



PERSONALITY TEST PROGRAMME 2019

(Current Affairs Interview Issues)

AIR POLLUTION IN NORTHERN INDIA

Introduction

Recent spike in pollution levels in Delhi brought to the fore the grave situation of toxicity of air, not only in Delhi but also whole of north India. Air pollution has significant economic, environmental, health costs which will have severe repercussions on developmental goals of India in coming years. This necessitate appropriate long-term strategic plan to tackle air pollution.

Appraisal of air pollution in India

- **India ranks 178 out of 180 countries in Environmental Performance Index, 2018** in terms of air quality.
- India's annual average level PM 2.5, was 90 µg/m³ is the fourth highest in the world. This is **more than twice the limit** of 40 µg/m³ recommended by the National Ambient Air Quality Standards in India and **nine times the World Health Organization annual limit** of 10 µg/m³.
- India accounts for **26% premature deaths** and disease burden due to air pollution.
- According to WHO the **three of the world's largest nitrogen oxide air pollution emission hotspots are in India**. Delhi-NCR, Sonbhadra in Uttar Pradesh, Singrauli in Madhya Pradesh and Talcher-Angul in Odisha.
- Recently, a **'public health emergency'** was declared in Delhi on the afternoon of November 1, 2019, after air quality plunged to **'severe plus'** levels since the night of October 31 as **AQI crossed 500 in many locations**.
- In Delhi, **pollution levels are 40% to 80% higher in the winter months** compared to the rest of the year.

How air quality is measured?

- **National Air Quality Index (AQI)** has been launched for monitoring the quality of air in major urban centres across the country on a real-time basis and enhancing public awareness for taking mitigative action.
- Air Quality Index transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour.
- AQI measures **eight pollutants (PM₁₀, PM_{2.5}, NO₂, SO₂, CO, O₃, NH₃, and Pb)**. Based on the measured ambient concentrations of each pollutant, sub-index is calculated and the worst sub-index determines the overall AQI.

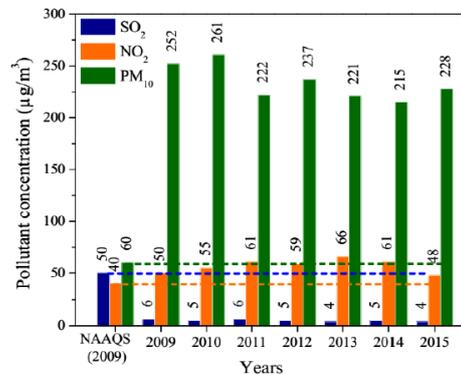
AQI Category	AQI
Good	0 - 50
Satisfactory	51 - 100
Moderately polluted	101 - 200
Poor	201 - 300
Very poor	301 - 400
Severe	401 - 500

Impact of Pollution

- **Economic Cost:** By the World Bank's calculations, health-care fees and productivity losses from pollution cost India as much as 8.5 per cent of GDP.
- **Health Cost:** Lancet Commission on Pollution and Health, attributed to air pollution an estimated 6.5 million premature deaths globally in 2017, with 1.1 million deaths in India.
- **Environmental cost:** **Global warming** (due to increased volumes of GHGs), **sea level rise** (rising at an average rate of 1.8 mm per year over the last century), **acid rain**, **depletion of the ozone layer**, **eutrophication etc.** are some of the many consequences on environment due to air pollution.
- **Political Discourse:** It creates a havoc in the city to live for. Growing dissatisfaction with the government agencies is visible in the recent **Urban Chipko Movement** being seen in the Delhi and Mumbai against the cutting of trees for various government residential and infrastructure projects.

Key sources of air pollution in Delhi

- According to study conducted by The Energy and Resources Institute (TERI) in 2018, 36% of the pollution has its source in Delhi itself, 34% in National Capital Region while 30% comes from across international borders.
- According to study by IIT Kanpur in 2015-16:
 - In summer, maximum contribution of PM 2.5 is from Soil and Road dust followed by Cool and Fly ash.
 - Whereas in winter, maximum contribution of PM 2.5 is from secondary particles followed by Biomass burning.
- **Vehicular Pollution:** TERI's study shows that vehicle pollution is the cause of 28 per cent of PM_{2.5} emissions. The total number of vehicles in Delhi increased from 4.24 million in 2004 to more than 10.8 million in March 2018.
- **Stubble burning:** Crop residue burning during winter is one of the chief causes for rising air pollution levels in Delhi. (see box)
- **Industrial pollution:** Industries contribute 30 per cent to PM_{2.5} levels, with 14 per cent from small industries.
 - **Power Plants:** India is the world's second largest coal burner after China. Burning of coal releases many harmful pollutants like Sulphur.
 - The **north-westerly winds** that come into Delhi transport Sulphur dioxide (SO₂) emitted from large power plants and refineries that are situated upwind of Delhi.



Air quality trends in Delhi (2009 – 2015) based on manual air quality monitoring stations

Stubble burning: Analysis

- **Problem:** The states surrounding Delhi are known collectively as the "grain bowl" of India after the agricultural sector underwent a green revolution in the 1960s, leading to a dramatic increase in rice and wheat productivity.
 - But as production grew, the sector could not keep up with an increasing demand for labor, with farmers eventually abandoning hand harvesting in favor of less labor-intensive methods such as the combine harvester.
 - Unlike manual harvesting techniques however, combine harvesters leave behind rice stubble, which prevents machines from sowing wheat seeds.
 - With as little as 10 days between rice harvesting season and the sowing of wheat, farmers often turn to stubble burning to quickly remove the remaining rice crop residue.
 - Also adding to the problem was law passed in 2009: Punjab Preservation of Subsoil Water Act which has delayed the date for paddy transplantation from June 1 to June 20 in order to arrest rapid decline in the groundwater table.
 - ✓ But late transplanting has meant that farmers are now setting fire to their fields mostly clashing with the time just before the onset of winter, when wind movement is very slow and moisture levels in the lower atmosphere are also high.
 - The wind carries all the pollutants and dust particles, which gets locked in the air. A study estimates that crop residue burning released 149.24 million tonnes of CO₂, along with CO, oxides of sulphur, particulate matter and black carbon.
- **Policy Response:**
 - National Green Tribunal (NGT) had banned crop residue burning in the states of Rajasthan, Uttar Pradesh, Haryana and Punjab.
 - The Air Prevention and Control of Pollution Act, 1981; The Environment Protection Act, 1986; The National Tribunal Act, 1995; and The National Environment Appellate Authority Act, 1997 have provisions pertaining to crop residue burning.
 - Ministry of Agriculture of India recently developed a National Policy for Management of Crop Residue (NPMCR), 2014 to ensure prevention of burning of crop residues, by incentivizing purchase of modern machineries to minimize left-over crop residue in the field, in situ conservation and mixing of residue in soil to increase soil fertility, multiple uses of crop residue, formulation of fodder pellets and briquettes.
 - Central Sector Scheme on 'Promotion of Agricultural Mechanization for In-Situ Management of Crop Residue in the States of Punjab, Haryana, Uttar Pradesh and NCT of Delhi' for the period from 2018-19 to 2019-20 has been launched to address air pollution and to subsidize machinery required for in-situ management of crop residue.

- States like Rajasthan, Punjab and Haryana **imposed fines** between Rs. 2500 to Rs. 15,000 on farmers indulging in crop-burning.
- Following the **Supreme Court guideline to incentivise farmers for stopping** the burning of paddy crop stubble to check air pollution, the governments of Punjab and Haryana have announced a **bonus of Rs 2,500 an acre for small and marginal farmers** who are yet to start such activity.

However, farmers continue to **burn because of lack of alternatives**:

- Expensive labour and less times mean manual extraction is not possible. Combine harvesters have become easier to buy, and even rent. But combine harvesters leave the stubble. That stubble has value as fodder, more for wheat, less for rice. **Moreover there is no viable market for crop residue.**
- The Economic Survey 2017-18 observes: “Once the machine has harvested **the cost of getting the stubble removed is Rs 3,500 per hectare...it is more economic for the farmers to just burn by using 1 Rupee match box and clear the fields.**”

In this context some suggestions are:

- NGT suggested that states **shall provide Machines, Mechanism and Equipment or its cost to the farmers** to ensure that agricultural residue in the field in these states are removed, collected and stored at appropriate identified sites in each district.
- Using stubble in **different ways** like cattle feed, compost manure, roofing in rural areas, biomass energy, mushroom cultivation, packing materials, fuel, paper, bio-ethanol and industrial production can be incentivised.
- **MS Swaminathan suggested** that the Delhi, Haryana and UP Governments put up **Rice BioParks** where farmers can convert stubble into income and employment.
- **Happy Seeder Machine** (used for sowing of crop in standing stubble), Zero till seed drill (used for land preparations directly sowing of seeds in the previous crop stubble) are some other alternatives.
- **Monitoring fire counts and rural air quality** which will help in better policing on air pollution.
- **Promotion of short duration rice varieties and crop diversification** like pulses, millets etc. for sustainable agriculture.

The Impact of above-mentioned sources is **accentuated by following meteorological and geographical factors** making Delhi the most polluted city in the world.

- **Lack of winds in winter season:** The lack of winds that can carry away pollutants is one of the most important factors impacting air quality. Dust particles and pollutants in the air become unable to move and get locked in the air and affect weather conditions, **resulting in smog.**
- **Delay in monsoon withdrawal:** Late monsoon withdrawal is not good for air quality in north India as the time progresses towards winter. When monsoon begins to withdraw, **an anti-cyclonic circulation gets formed nearly 4-5 kms above the surface of earth.** This period is marked by **dry weather, clear skies and very low speed of surface winds.** So, whatever the particulate matter is in the air, **it does not get dispersed and gets arrested in the atmosphere.**
- **Geography of Delhi:** Delhi lies to the north-east of the Thar Desert, to the north-west of the central plains and to the south-west of the Himalayas. As winds arrive from the coasts, bringing with them pollutants picked up along the way, they get ‘trapped’ right before the Himalayas.
- **Dust storms: Destruction of the Aravallis** that protects north India from dust storms has increased impact. Delhi-NCR comes under a thick blanket of dust primarily due to dust storms from Rajasthan which is facing extremely dry weather conditions, with high temperatures and wind speeds.
 - According to a study in 2017 by the System of Air Quality and Weather Forecasting and Research (under the Ministry of Earth Sciences) and India Meteorological Department (IMD) “multi-day dust storm” in Iraq, Kuwait and Saudi Arabia was one of the main causes of Delhi’s smog.
- **Despite the ban on cracker sales,** firecrackers were a common sight this Diwali which also contributed to build up of air pollution.

Stubble burning: The bright picture of Haryana

- Haryana and Punjab recorded **29,780 cases of farm fires between October 1 and November 3,** this year. Of this, Haryana’s contribution was only 4,414.
- Haryana has managed to bring down its last year’s fire count by **11.7 per cent as against Punjab’s 8.7 per cent.** These figures are quite similar to NASA’s fire maps showing crop residue burning in the region.

What Haryana did right?

- Haryana government **identified villages** where farm fires were rampant last year and just as the kharif season began in June, **it started distributing machines,** like Super sms, Rotavator, Happy Seeder and Zero Till Seed Drill **that can eliminate crop residue burning. E.g 5170 machines were given to individual farmers.**

- Through **Custom Hiring Centres** which act machine banks that give expensive machines to poor farmers on rent 8,281 machines were distributed.
- Understanding crop residue burning as a **behavioural problem**, the district authorities were asked to **spread awareness** among farmers, through gram sabhas and panchayats, about the alternatives to crop residue burning and also **shaming those lighting up their farms and praising those who did not**.
- Those farmers **who used machines last year realised that the overall cost was less (due to subsidy) and the yield was high**. Now many farmers are **willing to shift** to these machines.
- **Increased sowing of Basmati rice** was another reason for fewer crop residue burning cases this year. The **straws of this rice can be used as fodder**, and are, therefore, not burnt down.

Steps taken to curb Air Pollution

Action	Features
Environmental Pollution (Prevention and Control) Authority enforce Graded Response Action Plan (GRAP)	<ul style="list-style-type: none"> • For Delhi and the NCR region, which comprises the graded measures for each source framed according to the Air Quality Index categories. <ul style="list-style-type: none"> ○ Like During 'very poor' air quality, it recommends banning diesel generators and parking fee increased by three to four times. • Similar to EPCA's GRAP the NGT divided air pollution into four categories, for graded measures, which include odd-even scheme among others
Vehicular pollution	<ul style="list-style-type: none"> • Delhi government came up with GREEN Budget in 2018, which combines 26 programs and schemes of Transport, Power, Environment and PWD (Public Works Department) for devising a unified system of pollution control, bringing down levels of different pollutants. • Shift to compressed natural gas for commercial vehicles. • Ministry of Environment's orders issued in 2015 under the Air (Prevention and Control of Pollution) Act, 1981 to comprehensively green Delhi's road margins and open spaces. • Advancing Bharat Stage-VI norms to April 2018 from April 2020. Delhi became first city running on BS VI fuels.
National Clean Air Programme (NCAP)	<ul style="list-style-type: none"> • It is a pollution control initiative to cut the concentration of particles (PM10 & PM2.5) by 20-30% by 2024. It will have 2017 as the base year for comparison and 2019 as the first year. • It is to be implemented in 102 non-attainment cities. These cities are chosen on the basis of Ambient Air Quality India (2011-2015) and WHO report 2014/2018. • A non-attainment city is considered to have air quality worse than the National Ambient Air Quality Standards. • Various steps include: <ul style="list-style-type: none"> ○ PM 2.5 monitoring infrastructure to be expanded. ○ Number of manual monitoring stations to be increased from 684 to 1000 stations across the country ○ Tackling pollution from various sources-power plants, transport, industry, residential and agricultural sector.
Carbon Emission by Thermal Power Plants (TPPs)	<ul style="list-style-type: none"> • Ministry of Environment, Forest and Climate Change had notified environmental norms to reduce emission of PM 10, SO₂ and oxide of nitrogen.
Pradhan Mantri Ujjwala Yojana (PMUY)	<ul style="list-style-type: none"> • Subsidy to cooking fuel under this scheme to curb indoor pollution.
Focus on short-lived climate pollutants (SLCP)	<ul style="list-style-type: none"> • Like methane, HFCs, black carbon (soot), tropospheric ozone etc. SLCP mitigation has the potential to avoid up to 0.6°C of warming by mid-century while aggressive CO₂ mitigation in a comparable scenario leads to less than half as much near-term reduction in warming.
Other steps	<ul style="list-style-type: none"> • Ban on pet coke and furnace oil: Supreme Court banned the use of furnace oil and pet-coke in Haryana, Rajasthan and Uttar Pradesh. • Many other steps like Clean Air- India Initiative, Dust Mitigation Plan, India's Paris pledges etc.

Way forward

- NITI Aayog released report titled **Breathe India** giving following policy suggestions:
 - **Drive Mobility through Zero Emission Vehicles:**
 - ✓ Electrify last mile connectivity by 2022, including public transport, taxis and three-wheelers.
 - ✓ **Research and development activities should be enhanced in the areas of battery cell technologies, electric vehicle power train system integration, electric motors and power electronics.**
 - **Enact Strong Measures to Curb Vehicular Emissions:**
 - ✓ **Implement a large scale Feebate program from 2020 onwards:** A feebate is a policy by which inefficient or polluting vehicles incur a surcharge (fee) while efficient ones receive a rebate (bate). Austria, Denmark, France, the Netherlands, Norway, Ontario (Canada) and Singapore have introduced variations of feebates.
 - ✓ **Issue guidelines for vehicle ownership and usage:** Measures like congestion pricing, escalation of taxes and insurances, higher costs of parking, and implementing restrictions on certain areas and times need to be employed to reduce private vehicle usage.
 - ✓ Introduce a scrapping policy and ensure fleet modernisation.
 - **Reduce Emissions by Optimizing the Power Sector:**
 - ✓ Expedite strategic decommissioning of old and inefficient power plants.
 - ✓ Upgrade efficient thermal power plants to meet the requirements of dynamic operation.
 - ✓ Push rooftop solar and distributed generation.
 - ✓ Ensure high grade low polluting coal to the power plant.
 - **Reform Regulatory Framework for Industrial Air Pollution**
 - ✓ **Revise standards and practices:** The ambient air quality standards of Central Pollution Control Board (CPCB) as well as individual categories of industrial emissions should be considered for revision.
 - ✓ **Improve audit process:** Development of a right incentive structure for the **environmental auditors will lead to an improved auditing process.** Shift from current practice of self-audit.
 - ✓ **Incentivise law enforcement:** Improving law enforcement at the state level, for stricter law enforcement against polluting industries. Incentivising the performing states will be instrumental to speed up corrective action against air pollution.
 - **Implement a National Emissions Trading System:** Introducing a market-based instruments within a regulatory framework based on the concept of '**polluters pay principle**'.
 - **Adopt Cleaner Construction Practices:**
 - ✓ Mandate Environmental Risk Assessment for construction projects.
 - ✓ Expand the ambit of Green Building ratings to include adherence to construction process indicators that follow cleaner construction guidelines.
 - **Implement a Business Model to Utilize Crop Residue**
 - ✓ Direct procurement of crop residue by large agro-waste management companies
 - ✓ Promote inter-state trading for paddy stubble. E.g. paddy straw collected from Punjab can be procured by other States for mushroom cultivation, ethanol production and various other purposes
 - **Implement an Integrated Waste Management Policy:** Including Extended Producer Responsibility, landfill taxes and regulation, decentralised processing, waste to energy systems etc.
 - **Integrated Efforts to Tackle Forest Fires** by a comprehensive National Policy for Prevention and Control of Forest Fires.
 - **Encourage Clean Cooking Practices** like fuels such as LPG, biogas, solar energy and electricity.

Reasons for limited success of Pollution Control Actions-

- As per UN Environment, "If current policies aimed at reducing air pollution are effectively enforced, air quality will be no worse in 2030 than now, despite population growth, rapid urbanization and an ever-increasing demand for goods and services, but neither will air quality be better".
- **An efficient governance mechanism is central to the success of any anti-pollution effort.** The GRAP notified by EPCA is being implemented by at least 16 different agencies. Some are under the control of Union Government, some under the Delhi government and some are under the administrative control of neighbouring states. In general, there are no political and executive level coordination among them.
- **Delhi's air pollution is a regional problem.** No Policy is likely to work unless it takes regional considerations into account. Inter-agency efforts need to be controlled and coordinated by a central source.
- **Delhi needs to search for sources of emissions.** While sources of emissions remain same in all the studies, the contribution from different sources to Delhi's pollution varies greatly. Identification of sources is critical for appropriate policy actions.
- **Finally, Delhi lacks infrastructure:** for instance, The DPCC which has a mandate to enforce compliance with the air pollution rules in the city, suffers from a serious scientific and technical manpower shortage (operating at about 3/4th since 1990). The rising population added to woes of inadequate infrastructure.

- **Drive Public Ownership through Behavioural Change:** by targeted, national-level IEC campaign that reaches out to the various stakeholders with relevant messaging.
- **Improve Air Quality Monitoring Systems:** As monitoring movement is vital to provide comprehensive data for interventions aimed at improving air quality. It can be accomplished by using the data captured via geostationary satellites – like the Sentinel 5-P launched by European Space Agency.
- Recently, the Supreme Court asked the Centre to explore two emergency solutions: **hydrogen-based fuel for the city's transport system and setting up giant smog towers to help purify the air in a 10-km radius.**
 - **Smog tower** is a purifier which will be 40-feet tall and 20-feet wide.
 - ✓ **It sucks** 30,000 cubic meters of polluted air per hour, cleans it at the nano level — the PM_{2.5}, PM₁₀ particles — and then releases the clean air back into the city. (The tower is powered by solar energy.)
 - ✓ One such purifier will be able to provide clean air in the 3-km radius of its location, impacting about 75,000 lives. The purifier will take air from all angles, which in turn, will help generate 13,00,000 cubic meters of clean air per hour.
 - **Hydrogen fuel cell:** At the cathode, the hydrogen protons and electrons bind to the oxygen, forming water molecules. The only by-product or emission that results from the usage of hydrogen fuel is water — making the fuel 100 per cent clean.
 - ✓ Hydrogen fuel vehicles have the advantage of faster recharging - it takes a matter of minutes to refill the tank through a hydrogen dispensing station unlike hours to charge an electric vehicle (EV).
 - ✓ However, hydrogen fuel vehicles are still being **tested on quality and efficiency parameters and not used on a commercial basis on a large scale.**
 - ✓ Also, Hydrogen is **not competitive** with conventional fuels (1 kg of hydrogen is equal to roughly 3.8 liters of petrol).
 - ✓ Handling **hydrogen is considered risky and tricky.** Also given the early stage of evolution, **hydrogen fuel cell vehicles cost significantly more than even EVs.** Hydrogen cells cost can be prohibitive. For instance, the Toyota Mirai fuel cell car costs a minimum of \$60,000 (Rs 42 lakh).

The need for regional approach to combat air pollution:

- Recently, when a severe smog episode hit northern India, not just the big cities, but also **small cities recorded peaks, some even higher** than bigger cities.
- Thus, when **the entire region is covered in a blanket of smog**, small urban regions of human settlements cannot remain insular.
- This calls for a **regional action plan** based on **airshed (part of the atmosphere that behaves in a coherent way with respect to the dispersion of emissions OR a geographic boundary for air-quality standards)** approach, that spreads across multiple state jurisdictions and governance systems.
- Whereas, **traditional legal approach** remains confined within the boundaries of state, city and municipal areas.
- For instance, in order to address the **pollution crisis in Beijing**, the Chinese government has adopted the approach of **unified planning, unified monitoring and alerting, and unified standards in multiple contiguous regions.**
- In 2017, a combined work plan was adopted for Beijing, Tianjin etc. that demanded **“2 + 26” cities to decrease average PM 2.5 concentrations** and the number of heavy-pollution days by more than 15 per cent from the previous year.
- For **combined monitoring and inspection system**, Beijing Environmental Protection Inspection team is responsible for 15 provinces (autonomous regions and municipalities) contiguous to Beijing.

Best practices for air pollution

- **Success of Beijing:** In twenty years since 1998, the GDP, population and vehicles of Beijing sharply increased by 1078%, 74% and 335% respectively at the end of 2017. In the same period on-ground observation data shows that the annual average concentrations of SO₂, NO₂ and PM₁₀ **decreased by 93.3%, 37.8% and 55.3% respectively.**
 - Beijing introduced **comprehensive air pollution control programs in phases since 1998.**
 - local **environmental economic policies**, including subsidies for environment friendly technologies, electric vehicles, subsidies for phasing out old vehicles, buying new clean vehicles etc.
 - To tackle **coal-fired power plants**, Beijing has implemented a “coal-to-gas” policy since 2005 and reduced coal combustion by nearly 11 million tons by 2017.
 - To tackle vehicular pollution the integrated **“Vehicle-Fuel-Road”** framework was developed.
 - **Coordination** with surrounding areas.
- **Emission control device:** Delhi-based Chakr Innovation curbs air pollution with the world's first retro-fit emission control device for diesel generators. It **captures ~90% of particulate matter emissions** from the exhaust air without reducing energy efficiency. The diesel soot captured from the exhaust is converted into inks and paints.
- **CleanTech for Health and Clean Air:** Cellzyme Biotech from Coimbatore uses an engineered enzyme to make antibiotics at room temperature without using solvents – a main contributor to air quality. The novel production process reduces the environmental footprint by replacing harsh industrial chemicals and conserving energy.

Summary

- North India is reeling under a **wave of severe air pollution accompanied with smog as many cities** records an air quality index (AQI) of 400 and above, falling in the severe category.
 - **India ranks 178 out of 180 countries in Environmental Performance Index, 2018** in terms of air quality.
- Recently, a **'public health emergency'** was declared in Delhi on the afternoon of November 1, 2019, after air quality plunged to **'severe plus'** levels since the night of October 31 as **AQI crossed 500 in many locations**.
- Air pollution has **significant economic, environmental, health costs** which will have severe repercussions on developmental goals of India in coming years.
- **Key sources of air pollution are** Vehicular Pollution, Stubble burning, industrial pollution, construction activities etc. and contribution of these sources in air pollution of Delhi also **differs according to season**.
- The impact of above-mentioned sources is accentuated by **other meteorological and geographical factors** like lack of winds in winter season, delay in monsoon withdrawal, geography of Delhi, dust storms etc. making Delhi the most polluted city in the world
- Both Centre and state government had taken various steps to curb air pollution such as:
 - **Environmental Pollution (Prevention and Control) Authority enforce Graded Response Action Plan (GRAP),**
 - **Shift to compressed natural gas,**
 - **National Clean Air Programme (NCAP),**
 - **Restiction on Carbon Emission by Thermal Power Plants (TPPs),**
 - **Focus on short-lived climate pollutants (SLCP) etc.**
- Also, there many other suggestions for curbing the air pollution like: **NITI Aayog released report titled Breathe India giving following policy suggestions on**
 - Drive Mobility through Zero Emission Vehicles
 - Enact Strong Measures to Curb Vehicular Emissions
 - Reduce Emissions by Optimizing the Power Sector
 - Implement a National Emissions Trading System
 - Adopt Cleaner Construction Practices etc.

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