



Centre of Excellence for Research on Clean Air

Q1 Report 2020, (January - March)

CERCA Research Projects Updates

Monitoring Air Pollution impacting Delhi NCR using a Hybrid Approach

PI: Prof. Sagnik Dey



Started with the second objective of project i.e. Identifying the changes in open burning pattern, pollution at large point sources (Thermal Power plants (TPPs) and Brick Kilns)

Cluster analysis of the brick kilns and meteorological analysis will be done using same methodology as used for stubble burning analysis. We are also considering brick kilns outside India to understand the trans-boundary transport of pollution. The Density based spatial clustering of Applications with noise (DBSCAN) technique was used for clustering of power plants and Brick Kilns.

Considered the Power plants situated in 300 Km radius of Delhi. Done initial analysis for 70 Km radius and found that 3 Power plants in Delhi namely Rajiv Gandhi PP, Indira Gandhi PP, contribute 15% of total contribution of pollution by TPPs.

Planning to Synchronize with Prof. Vimlesh Pant for further use of data for forecasting.

Formulated methodology for Top down estimates of emission from TPPs, Estimated Annual scale emission rate, Correlation between Traditional bottom up approach with Top down approach

Identified the 24 clusters of 267 no. of Brick Kilns located in Indo Gangetic Plains, Identified the maximum polluting cluster using the preliminary results of air mass trajectory from BK clusters which is relevant to Delhi's Air pollution, Repeated the same analysis for NO₂ and SO₂ analysis..

Assessment and prediction of the air-quality using dynamically downscaled high resolution data from numerical models

PI: Prof. Vimlesh Pant



Atmospheric model WRF-Chem used for assessing the impact of power plants on the air quality in Delhi-NCR. The numerical simulations just started with all the emissions allowed in the model in one experiment and cutting down (masking) the emissions from a particular power plant in another experiment. In the first trial, the emissions of Badarpur power plant were masked in the model and simulated concentrations are being analysed in comparison with the concentrations when all the power plants were emitting in the model runs. The sensitivity experiment will be conducted for other power plants in Delhi-NCR. An inter-comparison of results for these experiments with and without power plant emissions in the model will be carried out to understand the exclusive contribution from each of the power plant.

Pilot deployment of Particular Matter (PM) sensors in Delhi buses

PI: Prof. RijuRekha Sen



Use vehicle fleets that travel across the city and instrument them with sensors. This will scale up the spatial coverage of the sensors. Delhi Integrated Multi-Modal Transit System (DIMTS) has kindly agreed to help us with their bus fleet Encouraging conversations are also happening with Ola cabs. In addition to measuring Particulate Matter (PM), the vehicle mounted instruments should have other sensors, computation and communication facilities-- so that policy questions become more tractable. Proposed instrument should have - PM sensor (low cost, but accurately calibrated against more expensive E-BAM sensors). Work done so far; Design and build the necessary instrument, as off-the-shelf instruments from Atmos and Airveda had some shortcomings and test runs in our own car, taking power from the car, installations will be resumes after Lockdown period.

Developed a prototype of health monitor which can observe the effects of air pollution by measuring sound.

Public Awareness generation on Indoor Air Quality for Priority Buildings in Delhi, NCR

PI: CERCA in partnership with SIE



Main aim of this project is to generate mass awareness on indoor air quality in public places (schools, colleges, hospitals, shopping malls, metro and residential complexes) of Delhi NCR for in urban India.

A base line survey of indoor air quality was carried out for various buildings in Delhi NCR such as schools, colleges, hospitals, restaurants, cinema halls, offices to find out the level of indoor air pollution in these premises in partnership with Society of Indoor air (SIE). A detailed report on the findings has been submitted by SIE. Further, It is also planned to develop indoor air quality guidelines in partnership with SIE and an event is being planned to release the findings of the survey around October, 2020

Select Study of Air Pollution Reduction Programs around the World: Governance and Implementation Issues

PI: Prof. Nomesh Bolia



Prepared a framework for CERCA Clean-air City Ranking (C3R) award by following methodology: Among 122 non-attainment cities with their action plans will be considered only. Institute a jury comprising of CERCA representatives and external representatives. For each of i) action plan, and ii) progress on action plans, Jury gives an overall score out of 100. For this, the Jury finalizes a score out of 100 on each of the 3 main heads proposed in NCAP: 1) Air Pollution Mitigation Actions, 2) Knowledge and Database Augmentation, and 3) Institutional Strengthening. Each of these 3 heads have further subheadings which can be used as a guideline while coming up with the score for each head. The final score of a city on the action plan as well as progress on the action plan is the sum of the three corresponding scores divided by 3 (to make it out of 100). For the final output, each city's AQI will be normalized on a scale of 0 to 100. The overall clean air score of a city is the weighted sum (60, 30, 10 for plan, progress and output respectively) of the respective scores determined in step 4 above. Announce the rankings and awards at a prestigious ceremony organized in Delhi. Downloaded the cities clean air plans, developed an evaluation methodology and a Toolkit for evaluation, award ceremony program, and prepared invitation letter for juries, guests.

A working paper is being prepared on "Governance and Policy Framework for Air Pollution Control Strategies", and key recommendations are: strengthen existing clean air legislations, encourage public awareness and active participation, good governance, and integration of clean air objectives into economic goals. Designed and circulated a "Research survey on effective framework of Clean Air Governance" to experts including India, China, Japan, South Korea and USA. Also, studied and prepared a summary of recently released "Draft Battery Waste Management Rules 2020" issued by MoEF & CC. Now Li-ion batteries are included in the draft policy.

- o Initiated research on reverse logistics of used EV
- Final Report with findings of best practices by June 2020

Study of E-rickshaw Operations & Development of Charging and Parking Infrastructure for E-rickshaws

PI: Prof. Nezamuddin



Finalization of the project objectives:

- i) Analysing the supply characteristics of e-rickshaw network, ii) Analysing the operational characteristics of e-rickshaw service, and iii) Identifying the optimal locations for setting up physical infrastructure for e-rickshaws and designing optimal capacity of the charging stations.

Methodologies for data collection and analysis have also been finalized.

Project deliverable and timeline

The outcomes of this project are detailed analysis of

- i) Supply characteristics (e.g. capacity, coverage, fleet size etc.) of the e-rickshaw network in the study regions.
- ii) Operational characteristics (e.g. pre-trip delay, on-board delay, average travel speed and time, travel time variability, service reliability etc.) of the e-rickshaw service in the study regions.
- iii) Framework for design of e-rickshaw infrastructure. Infrastructure design will include finding out optimal locations for setting up charging and parking stations for e-rickshaws, and determining optimal capacity of the charging stations based on their demand calculation. The capacity of charging stations will be such that the delay will be minimized.

The objectives will be achieved by collecting data with the help of smartphone applications, repetitive observations, and a limited application of questionnaire survey. In case of objective (iii), optimal locations will be determined using facility location based model, and optimal charging station capacities will be determined by queuing theory based simulation.

The objectives which are expected to be achieved by December 2020 are data collection and analysis of the e-rickshaw supply characteristics in the study region.

CERCA Event Updates



Visit of Swedish Delegation at IIT Delhi

A delegation of 12 journalists from Sweden Television Network visited IIT Delhi on 4th March 2020. The main purpose of this visit was to expose the media delegation to the current air pollution research activities at CERCA IIT Delhi. The media delegation interacted with various faculties from the different departments of IITD, who briefed them about the research work(s) being done to curb the air pollution issue in the country. The Delegation also visited Aerogram and Kriya Labs.

MoS HRD Shri Sanjay Dhotre inaugurates exhibition on clean air technologies at IIT Delhi



Union Minister of State for Human Resource Development Shri Sanjay Dhotre inaugurated the exhibition on clean air technologies organised by Centre of Excellence for Research in Clean Air (CERCA) at Indian Institute of Technology Delhi on 25th February 2020.

Speaking on the occasion, Shri Sanjay Dhotre emphasised that in an age of environmental concerns, the need is to accord highest priority to civic awareness regarding clean environment. He said that the government is entirely committed to the cause of fighting the rising air pollution levels in the country and is taking all possible measures to spread awareness on clean air issues and providing all possible support for the development and promotion of clean air technologies in the country.

The exhibition showcased clean air technologies developed by IIT Bombay, IIT Ropar, IIT (ISM) Dhanbad and IIT Delhi. IIT Delhi showcased the work it had carried out in the area of clean air through start-ups incubated at IIT Delhi namely Aerogram and Kriya Labs.

IIT Bombay developed three types of Ambient air cleaning systems and a self cleaning air purifier (Filter less Air Purification Technology with lowest environmental burden)

IIT Ropar developed a stubble removing machine and an app that can be used to manage the stubble in smooth way.

IIT (ISM) Dhanbad developed an Altered Tail pipe design with additional retrofit for reducing PM emissions from the engine Exhaust

For more details on prototypes visit: <https://owncloud.iitd.ac.in/nextcloud/index.php/s/3rijdZmYKSzsjb>

Collaboration Meetings/Visits

Delhi City Science and Technology Cluster Meeting (Theme: Air Pollution)



A meeting was held on 12th March, 2020 at CAS, IIT with representatives of participating institutions (Attendance List attached) to deliberate solutions to the air pollution issue in Delhi city. The member/members from each institution were requested to come up with a write-up brief proposing short term and long term measures for effective and sustainable management of

Delhi's air quality. The meeting concluded with a broad consensus on: command and control framework for solution driven technologies, community engagement and identifying roadblocks to common fixes, awareness, communication and behavioral change analysis, strong public vigilance to catch the local sources, investigation and maintenance of vehicles, landfills, etc.

Prof. Sagnik Dey advocated the need for technological interventions, ground testing for scale and effect feasibility. The group agreed upon sharing an institution wise one-page proposal for minimum 6 months to 1 year.

MOU signed with West Bengal Pollution Control Board (WBPCB)



A Memorandum of understanding has been signed in February by WBPCB and CERCA for undertaking source apportionment studies, preparing emission inventory and carrying capacity for three cities in West Bengal namely Durgapur, Asansol and Raniganj. A meeting in this regard was held on March 16, 2020 with Principal Secretary (Environment), WB & Chairman West Bengal Pollution Control Board on finalization of project. The West Bengal Pollution Control Board (WBPCB) is also planning to install remote sensors across the state to detect stubble burning which is a major cause of air pollution and working with IIT Delhi on this project. Two scientists from the board will be trained by IIT Delhi to work on the project. The sensors will help in tracking any incident of stubble burning across the state

News Link: <https://www.news18.com/news/india/bengal-will-become-first-state-to-use-real-time-satellite-data-for-air-quality-management-2495243.html>

List of important Visits/meetings held in this Quarter



1. Meeting with Mr K S Pannu, Secy (Agriculture) Punjab on March 6, 2020 to discuss the project on crop diversification as an alternative to stubble burning. The Team has also visited to School of Public Health PGIMER Chandigarh and Department of Environment, Punjab University Chandigarh
2. Meeting with ICIMOD Nepal on Feb 27, 2020 on taking up joint projects in the area of clean air
3. The Chairman WBPCB visited IITD on Feb 20, 2020 to discuss project on source apportionment and Emission inventory for the state of West Bengal and also visited to the remote sensing Lab
4. Meeting with World Bank on Feb 14, 2020 on discussing strategies to develop Indo Gangetic air quality modelling and interventions for managing air pollution in the Indo Gangetic plain
5. CERCA is also in talks with Bihar State Pollution Control Boards to undertake projects on air pollution



Beta Attenuation Monitoring (BAM) Installation at IIT Delhi

An air quality measuring equipment for continuous monitoring of ambient air quality has been installed at IIT Campus. This will enable further research on air quality as well as for calibrating of other air quality monitoring equipment. CERCA is constantly collecting data from BAM and it is also displaying Live on IIT Delhi Digital Notice Board.



CERCA Funding

We are very fortunate to receive funding from individuals and corporations committed to improving air quality and undertake joint funding of projects with government organisation in Clean Air area.