



Editorial

Air Pollution & Climate Change

Earlier this month, India made a commitment to achieve Net-Zero Greenhouse Gas (GHG) emissions by 2070. At about the same time Air pollution in North India, particularly New Delhi reached an unprecedented dangerous level and the PM 2.5 level exceeded 999, exposing the public to very serious health hazards. It raises a very important question: should India, with its limited resources, focus on measures to prevent Climate Change to safeguard the interests of future generations of the world's citizens or give priority to reducing Air Pollution to protect the health and wellbeing of its current citizens.

At the Cops-26 summit in Glasgow Prime Minister Shri Modi committed India to the goal of becoming "Net Zero "by 2070. He recited "Om Sarve Bhavantu Sukhina- the Divine mantra of Peace for All "and proposed a Global Movement "LifeStyle for Environment ". His speech was exciting, visionary, and farsighted.

But in contrast, living in Delhi, it was hard to be far-sighted. In fact, visibility was severely limited due to heavy, noxious, winter smog particularly on the day after Diwali. This was caused by heavy Air Pollution accentuated by Farm Fires and Diwali crackers. The PM2.5 reading was at a maximum of 999 on measuring instruments that have a 3 digit display. This means that the actual level could be 1100 or more. Some actions were taken by the government but not enough to result in significant improvement. In comparison, the same day Beijing had PM2.5 of 188, but the government there declared an environmental emergency closing all schools, offices, and limiting vehicular traffic.

The Supreme Court of India also has taken an active interest in Air Pollution issues, pushing the government to take action, but with limited success. The court's actions included ordering two giant air cleaning towers in New Delhi, which many experts believe are useless in addressing the basic problem of Air Pollution.

Air Pollution has also resulted in deep inequality, the rich and powerful live in homes full of air purifiers, travel in cars fitted with air purifiers, and work in offices with Air Purifiers. These Air



Purifiers run on electric power, which is mostly from coal-based plants which cause Air pollution as well as emit GHG resulting in Climate Change. While the poor citizens are breathing highly polluted air of PM 2.5 of 999 or more the rich and powerful live in a bubble of clean air.

It is worth remembering Mahatma Gandhi's advice "The Earth has enough resources for our needs but not for our greed". It was the basic premise of Prime Minister Modi's advice at the Glasgow summit, that all of us in the world, particularly in India.

Co-Benefits:

One fundamental question relevant to India remains - how do we reconcile our Climate Change commitment to the World of Net Zero- 2070 with the urgent need to protect our citizens' health from devastating Air Pollution in our cities.

Fortunately, there is no contradiction: most of the actions of Decarbonization, necessary to reduce air pollution, also result in reducing GHG, called Co-Benefits in economics parlance. For example, increasing renewable power and reducing coal-based power plants will reduce Air Pollution and also reduce CO2 emissions. Similarly, a number of other actions result in similar co-benefits such as a) Increasing Electric Vehicles, 2-wheelers, 3-wheelers, cars, small Commercial Vehicles, and buses, b) reducing industrial emissions, c) increasing energy efficiency (GDP per unit of energy consumed), d) using induction heaters for home cooking instead of coal, wood or gas, e) reducing coal, petrol and diesel consumption, f) tree plantation and increasing forest cover, g) crop rotation to reduce paddy cultivation (and stubble burning) in north India, h) ban on Diwali crackers, i) emission reduction from diesel power generators, j) promoting public transportation, k) making cities more pedestrian and cyclist-friendly, etc. But the most important action for reducing air pollution and Greenhouse Gas emissions is "Carbon Tax" which is necessary for meeting our Net Zero-2070 commitment.

Goals:

As the first step, we need to establish Goals for Air Quality improvement at the National, State, and City levels. At the National level, we should set a goal of reaching an average annual PM2.5 level of 5 Microgram per cubic meter, (the new WHO standards) by 2040 from the current level of around 90. There should be interim Goals at the national level for 2025, 2030, and 2035. Similarly, each state and City should set up their interim goals (based on their present level of Air Pollution) to finally meet the National Goal of average annual PM2.5 of WHO standard of 5 micrograms per cubic meter by 2040. The progress on achieving these goals at City, state, and national levels, should be monitored, independently audited, and widely reported.



Leadership:

To succeed in this mission of Air Quality Improvement and Climate Change we need to have leadership by a National Leader of very high stature, commitment to this cause, and proven competence to lead and coordinate these efforts among various ministries at the central government, with state and city governments. A "John Kerry" for India should be appointed for a 10-year term and given enough power and authority to succeed in this mission. Fortunately, we have had an excellent experience of having such Leaders succeed in issues of national importance such as Mr. Sreedharan, and Mr. Nandan Nilankani.

The Leader will need to have the support of the Prime Minister, Cabinet Ministers, State Chief Ministers, and City Administrations to effectively execute this very challenging mission.

Funding:

The Central Government, State Governments, and City Governments will need to allocate funds required for various actions required to meet the Goals. Some of these could be self-funded: for example, a tax on petrol and diesel and on IC engine vehicles could fund the support required for EVs including for charging stations, battery swapping stations, etc. Similarly, a tax on coal-based power plants could subsidize renewable energy. A

Carbon Tax will result in improving energy efficiency across industries and businesses.



Way Forward

In summary, concerted actions of setting Goals, having strong Leadership, and providing adequate funding need to be taken to improve Air Quality. Fortunately, most of these actions will have the Co-benefit of mitigating Climate Change.

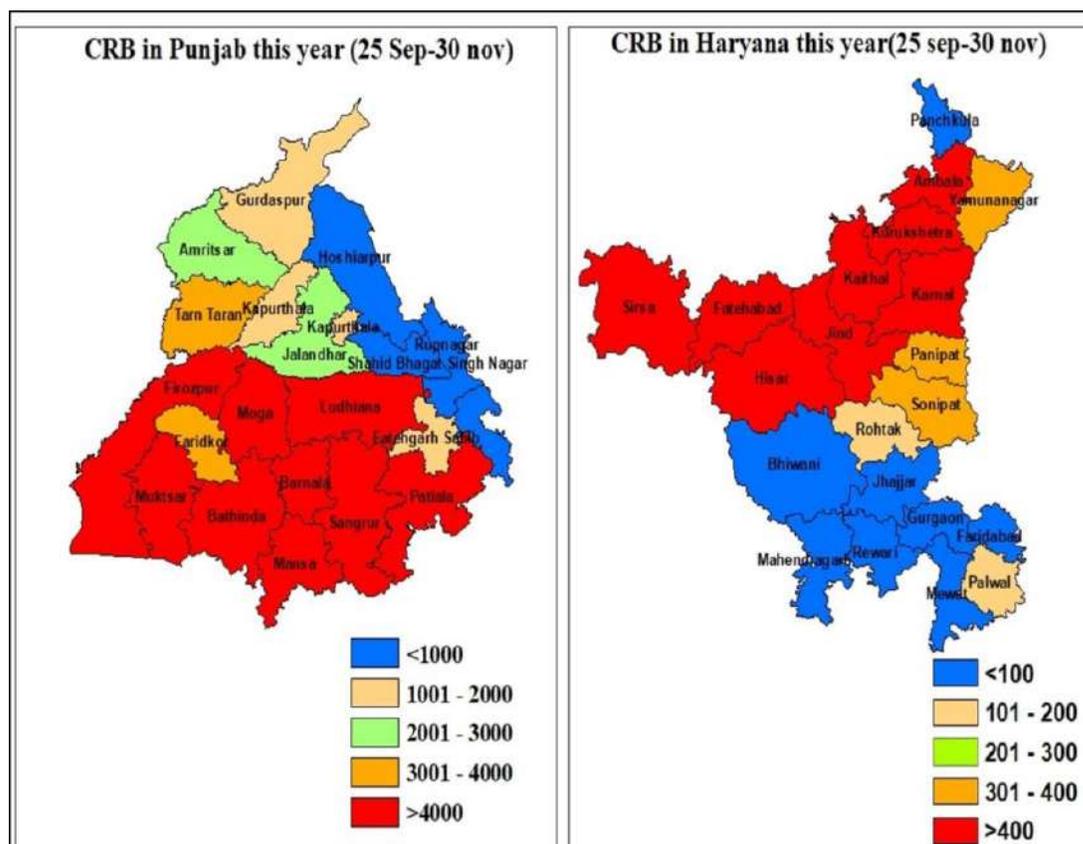


Arun Duggal

Founder of Arun Duggal Centre of Excellence for Research in Climate Change and Air Pollution (CERCA)

** An earlier version of this article was published in the Business Standard on Nov 25, 2021*

Stubble Burning Pattern



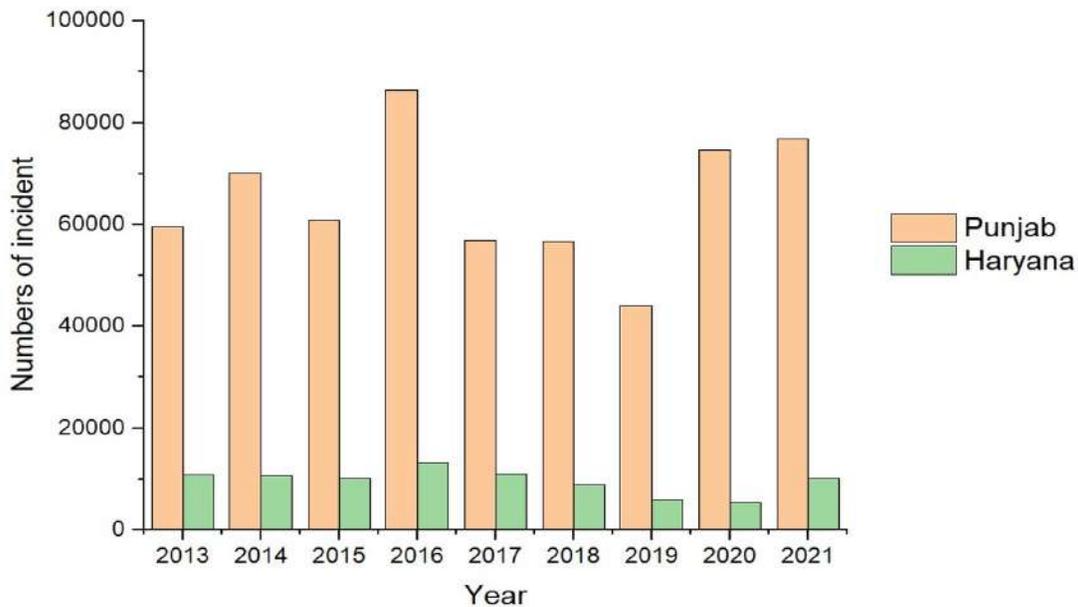
Every winter, stubble-burning metamorphoses into a crisis as the air in Delhi including NCR turns into a smoke chamber. Crop Residue Burning (CRB) over northern India is a major air quality and human health issue. This concern has resurfaced again as farmers have resumed the crop residue burning. The figure above shows the status of CRB in Punjab and Haryana. This analysis has been performed for this year season (25th September – 30th November 2021) for the data from the VIIRS-SNPP satellite

A total number of 76847 incidents of CRB have been reported so far in Punjab this year 2021. In the year 2020, for the same period, the number of incidents was 74664 as against 44040. in 2019. Additionally, Haryana recorded 10082 incidents, so far this year 2021. In the year 2020, the reported fire incidents

were 5450 as compared to the same period last year 5953 in 2019.

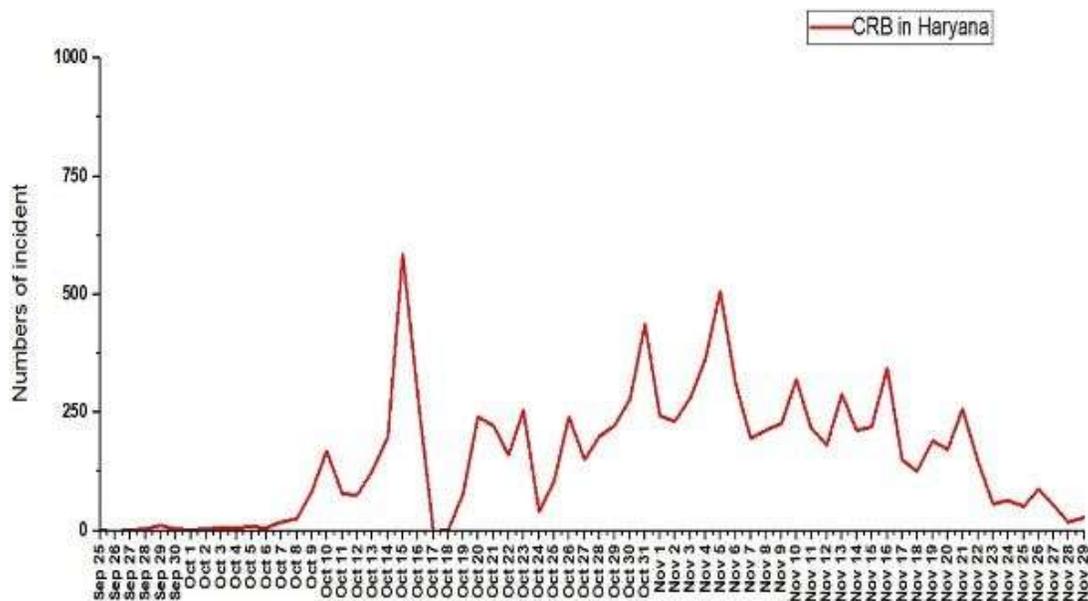
As shown in the figure above, the major hotspots in Punjab reporting a maximum number of incidents recorded in this year are – Firozpur, Sangrur, Bhatinda, Moga, Muktsar, Ludhiana, Patiala, Mansa, Barnala, Tarn taran. Similarly, the major hotspots in Haryana are Fatehabad, Jind, Kaithal, Karnal, Sirsa, Kurukshetra, Ambala, Hisar, Panipat, Sonipat

Analysis of CRB from 2013-2021



A year-by-year analysis of the number of fire counts in Punjab and Haryana from 2013-2021 indicates the current season's fires are the highest in the last five years. There has been a significant number of fire counts recorded for 2021 that have made the air pollution concerns resurface in northern India and are still a matter of grave concern. This year, almost half of the districts in Punjab and Haryana have witnessed fire counts higher than those in 2020. The data also reveals a sharp increase in burning in Haryana as compared with the 2020 season.

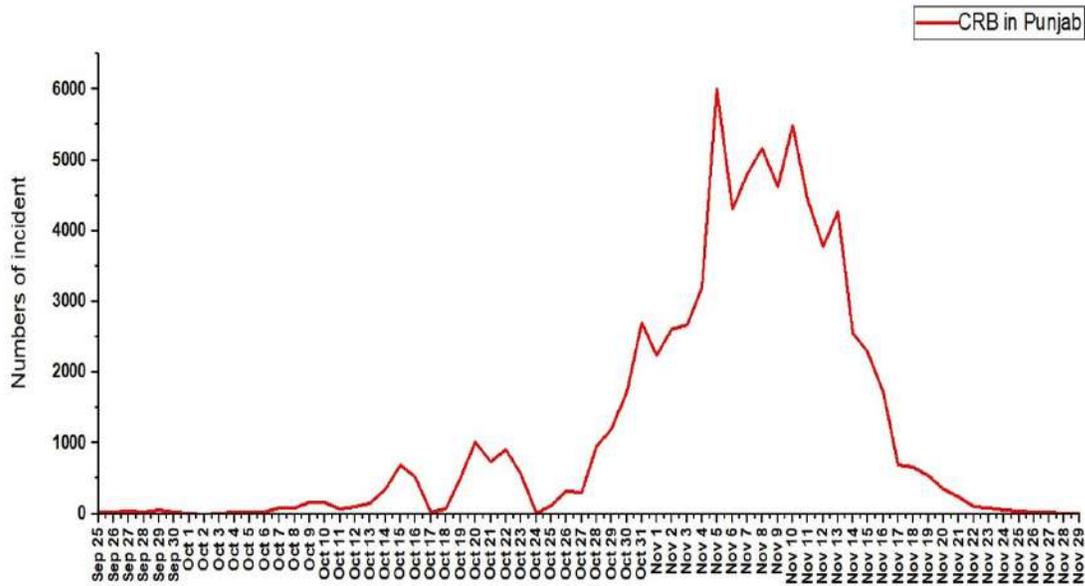
The trend in Haryana for this year (25th September – 30th November 2021)



The graphs here show the trend of cumulative fire counts in the states of Haryana and Punjab, recorded since 25th September 2021. The increase in fire count is quite evident in the month of November. Both the states have reported a five-year high in farm fires this year. The fire count almost peaked in the first week

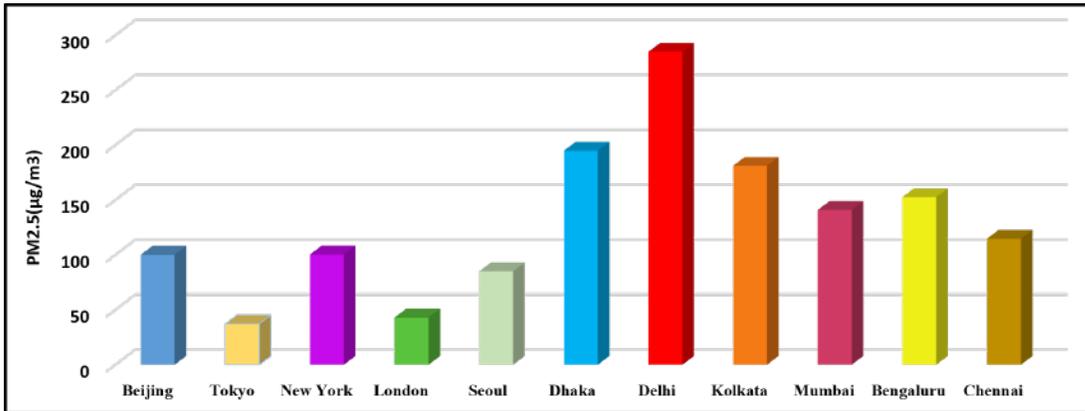
of November for Haryana and between 5th-12th November 2021 for the state of Punjab. Overall, the stubble burning season has come to an end with the cumulative "fire counts" in Punjab and Haryana recorded by NASA satellites (VIIRS 375m) from 25 September to 30 November 2021 being the highest in five years.

The trend in Punjab for this year (25th September – 30th November 2021)



Indian & International Cities- November 2021

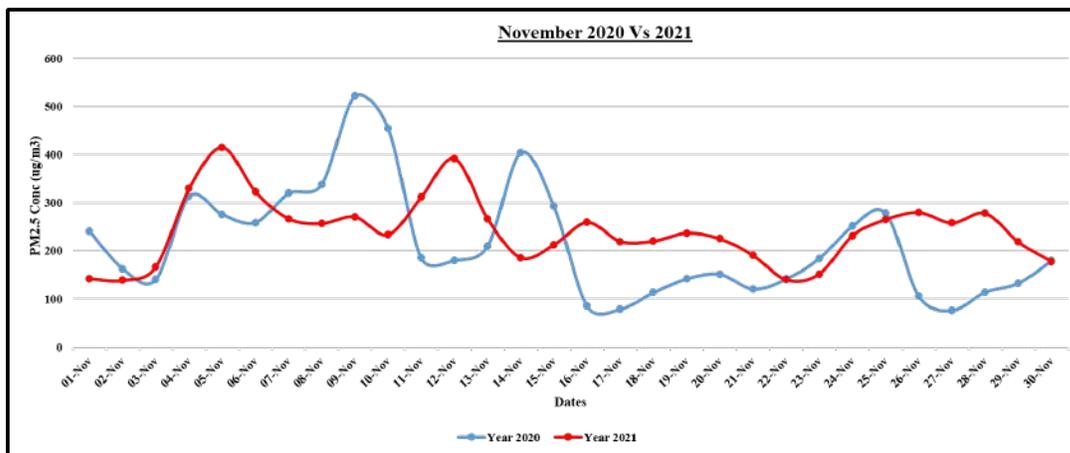
Delhi is found to be the highly Polluted city



Data Source: aqicn.org

The graph above shows the daily average PM_{2.5} for the month of November 2021. Amongst the popular cities worldwide, Delhi has shown the highest concentration of PM_{2.5} followed by Dhaka and Kolkata. Delhi and Kolkata within India rank amongst the topmost polluted cities worldwide while the other Indian cities in the graph are amongst the top 10 metropolitan cities.

Delhi PM_{2.5} (24 hr. daily average) Trend
November 2020 Vs November 2021



Data Source: CPCB

As compared to the last few years, the major reason why November saw poorer air quality this year, is attributed to the extreme pollution events – Diwali that witnessed the rampant cracker bursting as well as a sharp increase in the farm fires as stubble burning deferred this year due to prolonged rains. In addition to these, the adverse meteorological conditions trapped the local pollutants. A long-running decline in COVID-19 cases resulted in an increase in social gatherings and anthropogenic activities whose impact is visible on the Delhi Air Quality, which can be clearly correlated and observed in the graph. Hence, PM2.5 has increased by 26.93 µg/m³ on an average in November 2021 as compared to November 2020.



From Air pollution to Climate change, CERCA virtual **Expert Monthly Talk series** spotlights a range of contemporary issues while providing a platform for renowned speakers from around the world to share their knowledge and views.

UPCOMING EVENT

CERCA IIT DELHI EXPERT TALK SERIES

A Breath Of Fresh Air

Prof. Jay Dhariwal
Assistant Professor
Department of Design, IIT Delhi
Alumnus of IIT Guwahati, Purdue University, USA and IIT Bombay

30th December, 2021
4:00 PM, IST

Scan to Register

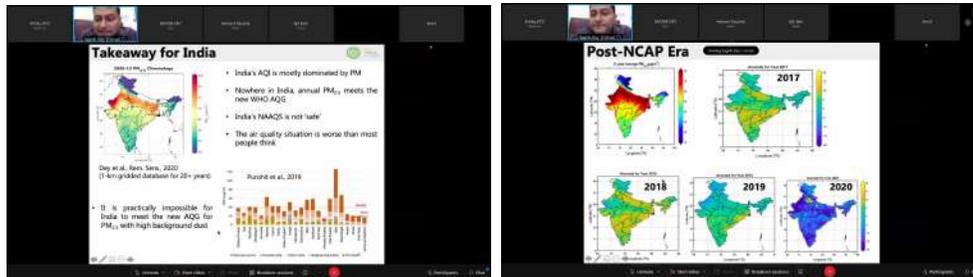
Hosted by:- Arun Duggal Centre of Excellence for Research in Climate Change and Air Pollution, IIT Delhi

To register for this Talk Series, [Click here](#)



Expert Talk delivered by [Professor Sagnik Dey](#) on 22 November 2021

Prof. Sagnik Dey delivered a talk on “Decoding the new WHO Air Quality guidelines for India” on November 26th, 2021. As the annual AQG levels for particulate matter smaller than 2.5 (PM_{2.5}) and 10 (PM₁₀) μm are lowered to 5 and 15 $\mu\text{g}/\text{m}^3$ from the existing levels of 10 and 25 $\mu\text{g}/\text{m}^3$, respectively, in the light of this recent update, he discussed the chronology of AQG (Air Quality Guidelines) in addition to the adoption rate of PM_{2.5} standards worldwide. He also discussed the procedure followed for framing these guidelines and how each group plays its respective roles. He highlighted the importance of short term AQG and suggested how India can step forward in this journey of battling air pollution by investing in developing India-specific evidence to define our NAAQS and interim targets (and AQI levels)



If you have missed this event, the link below will direct you to the recorded video.

[Watch the complete Expert Talk Series Here.!](#)

MoU Signed with IIT Delhi- Business Sweden-The Swedish Trade and Invest Council

India Institute of Technology Delhi and Business Sweden-The Swedish Trade and Invest Council signed a memorandum of understanding (MoU) on Friday, 26th November 2021, to strengthen collaboration in the field of Clean Air and Green Energy. The MoU was signed by V Ramgopal Rao, Director, IIT Delhi, and Cecilia Oskarsson, Trade and Invest Commissioner of Sweden to India. The MoU aims to identify mutual collaboration opportunities with IIT Delhi including joint R&D projects in the domain of clean air, energy, environment, and urban development, etc. Additionally, it focused on proposing academic exchange programs, cooperation with innovative solutions providers from Sweden, and considering the continuity of India Sweden Innovations Accelerator Programme and Sustainability by Sweden Showroom and Platform in India. All the collaboration with Business Sweden would be done through the Arun Duggal Centre of Excellence for Research in Climate Change and Air Pollution (CERCA).



Visit of ITC Chairman in Arun Duggal Centre of Excellence for Research in Climate Change and Air Pollution (CERCA)

Sanjiv Puri (59), the Chairman & Managing Director of ITC Limited visited the Arun Duggal Centre of Excellence for Research in Climate Change and Air Pollution (CERCA) office on 20th November 2021. He was apprised of all the research work(s), currently undergoing in CERCA to curb the growing issue of air pollution faced by India and how CERCA is actively involved in promoting scientific research in this domain of clean air, climate change, and air pollution. The team interacted and discussed various research projects of CERCA that have focused on clean air and emphasized providing sustainable solutions for pollution mitigation in India.



CERCA Expert Opinion and Research Outcomes

Source apportionment of black carbon over Delhi: A case study of extreme biomass burning events and Diwali festival

Vikas Goel, Naba Hazarika, Mayank Kumar, Vikram Singh

- This study investigated the temporal and diurnal variations of Black Carbon (BC) and quantifies the contribution of fossil fuel (BC_{ff}) combustion and biomass burning (BC_{bb}) to the BC concentrations in Delhi using the Aethalometer model.
- The highest BC_{bb} contribution, amounting to 52.04%, was found in the month of November (stubble burning season). The effect of Diwali firecrackers on BC concentrations was also investigated which was transient, lasting for a few hours only.
- The results revealed that the biomass burning activities in Punjab and Haryana contribute significantly to Delhi's post-monsoon air pollution suggesting an urgency to implement the carbonaceous aerosols emission abatement strategies over northern India.

[Read More](#)

Air pollution in three megacities of India during the Diwali festival amidst COVID-19 pandemic

Jayatra Mandal, Abhra Chanda, Sourav Samanta

- This study characterized the difference in air pollution levels between Diwali celebrations amidst the Covid-19 pandemic (14 November 2020) and the previous year (27 October 2019).
- The concentration of seven principal air pollutants, namely $PM_{2.5}$, PM_{10} , NO_2 , NH_3 , SO_2 , CO , and O_3 , was substantially higher in 2020 Diwali than in 2019 Diwali.
- $PM_{2.5}$, PM_{10} , and CO were always above the permissible limits in all three megacities, with the highest concentrations observed in Delhi.
- The firework-induced air pollutant load in Delhi was enhanced by a higher margin in the pandemic year. The difference in meteorological conditions between the two consecutive year's Diwali might have led to the enhanced pollutant load in 2020, especially in Delhi.
- This study implies the need for stringent law enforcement to ameliorate the pollution levels due to such celebrations.

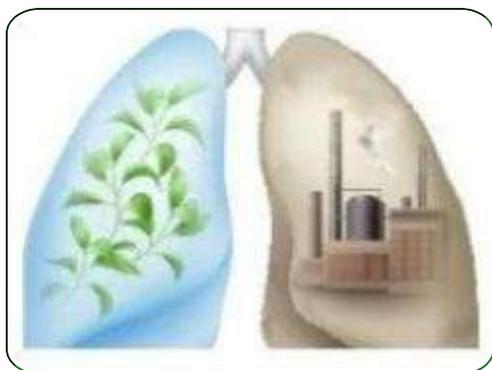
[Read More](#)

Air pollution interacts with genetic risk to influence cortical networks implicated in depression

Zhi Li, Hao Yan, Xiao Zhang, Shefali Shah, Guang Yang, Qiang Chen, Shizhong Han, Dai Zhang, Daniel R. Weinberger, Weihua Yue, and Hao Yang Tan

- This study examines across multiple levels of brain network function the extent to which particulate matter (PM_{2.5}) exposure influences putative genetic risk mechanisms associated with depression.
- The neural bases of air pollution exposure and impaired cognition associations have been unclear.
- Working memory and stress-related information transfer (effective connectivity) across cortical and subcortical brain networks were influenced by PM_{2.5} exposures to differing extents depending on the polygenic risk for depression in gene-by-environment interactions.
- Effective connectivity patterns from individuals with higher polygenic risk for depression and higher exposures with PM_{2.5}, but not from those with lower genetic risk or lower exposures, correlated spatially with the expression of depression-associated genes across corresponding brain regions in the Allen Brain Atlas. These converging data suggest that PM_{2.5} exposure affects brain network functions implicated in the genetic mechanisms of depression.

[Read More](#)



Jharkhand, first eastern state to use lung billboard displays

Jharkhand will be the first state in the eastern region to use lung billboard displays in creating awareness about air pollution and its effect on health. Ranchi, Dhanbad, and Jamshedpur will have such billboards installed by the Centre for Environment and Energy Development (CEED) in association with respective civic bodies through State Urban Development Authority (SUDA) and Jharkhand State Pollution Control Board (JSPCB). Such systems are already in several southern states and in Maharashtra and Uttar Pradesh. It would have a giant pair of artificial lungs fitted with filters and fans to mimic the human lungs. The installation changes color with each day displaying air pollution levels impact on the lungs. It would also have an air quality index (AQI) monitor giving real-time AQI on the pollution level. After the lungs' color gets dark, the artificial lungs would be replaced.

[Read More](#)



Covid lockdown in India didn't cut air pollution as much as a thought, finds study

The study, published in the journal *Environmental Science: Processes & Impacts* found that air quality in India did not improve as much during the first COVID-19 lockdown as originally thought, also the ozone levels increased even as other pollutants decreased. The study focused on nitrogen oxides (NO_x), fine particulate matter (PM_{2.5}), and O₃, as well as meteorological factors within two cities in India - Delhi, and Hyderabad - during the start of the first lockdown, from March 24 to April 24, 2020. The study highlights the impact of emissions, meteorology, and chemistry on air pollution and that all three should be considered when assessing the effects of any short-term intervention on air pollutants. The team also found that ozone production in Delhi is likely influenced by volatile organic compounds (VOC) and attempts to mitigate it should focus on dominant VOC sources.

[Read More](#)

[Read More](#)



Global warming to hit India the worst in Asia by 2070

The Earth is currently warming at the rate of 1.1°C. Even in the best-case scenario with emission cuts, the Earth will warm at 1.5°C in the next 20 years. This warming scenario, according to the researchers of the study, will lead to people experiencing an average annual temperature of at least 29°C across 19 percent of the Earth's surface by 2070. Global warming could trigger the next wave of migration — and at least 3 billion people would be affected by it by 2070. India would be among the worst-hit in Asia, with over half of the 1.6 billion people (projected population by 2070) exposed to extreme heat. Other countries like the United Arab Emirates, Cambodia, and parts of South Vietnam and eastern Pakistan will become unlivable, according to the projections. The study was published in Proceedings of the National Academy of Sciences of the United States of America in 2020.

[Read More](#)



Air pollution is particularly harmful to kids, say WHO, UNICEF

According to the two organizations, World Health Organization (WHO) and UNICEF, pollutants attack kids the most as their bodies are yet to fully develop. According to WHO, the lungs of a child, who is living in a region where air pollution is quite severe, may not function properly by the time he attains adulthood. Due to weak lungs, such children, when they grow up, are likely to develop asthma. A 2018 report of the global health body said that around 93 percent of children, who are under the age of 15, breathe toxic air.

UNICEF, citing one of its recent reports, has said that kids take in polluted particles two to three times more than those taken in by adults. India, with a rank of 168, fared worse than its neighbors, according to the 12th biennial Environmental Performance Index (EPI).

[Read More](#)

Subscribe Now for the CERCA Monthly Newsletter

CONTACT US

Email: cerca@iitd.ac.in, cerca.iitd@gmail.com

Phone (Office): +91 (11) 2659 7361

Address: MS 207/ C 20, Indian Institute of Technology (IIT) Delhi, Hauz Khas, New Delhi 110016, INDIA

