vulnerability Assessment
10.3		Percentage of facilities reporting Prevalence of hypertension			Report based on Information sourced from NCD App shared
10.4		Percentage of facilities reporting Prevalence of diabetes mellitus			
10.5		Percentage of facilities reporting Prevalence of comorbid conditions			
10.6		Percentage of facilities with vulnerable population identified in under their geographical area			
11.1	Availability of Information on Incidence/ Prevalence of Air pollution related illnesses	Percentage of facilities reporting Lower respiratory infections on IDSP platform	Once a week	DNO, NPCCHH DNO, IDSP	IDSP platform
11.2		Percentage of facilities reporting new TB cases on a weekly basis	Once a week	DNO, NPCCHH DNO, NTEP	NTEP reports
11.3		Percentage of facilities reporting prevalence of lung cancer	Once a month	DNO, NPCCHH DNO, NPCDCS	Monthly NPCDCS Report
11.4		Percentage of facilities reporting prevalence of COPD	Once a month	DNO, NPCCHH DNO, NPCDCS	Monthly NPCDCS Report
11.5		Percentage of facilities reporting prevalence of Asthma	Once a month	DNO, NPCCHH DNO, NPCDCS DNO, RCH	Monthly NPCDCS Report
12.1	Establishing Inter-departmental Coordination for Climate Alerts and Early Warning System	Percentage of fortnights when District Climate Cell received weather forecasting from IMD/RMC	Once in 2 weeks	DNO, NPCCHH	Reporting Form
13.1	Governance	Number of District Level Committee Meetings involving discussion on Air pollution and related illnesses management	Quarterly	DNO, NPCCHH	Minutes of Meetings State Annual Report

The training module is meant for the District Nodal Officers under NPCCHH to enable them to understand on the issue and ways to address air pollution related illnesses at the district level.

District Nodal Officers are the functional leaders at the district level for implementation of the programme. Under their leadership, the programme is focused to address the health concern through the health functionaries constituted and identified and the appropriate mobilization of the resources for any need in addressing the concern of air pollution and human health. This may also support DNOs in the drafting of the District Health Action Plan on Air Pollution related Illnesses for their respective districts in the country.



National Programme
on Climate Change
and Human Health



NATIONAL HEALTH MISSION
सुखे माने रहे



National Centre
for Disease Control
Government of India



भारतीय चिकित्सा अनुसंधान संस्थान
भारतीय चिकित्सा अनुसंधान संस्थान