



NATIONAL CLEAN AIR PROGRAMME IN INDIA -AN INTRODUCTION

Community Medicine

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ABSTRACT

Air pollution is currently progressive as the major cause of mortality and morbidity in world. About half of the world population is impacted by it. Problem is worse in India a many of the cities have severe air quality index with almost nil or less effective policies. In the midst of all these, Govt of India started the programme of "National clean air program". The goals, policies and implementation bodies, and the initiatives which are taken under this program have been discussed in this article.

KEYWORDS

Air pollution, India, NCAP.

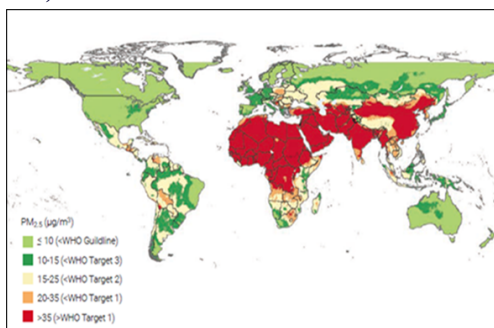
INTRODUCTION

Air pollution is one of the most serious threats on planet in today's time, contributing almost a third of global pollution death in Asia and the Pacific region. Air pollution is a risk factor in many for global burden and has impact on human health⁽¹⁻⁵⁾ particularly among the poor and vulnerable such as the aged and children⁽⁶⁾. Less than 8% of the population of Asia and the Pacific enjoyed healthy air that means the other 92% people, or approximately 4 billion people are exposed to levels of air pollution that poses significant risk to their life⁽⁷⁾. International energy agency estimated for 2.7 billion people globally of whom 1.9 billion live in Asia; continue to depend on burning solid fuels such as wood, coal, charcoal, crop residue and dung in their homes for cooking and heating⁽⁸⁾.

According to WHO 2016⁽⁹⁾ and Health Effects Institute 2018⁽¹⁰⁾ the Population-weighted annual mean concentration of PM_{2.5} in the Asia and Pacific region was 58 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$), with a majority of the population living in areas exceeding the WHO Interim Target 1 of 35 $\mu\text{g}/\text{m}^3$. 58 per cent of the global population that lives in areas that exceed WHO Interim Target 1, it is clear that the population of Asia and the Pacific is among the most highly exposed to PM_{2.5} in the world (Figure 1). Not just the exposures to PM_{2.5}, the Ozone concentration exposure were also increased at greater rate. Also daily particulate matter concentration exposure in homes burning fuels and solid fuels range from 300 and 3000 $\mu\text{g}/\text{m}^3$ ⁽¹¹⁻¹²⁾, way above recommended guidelines. WHO guidelines for ambient and indoor air quality intended to protect public health – the guidelines for daily mean PM_{2.5} and particulate matter equal to or less than 10 microns in aerodynamic diameter (PM₁₀) are 25 $\mu\text{g}/\text{m}^3$ and 50 $\mu\text{g}/\text{m}^3$, respectively⁽¹³⁾.

If current policies aimed at limiting emissions are effectively introduced and enforced, air quality will be no worse in 2030 than it was in 2015, despite population growth, rapid urbanization and an ever-increasing demand for goods and services. But nor will it be any better. This suggests that current policies are mitigating air pollution in valuable but limited ways⁽¹⁴⁾.

Figure 1: Comparison of annual average P.M2.5 Population-weighted concentration in 2016 with WHO Quality guidelines (HEI2018)



Health implications

There are many epidemiological studies established the robust association between long term exposure to air pollution and premature mortality associated with ischemic heart diseases, strokes, chronic respiratory diseases and lung cancers. Association is stronger in relation to children since they develop such chronic diseases early in their life with more severe impact. 7 million premature deaths each year globally⁽⁹⁾ 60 per cent of all premature deaths from indoor air pollution were observed in women and children⁽⁸⁾, preterm and low-weight births^(12,15-19), acute respiratory infections^(19,20), Non-accidental cardiovascular disease, chronic obstructive pulmonary disease and lung cancer mortality. An expanding body of evidence points to both short-term consequences of exposure to air pollution^(21,18) and a number of areas of growing concern, including fertility and birth-related outcomes^(15,16,17,18), neurocognitive effects⁽²²⁾ and diabetes⁽²³⁾. Additional effects on children are rapidly developing respiratory, neurological and immune systems are thought to persist well into adulthood⁽²⁴⁾.

Not just the human health but the ecosystem also getting impacted by air pollution severely with impact on vegetation (decrease in yield and production) For example Tie *et al.* estimated the reduction in yields in several regions of China caused by the reduction in radiation alone to be 2 per cent for the total rice crop and 8 per cent for wheat⁽²⁵⁾.

Status of air pollution in India

Approx. 620,000 premature deaths occur in India from air pollution-related diseases each year almost 6 fold increase in a decade⁽²⁶⁾. It has become the fifth largest killer in India after high blood pressure, indoor air pollution, tobacco smoking, and poor nutrition. Also half of the cities in India are reeling under severe particulate matter pollution which is worsening with time with no or minimal control strategy in place. India is home to nine of the world's 10 most-polluted cities⁽²⁷⁾.

Various initiatives started by Govt. of India to curb air pollution

1. National air quality monitoring programme (NAMP)⁽²⁸⁾

Aim is to monitor air quality throughout the year in designated sites.

Objectives are to:

1. To determine status and trends of ambient air quality.
2. To ascertain whether the prescribed ambient air quality standards are violated.
3. To identify Non-attainment cities.
4. To obtain knowledge and understanding necessary for developing preventive and corrective measures.
5. To understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind based movements, dry deposition, precipitation and chemical transformation of pollutants generated.

It consists of network of Manual operating stations (MOSs) and real time continuous ambient air quality monitoring stations (CAAMQS). In MOSs – A web of 691 MSOs covering 303 cities/towns in 29 states and 06 Union Territories has been established. In these sites 04 air pollutants namely Sulphur Dioxide (SO_2), Oxides of Nitrogen as NO_x ,

Suspended particulate matter (PM10) and Fine Particulate Matter (PM 2.5) will be monitored regularly.

In CAAMQS - In 57 cities, 08 air pollutants will be monitored regularly. These are PM10, PM2.5, SO₂, NO_x, Ammonia (NH₃), Carbon monoxide (CO), Ozone (O₃) and Benzene.

Activity- The monitoring of pollutants to be carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, will result in capture of 104 observations in a year.

Monitoring agencies - Central Pollution Control Board (CPCB); State Pollution Control Boards (SPCB); Pollution Control Committees (PCC); National Environmental Engineering Research Institute (NEERI), Nagpur.

2. National Ambient Air Quality Standards (NAAQS)-

These are the standards to measures the ambient air quality with reference to various identified pollutant⁽²⁹⁾

Main objectives are:

- To indicate necessary air quality levels and appropriate margins required to ensure the protection of vegetation, health and property.
- To provide a uniform yardstick for assessment of air quality at the national level,
- To indicate the extent and need of monitoring programme.

Also 118 emissions/effluent standards for 112 different sectors of industries, besides 32 general standards for ambient air have also been notified. Installation of online continuous monitoring devices by 17 major polluting industries has been made mandatory.

3. National air quality index (AQI)⁽³⁰⁾

Air quality index is a tool for effective communication of air quality status. It transforms complex air quality data of various pollutants into a single number or index value, nomenclature and colour. It was launched in April 2015 with monitoring in 14 cities now it has been extended to 57 cities. There are six AQI categories, There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each of these categories is decided based on ambient concentration values of air pollutants and their likely health impacts (known as health breakpoints). AQ sub-index and health breakpoints are evolved for eight pollutants (PM10, PM2.5, NO₂, SO₂, CO, O₃, NH₃, and Pb, short-term up to 24-hours) based on the measured ambient concentrations of a pollutant, sub-index is calculated, which is a linear function of concentration (e.g. the sub-index for PM2.5 will be 51 at concentration 31 µg/m³, 100 at concentration 60 µg/m³ and 75 at concentration of 45 µg/m³). The worst sub-index determines the overall AQI. AQI categories and health breakpoints for the eight pollutants are as follow:

Table 1: Air Quality Index (AQI) categories and health breakpoints for the eight pollutants

AQI Category	AQI	Concentration range*							
		PM ₁₀	PM _{2.5}	NO ₂	O ₃	CO	SO ₂	NH ₃	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	201 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 - 400	301 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 - 1800	3.1 - 3.5
Severe	401 - 500	401 - 600	250+*	400+*	748+*	34+*	1600+*	1800+*	3.5+*

* CO in mg/m³ and other pollutants in µg/m³; 24-hourly average values for PM₁₀, PM_{2.5}, NO₂, SO₂, NH₃, and Pb, and 8-hourly values for CO and O₃.

AQI	Associated Health 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 disease such as asthma and discomfort to people with heart disease, children and older adults
Poor (201-300)	Breathing discomfort to people on prolonged exposure and discomfort to people with heart disease
Very Poor (301-400)	Respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart disease
Severe (401-500)	Respiratory effects even on healthy people & serious health impacts on people with lung / heart disease. Health impacts may be experienced even during light physical activity

4. Forty-two Action Point³¹

Set of 42 measures set by CPCB for implementation in major cities Delhi and NCR to mitigate air pollution problem where primary source of air pollution in NCR states are: **a) Vehicular emissions** (17 measures were formulated for this category such as awareness drive against polluting vehicles, strict action against polluting vehicles, Switch to CNG mode of public transport, Promote battery operated vehicles etc.) **b) Burning of biomass**, crop residues, Municipal solid waste and garbage (04 measures such as stringent action against open burning of biomass) **c) Road dust** (06 measures such as introduce wet/mechanized vacuum sweeping of roads, maintain pothole free roads etc., Ensure proper collection of horticulture waste etc.) **d) Constructions and demolitions** (03 measures such as control dust pollution at construction sites through appropriate cover, ensure carriage of construction material in closed carriages. etc.) and **e) Industrial emissions etc.** (04 measures such as strict actions against unauthorized brick kilns, or industrial units not complying with standards etc.) and few other steps such as setting up helplines in states /UTs for taking action against reported noncompliance, established standard operating procedure to provide quick and effective response to complaints etc.

5. Environment Pollution (Prevention and Control) Authority (EPCA)

Environment Pollution (Prevention and Control) Authority (EPCA) was constituted under Section 3(3) of Environment (Protection) Act, 1986 in 1998 for national capital region (NCR). It has the power suo-moto, or on the basis of complaints made by any individual, representative body or organization functioning in the field of environment, It deal with environmental issues and takes all necessary steps to for controlling vehicular pollution, ensuring compliance of fuel quality standards, monitoring and coordinating action for traffic planning and management.

6. Impetus on Vehicular Pollution

Bharat stage emission standards (BSES) are emission standards instituted by the Government of India to regulate the output of air pollutants from internal combustion engines and Spark-ignition engines equipment, including motor vehicles and to curb vehicular pollution these Bharat Stage IV (BS-IV) norms has been launched for mandatory implementation since 1st April 2017 and leap-frogging to BS-VI by 1st April, 2020 has been proposed.

7. Graded Response Action Plan (GRAP)³²

GRAP was prepared in 2016 regarding maintaining the air quality in Delhi and NCR which comprises of the graded measures for each source framed according to different AQI categories namely, Moderate & Poor, Very Poor, and Severe as per National Air Quality Index. A new category of "Severe+ or Emergency" has been added. On the basis of category, responses are initiated. For eg. In severe category if ambient PM2.5 and PM10 concentration values reaches to 300 µg/m³ and 500 µg/m³ respectively and persists for 48 hours or more, measures such as stop entry of truck into Delhi or Stop construction activities are done with Municipal corporations and traffic police of Delhi and NCR and Delhi pollution control committee are implementing authority.

8. Source apportionment studies

To find the source and to focus on cost effective approach for improving air quality in polluted areas, source apportionment studies have been initiated in six major cities viz. (i) Delhi (ii) Mumbai (iii) Chennai (iv) Bangalore (v) Pune and (vi) Kanpur.

9. Other measures

Keeping in mind the pollution from waste also, five Waste Management Rules on solid waste, hazardous waste, plastic waste, biomedical waste and e-waste has been revised and rules on Construction & Demolition Waste major source of dust pollution was newly notified during 2016. Further, ban was imposed on burning of leaves, biomass and municipal solid waste.

National clean air programme (NCAP) what is it³³ -

To combat the problem of air pollution many initiatives were started by GOI such as launching of National Air quality index (AQI), Universalization of BS-IV by 2017, banning of burning of biomass etc. but such measures though momentarily improved the situation, could not bought desired reduction in air pollution and other measures as such. Hence NCAP -India has been launched as national level

strategies for reduction in air pollution level of both regional and urban scales. The national clean air programme (NCAP) is air pollution control initiatives, launched by Ministry of Environment, Forest and Climate Change, Govt. of India to "cut the concentration of coarse and fine particulate particles defines as (Particulate matter of diameter 10 micrometer or less also called as PM10 or of diameter 2.5 micrometer or less called as PM2.5)" y at least 20% in the next five years, with 2017 as the base year. A "new technology assessment cell" (TAC) has also been envisaged under NCAP to ensure use of new technologies and to evaluate the technologies for prevention, control and abatement of air pollution. Comprehensive strategy in NCAP will be used to plug in maintenance of air quality in the country.

GOAL

"To meet the prescribed annual average ambient air quality standards at all locations in the country in a stipulated timeframe"

OBJECTIVES

- 1 To augment and evolve effective and proficient ambient air quality monitoring network across the country for ensuring comprehensive and reliable database.
- 2 To have efficient data dissemination and public outreach mechanism for timely measures for prevention and mitigation of air pollution and for inclusive public participation in both planning and implementation of the Programmes and policies of government on air pollution
- 3 To have feasible management plan for prevention, control and abatement of air pollution.

APPROACH

It will be more Collaborative, Multi-scale and Cross-Sectoral Coordination between all relevant Central ministries, State government and local bodies. Focus will be on no Regret Measures (i.e. **measures** which are worth implementing **no** matter which event actually happens whenever consequences are uncertain.), Participatory with all the stakeholders and Disciplinary.

Institutional Framework-institutional framework involves creation of specific organizational structure and outlining the responsibilities and coordination on air pollution issues. Accordingly, it is proposed to have following organizational structure::

- i. Apex Committee under Hon'ble MEF&CC
- ii. Steering Committee under Secretary (EF&CC)
- iii. Monitoring Committee under Joint Secretary
- iv. National Level PMU at MoEF&CC- 25 scientific personal and 3-4 secretarial assistance
- v. National level Project Implementation Unit (PIU) at CPCB- 5-6 scientific personal
- vi. State Level PMU- 3-4 scientific personal

States or cities the programme will be covering

Based on the previous data monitoring of the air pollution and WHO reports, **102 cities** have been identified for the initial implementation of the program. From Maharashtra state 17 cities are included in the list followed by Uttar Pradesh with 15 cities. Apart from 04 Metros namely Delhi, Mumbai, Kolkata and Bangalore all other cities selected are tier 2 cities .Selection of these cities simply implies that air pollution and its effects are only limited to metros .it has been spreading in cities comparatively with less population and vehicular movements also.

Ministries involved

The success of the programme is based on inter sectoral participation of the various sectors of government involved in implementation of the programme. The coordinating ministries will be Ministry of Road Transport and Highways, Ministry of Petroleum and Natural Gas, Ministry of New and Renewable Energy, Ministry of Heavy Industry, Ministry of Housing and Urban Affairs, Ministry of Agriculture, Ministry of Health, NITI Aayog, and Central Pollution Control Board.

Initiatives under NCAP

1. Augmenting air quality monitoring system

- i) **Manual monitoring stations** -Increase the number of manual monitoring stations from existing 691 to 1000 for 4000 cities in country.
- ii) **Continuous ambient air quality monitoring stations (CAAQMS)** - Increase the number of CAAQMS from existing 101 in 64 cities to 210 in graded manner to cover more air polluted cities the states of Assam, Bihar, Haryana, Jharkhand, Madhya

Pradesh, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh and West Bengal.

- iii) **Identification of alternative technology for real time monitoring-** CPCB initiative involving IIT, CSIR and other institute as NEERI to identify and develop alternative cost effective technology for monitoring source and ambient air quality.
- iv) **Rural Monitoring Network-** Apart from Outdoor air pollution rural areas are suffering or experiencing indoor air pollution also. Atmospheric concentration of ozone has been observed higher in rural areas as compared to urban areas. To cover these areas 50 monitoring stations are proposed to establish.
- v) **Protocol for setting up of monitoring stations and monitoring** – In 2003,first guidelines for Ambient Air Quality Monitoring were issued .These guideline are to be revised with respect to sound decision making in selection of pollutants, selection of locations, frequency, duration of sampling, sampling techniques, infrastructural facilities, man power and operation and maintenance costs.
- vi) **Monitoring of PM 2.5-** To augment the number of monitoring stations for PM2.5 from existing 67 to all stations under NAMP.
- vii) **Setting up of 10 city Super Network-** This super city network may capture overall air quality dynamics of the nation, impact of interventions trends, investigative measurements etc.

Each city may have one well-equipped monitoring station representing the city background. In addition to notified 12 pollutants, constituents of particle number, etc. may be monitored.

- 2) **Air quality monitoring plan for 100 non-attainment cities-** The cause of air pollution in India varies from states to states. Around 100 such cities with population level more than a million will be taken for apportionment study with the help of leading institute IITs, NEERI, TERI, ARA in graded manner.
- 3) **Indoor air pollution monitoring and management-** Both urban areas and rural areas are at the risk of exposure to indoor air pollution .Both the areas have different cause for indoor air pollution. Guidelines and protocols are to be formulated to tackle this issue.
- 4) **Air Pollution Health Impact Studies-**A high levels apex committee and a working group under the joint chairmanship of ICMR and MoEF&CC has been established to identify the thrust area in environmental health and related project and to generate more authentic data.
- 5) **Setting up air information centre-** The centre will responsible for data analysis, interpretation, dissemination including through GIS platform, issuing bulletins, keeping track of international developments, and bringing out policy updates.
- 6) **Certification system for monitoring instruments-** An apex body to provide certification of the equipments used in environmental monitoring programme by authentic Accreditation Service according to the existing ISO standards.
- 7) **Air Quality Forecasting System-** Air Quality Forecasting System (AAQFS) as a state of the art modeling system which forecasts the following day's air quality is being envisaged. The meteorological and emissions information is to be entered into the model which aims to accurately forecast air pollution on daily basis and also expected air pollution exigencies.
- 8) **Extensive Plantation Drive-** Extensive planation drive by identification and use of plant have high pollutants absorbing capacity to purify air and improvement of health.
- 9) **Issuance of Notification on Dust Management (Road dust and C&D)-** Since there are no regulations prescribing preventive measures to be taken for management of dust including road dust and C&D dust that arises during construction. It is proposed to formulate and notification on dust management [Road dust and C&D].
- 10) **Intensive Awareness, Training and Capacity Building Drive-** to increase awareness and public outreach programme and capacity building of manpower involved in air quality management.
- 11) **Three tier mechanism for review of monitoring, assessment and inspection for implementation** - A credible, transparent, and accountable data collection and monitoring system that is available for timely swift action. A three-tier system that include real time physical data collection, data archiving and data analytics infrastructure, and Action trigger system. These three tier systems will work independently under the supervision of a

single authority, which will ensure accreditation of three independently operating entities.

- 12) **National Emission Inventory-** An emission inventory is an accounting of the amount of pollutants discharged into the atmosphere. It will help in understanding environmental problems and in monitoring progress towards resolving these. A Comprehensive National Emission Inventory will be formalized under this mission.
- 13) **Network of Technical Institutions- Knowledge Partners** Network of highly qualified and experienced academicians, academic administrators and technical institutions in the area of air pollution will be created to provide holistic services for the establishment and operation of policies and Programmes on air pollution.
- 14) **Technology Assessment Cell** -Technology Assessment Cell is being envisaged to evaluate the technologies having significance in reference to prevention, control and abatement of pollution. It will focus on both indigenous and international monitoring and abatement technologies.
- 15) **Technology Support-** It focus towards developing the technologies suiting to Indian scenarios with respect to short and long term ecological and environment impacts, social infrastructure, cultural ethos, and characteristics of the Indian economy. Technologies with potential for air pollution mitigation will be supported under the programme
- 16) **International Cooperation including sharing of international best practices on air pollution-** Multilateral and bilateral cooperation on air pollution including in related demonstration/pilot Projects, including prototype development for Best Available Technologies and Best Environmental Practices for pollution prevention, minimization and mitigation strategies and for control and abatement of pollution specifically air pollution is being proposed.
- 17) **Extending source apportionment studies to all non-attainment cities-** Source apportionment studies, are primarily based on measurements and tracking down the sources through receptor modeling, will help in identifying the sources and extent of their contribution towards causing air pollution. Such studies which have been initiated in six major cities viz. (i) Delhi, (ii) Mumbai, (iii) Chennai, (iv) Bangalore, (v) Pune and (vi) Kanpur at present is planned to be extended to all 94 non-attainments.
- 18) **Review of ambient air quality standards and emission standards** - existing standards need to be strengthened periodically and new standards need to be formulated for the sources where standards are not available, based on extensive scientific evidence with reference to protection of public health and environment.

According to one recent report from the Air Quality Life Index if **NCAP** goal are met and if able to reduce PM pollution level by 25%, residents of Delhi and Uttar Pradesh could live almost three years longer, and an average Indian could live 1.3 years longer which would be an achievement³⁴.

Critical evaluation of the programme

1. Sector wise targets, specific targets for cities are missing. Also targets are not quantified.
2. The lack of strong legal backing to take action against non-implementation is also absent.
3. Absence of clarity on funding provisions and lack of legal framework.

In one report, An NGO Greenpeace India has said that half of the cities who were having worst air quality standards have been missing from the non-attainment cities list. And also if the target of 30% air pollution reduction by 2024 is achieved, 153 cities across the country will not even comply with the NAAQS, and only 12 cities will comply with WHO guidelines³⁴. (Greenpeace report)

Globally recommended measures and guidelines

1. UNEP (2019). Air Pollution in Asia and the Pacific: Science-based Solutions- 25 clean measures were given by UN Environment to combat the air pollution in Asia and Pacific regions in more scientific ways, whilst helping achieve the Sustainable Development Goals (SDGS). This suggests that current policies are mitigating air pollution in valuable but limited ways.

2. WHO guidelines (WHO (2016). *Ambient Air Pollution: A Global Assessment of Exposure and Burden of Disease.*

The WHO has established air quality guidelines to protect human health, with a value for PM_{2.5} of 10 µg/m³ as an annual mean concentration in ambient air (Table 1). As a result, the WHO has established Interim Targets as milestones along the way towards an end-goal of achieving the WHO Guideline value.

Table 2: World Health Organization Air quality criteria for PM_{2.5}

Annual mean PM _{2.5} concentration	WHO Air Quality Criteria
35 µg/m ³	WHO Interim Target 1
25 µg/m ³	WHO Interim Target 2
15 µg/m ³	WHO Interim Target 3
10 µg/m ³	WHO Guideline

CONCLUSION

Enough studies are available to link the various health morbidities to air pollution. Whole of the world population is impacted by it in one way or another. India is no exception. Many strategies were started in India from time to time to curb the problem but they proved to be mildly effective. To address the issue now the country has planned to start an NCAP in graded manner covering most polluted cities in first phase. If the programme is implemented it is expected to cut down the problem of air pollution to related health effects to tolerable level if not up to expected level as recommended by WHO.

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