Compendium of Viable Technologies and Practices

Lessons from NCAP Cities

September 7, 2024





Shri Bhupender Yadav
Hon'ble Minister
Ministry of Environment, Forest, and Climate Change
Government of India

The National Clean Air Programme (NCAP), launched in 2019, aims to improve air quality across the country by implementing various measures to address sources of air pollution. Since its inception, significant initiatives have been undertaken in the 131 identified cities to reduce particulate matter levels. These efforts include deploying cleaner technologies, implementing IT-enabled coordination strategies, fostering public participation, creating green spaces, and more.

I am pleased to see that this compendium presents numerous examples of initiatives undertaken by cities to enhance air quality, tailored to local contexts and requirements. These examples are a testament to the enthusiastic involvement and strengths of our implementation agencies, as well as the collective wisdom of everyone involved. This compendium is a valuable resource, offering insights into diverse strategies that other cities can adopt and replicate to improve air quality.

As we celebrate Swachh Vayu Diwas, I extend my heartfelt congratulations to all those who have contributed to the implementation of these innovative measures. Together, let us embrace the spirit of collaboration and continue our collective journey toward clean air for all.

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Shri Kirti Vardhan Singh
Hon'ble Minister of State
Ministry of Environment, Forest, and Climate Change
Government of India

In our pursuit of a healthier and more sustainable future, clean air stands as a fundamental priority. The element of air, or "Vayu" as it is known in Sanskrit, is not only a crucial component of our environment but also synonymous with the essence of life-PRANA. The quality of the air we breathe directly impacts our well-being, and its degradation poses a significant threat to human health.

Urbanization has adversely affected air quality in many of our cities. Acknowledging this critical issue, the Ministry of Environment, Forest, and Climate Change (MoEF&CC) has been at the forefront of efforts to combat air pollution. A cornerstone of these efforts is the National Clean Air Programme (NCAP), launched in 2019, with the goal of achieving up to a 40% reduction in particulate matter (PM10) levels across 131 cities by 2025-26.

To support this ambitious goal, cities have implemented a range of measures to improve air quality. These collective efforts are documented in this "Compendium of Viable Technologies & Practices: Lessons from NCAP Cities." This compilation highlights the collaborative actions of cities, communities, and organizations across the country, each contributing to the shared vision of clean air and blue skies.

I extend my heartfelt gratitude to all those who have played a crucial role in implementing these measures.

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Smt. Leena Nandan
Secretary
Ministry of Environment, Forest, and Climate Change
Government of India

The most fundamental element that sustains life is the air we breathe. It goes without saying that clean air is essential for the health, well-being, and future of our citizens.

To improve air quality across the nation, the Government of India launched the National Clean Air Programme (NCAP) in 2019. This program sets an ambitious target of reducing particulate matter (PM10) concentrations by up to 40% in 131 cities by 2025-26.

To achieve this goal, each city has developed comprehensive Action Plans addressing critical areas such as vehicular emissions, industrial pollution, road dust, construction and demolition waste, biomass burning, and waste management. The plans also focus on public outreach strengthening monitoring networks, capacity building, and conducting source apportionment studies. These measures are aligned with Mission LiFE, a global initiative led by India that promotes individual and community actions for environmental protection.

The efforts to combat air pollution require collective action and the sharing of knowledge. This "Compendium of Viable Technologies & Practices: Lessons from NCAP Cities" is a vital resource that highlights innovative measures and successful interventions adopted by cities across the country. It also underscores the collaborative efforts of cities and states working together to overcome challenges and thereby achieving their targets.

I extend my sincere congratulations to all the organizations and individuals whose dedication and hard work have contributed to this remarkable compilation.

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Shri Tanmay Kumar
Special Secretary
Ministry of Environment, Forest, and Climate Change
Chairman
Central Pollution Control Board

The National Clean Air Programme (NCAP), launched by the Government of India in 2019, represents a pioneering initiative in the fight against air pollution. This flagship program is dedicated to improving air quality across cities, with an ambitious goal of reducing PM10 levels by up to 40% by 2025-26.

Our journey under NCAP has been marked by significant progress, with many Indian cities adopting effective action plans and localized interventions that have led to notable improvements in air quality. The success of these measures underscores the critical importance of collaboration and coordination among various organizations and stakeholders.

To support this collaborative approach, the PRANA (Portal for Regulation of Air Pollution in Non-Attainment Cities) portal plays a pivotal role. It serves as an integrated tool for planning, monitoring, and implementing air quality strategies while also functioning as a knowledge repository for sharing best practices among cities.

In this context, the "Compendium of Viable Technologies & Practices: Lessons from NCAP Cities" emerges as a vital resource. This document, compiled with the aim of providing specific strategies and practical interventions from cities across India, enables NCAP cities to tailor these solutions to their local conditions.

I extend my sincere appreciation to everyone involved in compiling this compendium, to Team CPCB who have been continuously monitoring the implementation of NCAP and also to those on the ground who have diligently implemented these interventions.

The success of NCAP lies in following “Whole of Government” and “Whole of Society” approach so as to collectively address the multi-sectoral and cross cutting issues affecting air quality.

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Shri Naresh Pal Gangwar
Additional Secretary
Ministry of Environment, Forest, and Climate Change
Government of India

Launched in 2019 by the Ministry of Environment, Forest, and Climate Change (MoEF&CC), the National Clean Air Programme (NCAP) serves as a strategic framework to enhance air quality across 131 identified cities. NCAP emphasizes the execution of action plans at the national, state, and city levels, supported by financial resources from the XV Finance Commission Million Plus City Challenge Fund, the NCAP fund, and various central and state government schemes.

I am pleased to share that 95 of the 131 cities have demonstrated improvements in air quality as indicated by the annual PM10 concentrations for FY 2023-24 compared to the baseline year of 2017-18. Notably, 18 cities have met the National Ambient Air Quality Standards (NAAQS) for PM10 during this period.

The cities participating in NCAP have employed a range of planning and operational practices that have proven effective in combating air pollution. These practices offer valuable lessons for other cities aiming to improve air quality. This "Compendium of Viable Technologies & Practices: Lessons from NCAP Cities" provides a comprehensive overview of these interventions, highlighting their potential for replication and scaling in other urban areas. It serves as an essential resource for understanding and implementing successful air quality improvement strategies.

I extend my gratitude to everyone who has contributed to the successful implementation of these interventions and the compilation of this valuable compendium.

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** The city interventions illustrated are based on actual initiatives undertaken by the respective city. For any details, discrepancies and clarification readers are encouraged to contact the respective city.*

1 BENGALURU

Vehicles

Intelligent Transport System

Bengaluru – also known as the Silicon Valley of India, is a city of ten million people, growing fast and facing severe urban transport problems. Since 2001, more than five million vehicles have been added to the city's roads and average traffic speeds have dropped from 33 kmph to less than 5 kmph.

Buses are a key part of the urban transport architecture and Bengaluru Metropolitan Transport Corporation (BMTC) has more than 6,000 buses and more than 35,000 employees for operations and maintenance. Amidst this growing traffic congestion and growing urban population, maintaining commuter routes is vital for BMTC to keep up with its operations.

To address the same, BMTC has come up with the Intelligent Transport System (ITS). BMTC's Intelligent Transportation System (ITS) can help prevent buses from deviating from their routes. The system uses GPS and a Vehicle Tracking System (VTS) that is monitored by a central command center every 10–15 seconds. The ITS project involves integrated implementation of over 10,000 internet-enabled electronic ticketing machines and over 6,400 online vehicle tracking units.

Problem(s) Addressed

Traffic Congestion:
ITS helps reduce traffic congestion by optimizing traffic flow through adaptive traffic signals, real-time traffic monitoring, and providing alternative route suggestions to drivers.

Public Transportation Efficiency:
ITS improves the efficiency of public transportation systems by providing real-time information on bus arrivals, optimizing routes based on passenger demand, and enabling smart ticketing systems.

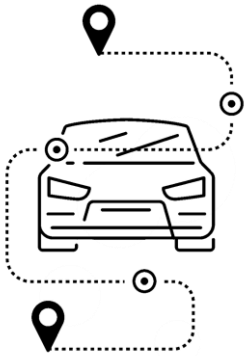
Environmental Impact:
ITS contributes to reducing the environmental impact of transportation by optimising routes and reducing idling time.

Road Safety:
ITS enhances road safety with technologies such as collision avoidance systems, automated braking, and real-time alerts about road hazards or dangerous driving conditions.

Traveler Information:
ITS provides real-time information to travelers through apps, websites, and roadside displays. This includes updates on traffic conditions, travel times, and weather-related hazards, helping travelers make informed decisions and avoid delays.

Intelligent Transportation System (ITS)

Components



Vehicle Tracking System (VTS)

This comprises two components: the Vehicle Tracking Unit (VTU) and the Voice Kit. The GPRS-enabled VTU is installed near the driver's seat in more than 6,000 BMTC buses operating in the city.

It shares real-time location data every 10 seconds, along with the vehicle number and shift number (of the driver and conductor of the bus concerned).

This short interval collection of data allows for analysis of the driving pattern, including issues like skipping of bus stops and deviation from planned routes, as well as indicating the traffic situation at the current location of the buses.



Real-time data shared every 10 seconds



Location



Shift number of driver and conductor



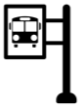
Electronic Tracking System (ETS)

This comprises two connected elements – the Electronic Ticketing Machines (ETM) and the Depot Application.

The ETM is used by the conductors to issue journey tickets to passengers, and it transmits this ticket data to the ITS every five minutes via the mobile (GPRS) network.

The Depot Application is installed at all bus depots, and it gathers information from both the ETM and VTU as well as top-down sources. It can then generate information on the crew duty Quota, the log sheet for the driver, kilometers traveled, and details about fuel usage, ticketing etc. This information is sent to the desktop application at the ITS Control Room, which generates schedules and timetables. This data is also fed into the ETM, which is used by the bus conductors and is issued at the time when they begin their duty.

Electronic Ticketing Machine collects and transmits data



Bus stop



Ticket amount



Passenger Information System (PIS)

This is the bus location information system, powered by real-time data from the VTS. Basic PIS output can be found on display screens at all major bus stations.

ITS Control Room

Data from vehicle tracking and ticket sales are transmitted to servers located at the Karnataka State Data Centre. From there, data can be accessed at several locations but primarily at the ITS Control Room.

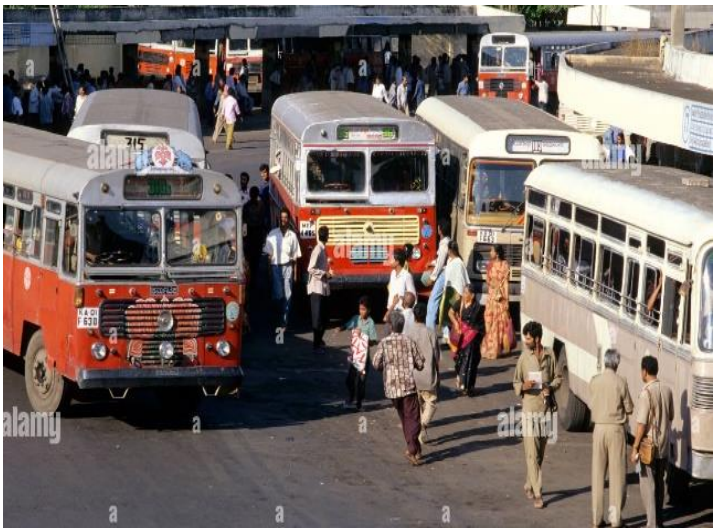
This is the 24/7 operations centre of the ITS, with a video wall consisting of six large LCD screens showing location information and other key monitoring and performance indicators.

This centre has space for up to twenty people including operators, technicians and BMTC officials. The Control Room also has a two-way communication system with all buses and thus functions as a point of contact for emergency incidents.



Impacts of the Intervention

1. Avoiding traffic congestion and deviating routes will mainly help in reducing pollution. The system uses GPS and a Vehicle Tracking System (VTS) that is monitored every 10–15 seconds.
2. Facilitates the buses to be on time and route.
3. This system helps passengers plan their journeys and makes bus services more predictable, thereby facilitating them to plan their travel and routes accordingly.





Details of the Intervention

Duration of implementation
1.5 years

Cost
Rs. 37.50 Cr

Implementing authority
Bangalore Metropolitan Transport Corporation (BMTC)

Source of funds
Nirbhaya scheme

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Challenges

1. ITS involves multiple data sources and includes - sensors, cameras, GPS, and communication devices. Integrating these diverse data types into a coherent system is complex.
2. As urban populations grow, ITS must scale to handle increased traffic and more complex transportation networks.
3. Delays in data processing can lead to incorrect traffic predictions, inefficient routing, and potential safety hazards.
4. ITS systems require fast and reliable communication between vehicles, infrastructure, and central control systems.
5. Resistance to change or lack of trust in ITS can reduce its effectiveness, leading to underutilization of advanced features.

Strategies to Resolve Challenges

1. All buses are upgraded and equipped with modern, high-precision GPS devices that transmit accurate location data in real-time.
2. Enhanced the integration between ETMs, GPS, and the central monitoring system to ensure data consistency.
3. Developed and implemented mandatory training sessions for all drivers on the operation of all onboard devices, including emergency transmitters.
4. Provided easy-to-understand user manuals and in-bus guides to assist drivers with operating the equipment correctly.
5. Updated the tracking software to ensure that bus numbers are linked to the ETM information and displayed on both the app and bus stop digital displays.
6. Updated the BMTC app to ensure that passengers have easy access to real-time information.

2 PUNE

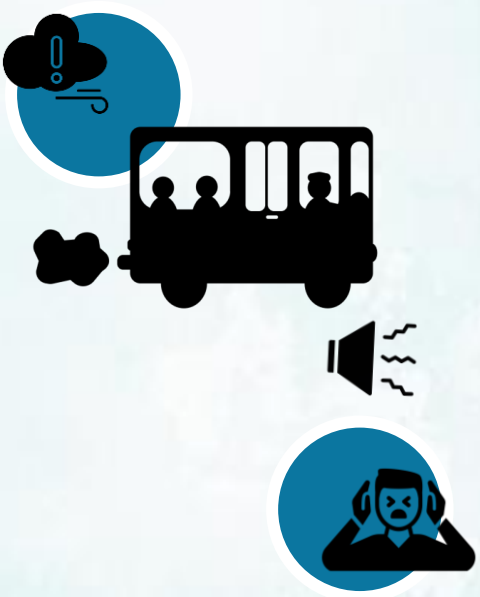
Vehicles

Electric Buses for Sustainable Mobility

Pune, a vibrant city in Maharashtra, is in the process of electrifying 25% of its public bus fleet by 2031. This initiative is part of a comprehensive strategy to combat urban air pollution and meet NCAP goals.

The project was launched in 2019 to partially replace the city's diesel-powered buses. Currently, 490 electric buses are operating in the city. The initiative is jointly funded by the Pune Municipal Corporation (PMC), Pimpri Chinchwad Municipal Corporation (PCMC), Pune Smart City Development Corporation Ltd. (PSCDCL), and the FAME II Central Government Scheme, at a cost of Rs. 250 Crores.

490
Electric buses operational



Problem(s) Addressed

Air Pollution:
Diesel-driven buses contribute to particulate matter (PM) and nitrogen oxide emissions. The PM emitted by diesel engines contains various components, such as soot, ash, unburned hydrocarbons, metals, elements, and inorganic ions. The partial replacement of these buses with electric ones will reduce emissions of these pollutants, thereby decreasing air pollution.

Noise Pollution:
The diesel buses are noisier than electric buses. With introduction of more electric buses, the ambient noise levels are expected to reduce in the city resulting in improved quality of life.


Before


After



Challenges

1. **High Capital Costs**: The initial investment required for purchasing electric buses is significantly higher compared to traditional diesel buses.
2. **Limited Domestic Production**: Domestic production capacity for electric buses is limited, which leads to delays in the timely delivery.
3. **Passenger Loading and Energy Efficiency**: During peak hours, when the buses carry more passengers than usual, they use more energy, which can reduce their ability to operate efficiently.
4. **Charging Infrastructure**: Setting up of the required charging infrastructure and depots is required.

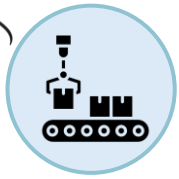


Strategies to Resolve Challenges

Financial Support through Subsidies and Grants: To cover the high capital costs, the project leveraged subsidies and grants from various schemes provided by local government bodies like PMC, PCMC, PSCDCL, and received additional support from the FAME II Central Government Scheme.



Boosting Domestic Production Capacity: The authorities collaborated with manufacturers to enhance local production capacity, ensuring a more reliable and timely supply of electric buses.



Real-Time Monitoring and Route Optimisation: Implementing real-time monitoring and route optimization systems helped in managing passenger loads more effectively and improved energy efficiency during peak hours.



Strategic Land Allocation for Depots: The project worked in close collaboration with urban planning authorities to identify and allocate appropriate land parcels for the development of e-bus depots and charging stations.



Upgrading Power Grid for Charging Infrastructure: Partnerships with utility companies were established to upgrade the power grid infrastructure, ensuring it could meet the increased demand from the newly developed e-bus charging stations



Impacts of the Intervention

1. **Reduction in Air Pollution:** The operation of 490 electric buses in Pune is reducing particulate matter emissions from the transportation sector.
2. **Reduction in CO_2 Emissions**: Since the project was implemented, 490 electric buses have been put into operation, leading to a reduction of 7,000 tons of CO_2 emissions.
3. **Reduction in Noise Pollution**: The introduction of e-buses has resulted in a decrease in noise pollution, as these buses operate more quietly compared to their diesel and CNG counterparts.
4. **Enhanced Commuter Experience**: The air-conditioned electric buses provide a more comfortable and accessible commuting experience, with special design considerations for differently abled citizens and reserved seating for women.

Details of the Intervention

Duration of implementation
12 Years (2019 to 2031)
Ongoing Project

Cost
Rs. 250 Cr

Implementing authority
Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML)

Pune Municipal Corporation (PMC)

Pimpri Chinchwad Municipal Corporation (PCMC)

Pune Smart City Development Corporation Ltd. (PSCDCL)

Source of funds
PMC, PCMC, PSCDCL, and FAME II Central Government Scheme

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Transformation due to the Intervention

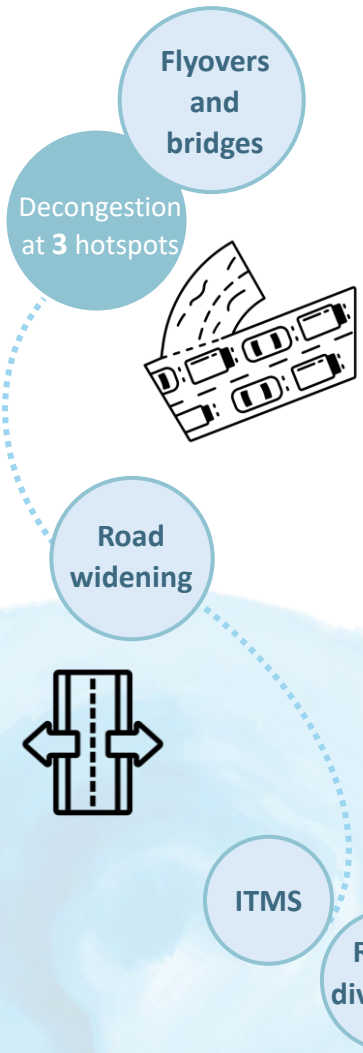
The partial electrification of Pune's public transport system marks a significant milestone in the city's shift towards greener urban mobility and serves as a model for other similar cities to emulate. It showcases the feasibility of large-scale electric mobility solutions in urban environments. The resulting reduction in air and noise pollution is enhancing the quality of life in the city.

3

LUCKNOW

Vehicles

Strengthening Infrastructure and Intelligent Traffic Management System for Traffic Decongestion



Lucknow, a rapidly growing city, faces significant traffic congestion, particularly at major intersections and key thoroughfares. The current road infrastructure struggles to accommodate the increasing number of vehicles, leading to prolonged travel times, inefficient traffic flow, and heightened commuter frustration. The lack of adequate traffic management exacerbates these issues, causing frequent bottlenecks and safety concerns. Additionally, the increased vehicle emissions from prolonged idling and stop-and-go traffic have contributed to deteriorating air quality. This situation necessitates a comprehensive solution to enhance road capacity, optimize traffic distribution, improve overall commuting efficiency, and mitigate the impact on air quality from traffic-related pollution.

The intervention addresses this issue by constructing flyovers and bridges at three major congestion points and widening roads in five key areas.

From June 1, 2024, to July 12, 2024, the Nagar Nigam Lucknow constructed 50.35 km of roads using XV-FC funds. During this period, a 2 km long flyover was also built, linking Shaheed Path with Chaudhary Charan Singh International Airport as part of the same initiative. The Intelligent Traffic Management System (ITMS) was introduced to reduce wait times at intersections and route diversions were implemented to optimize traffic distribution.

Problem(s) Addressed

Traffic Congestion:
Traffic congestion in Lucknow had reached a critical point, adversely impacting the city's mobility, productivity, and air quality.

Air Pollution:
Traffic congestion contributed significantly to city air pollution due to increased vehicle emissions and idling engines.

Inconvenience to commuters:
The commuters were inconvenienced by the traffic congestion, and impacted by air and noise pollution.

Inadequate Infrastructure:
The existing road infrastructure was inadequate to handle the growing volume of vehicles, resulting in prolonged wait times at intersections and heightened frustration among commuters.

Economic cost of traffic congestion:
The costs from traffic congestion arise due to commuters losing productive hours, fuel consumption, environmental costs etc.





Challenges

1. **Land Acquisition:**
Acquiring land for construction led to delays, particularly in dense urban areas.

2. **Air & Noise Pollution during construction:**
The construction activities impacted air quality, especially in densely populated areas like Indira Nagar.

3. **Traffic Disruptions:**
Traffic disruptions occurred during the infrastructure development phase.

4. **Community/ Residents Resistance:**
This arises due to potential disruptions and anticipated losses.

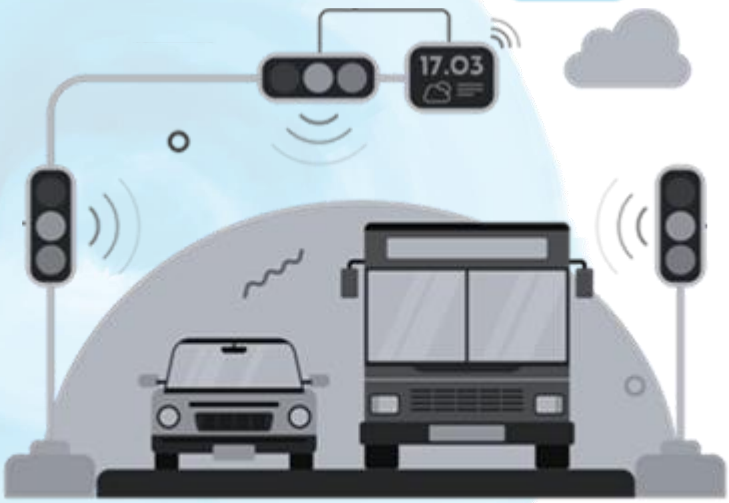
Strategies to Resolve Challenges

1. **Streamlined Land Acquisition:** Implementing a more efficient land acquisition process through clear communication with affected parties and fair compensation can reduce disputes.

2. **Environmental Management Plans:** Developing plans to mitigate air pollution and implementing measures such as dust control and noise mitigation can alleviate community concerns.

3. **Traffic Management Plans:** Instituting traffic management strategies, including detour routes, can minimize disruptions during construction phases.

4. **Public Engagement:** Actively involving the community in project planning through consultations can address concerns and help in gaining public trust.





Impacts of the Intervention

1. **Improved air quality:** The measures led to a reduction in traffic congestion and in turn lowered air pollution from vehicular sources.
2. **Optimised traffic flow:** The measures have optimized the traffic flow and reduced congestion in critical areas of Lucknow.
3. **Reduced fuel consumption:** Optimised wait time at intersections has reduced fuel consumption and emissions.
4. **Economic costs** associated with traffic congestion are reduced.

Details of the Intervention

Duration of implementation
2 - 3 years

Cost
Rs. 18.50 Cr

Implementing authority
Lucknow Nagar Nigam
Public Works Department (PWD)
Lucknow Development Authority (LDA)
Lucknow Municipal Corporation (LMC)
National Highway Authority of India (NHAI)
Smart City Mission
Uttar Pradesh Power Corporation Limited (UPBCL)

Source of funds
Nirbhaya scheme

Contact person
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Transformation due to the Intervention

The intervention has led to a substantial and lasting improvement in the city's traffic management and environmental quality. By addressing congestion and enhancing infrastructure, the initiative has decreased travel time and contributed to reduction in air pollution from vehicular sources.

Key developments, such as the construction of flyovers, road widening, and the implementation of an Intelligent Traffic Management System (ITMS), have optimised traffic flow and enhanced commuting efficiency. It has positioned Lucknow as an example of effective urban traffic management and sustainable city planning.

4

SURAT

Industry

Emissions Trading Scheme for Particulate Matter

Surat, located in Gujarat, India is known for its textile and diamond industries. Gujarat Pollution Control Board (GPCB) implemented **Emissions Trading Scheme for Particulate Matter** (**ETS - PM)** in 2019 across 300 textile units in Surat, as a new regulatory approach to industrial pollution control and promoting self- regulation.

Under this scheme, a cap is established on the amount of air pollutants that industries can emit. The participating industries are allocated permits based on their boiler size by GPCB and these permits can be traded within a market set up by the GPCB.

The total PM mass is continuously monitored in participating units by **Continuous Emission Monitoring Systems (CEMS)** and at the end of a specified trading period, the total emissions from an industry are compared to the emission permits they hold. To comply, permit holdings must be equal to or greater than actual emissions. To meet this requirement, the industries are obligated to install efficient/advanced abatement & Control technologies, and surplus permits can be sold to industries that find it difficult/ expensive to install the required technology.

Problem(s) Addressed

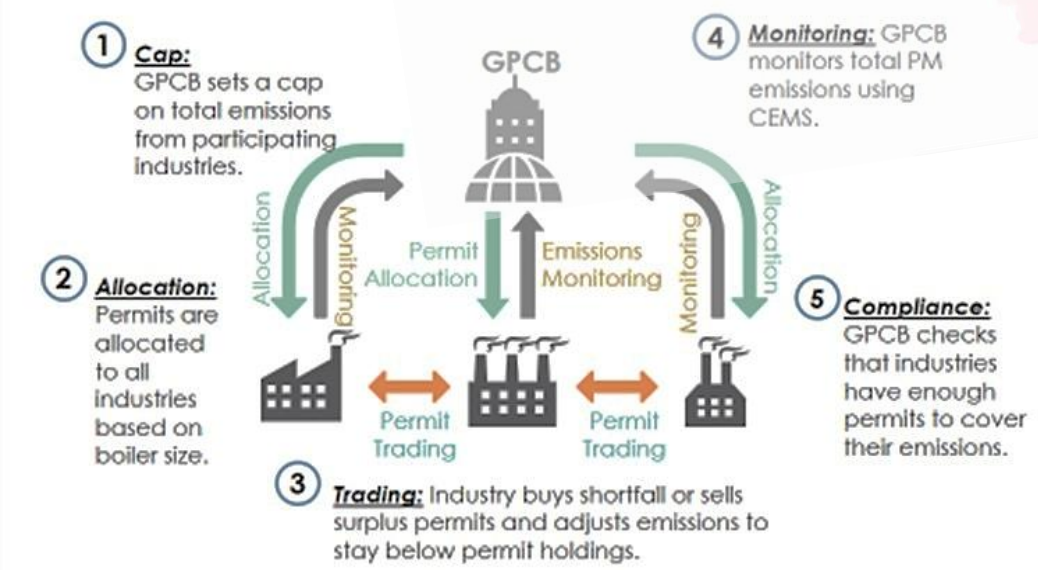
Reducing overall air pollutants from the industrial sector.

Incentive to industries with better pollution abatement, control and treatment technologies.

Encouraging technical innovation in process and pollution control technology.

Promoting self-regulation and increased regulatory flexibility.

Key Factors of Emission Trading Scheme



Impacts of the Intervention

1. Industries participating in the scheme tend to reduce up to 30% emissions compared to other industries regulated by a command-and-control approach.
2. The Gujarat Pollution Control Board tracks data generated on CEMS which is used to identify violators and also review pollution control strategies.
3. CEMS data can be useful to industries for improving process operation, especially with regards to fuel consumption and environmental performance of the industry.
4. ETS dramatically improved CEMS data availability from approximately 30% before the experiment to more than 90%.
5. ETS has managed to bring a lot more buy-in from the industries towards conservation and mitigation of issues related to the environment.

Transformation due to Intervention

The implementation of the Emissions Trading Scheme for Particulate Matter (ETS-PM) in Surat has transformed the city's approach to environmental regulation within its industrial sector.

By establishing a cap-and-trade system across 300 textile units, the Gujarat Pollution Control Board (GPCB) has incentivized industries to adopt advanced emissions reduction technologies.



Challenges:

1. **Building Industry and Regulatory Capacity:**
   - **Installation of appropriate CEMS technology:** Industries tended to install the most affordable CEMS devices even if incompatible with their stack characteristics resulting in various operational issues.
   - **Lack of trained personnel for operation & maintenance of CEMS.**

2. **Ensuring Accurate and Robust Transmission of CEMS Data:**
   - Risk of data tampering
   - Poor data availability



Steps Taken to Resolve Challenges

1. Capacity building and awareness workshops were conducted to impart knowledge about the CPCB guidelines for CEMS that has an in-built technical framework, which helped participating industries in the installation of effective CEMS devices based on the technology appropriate for their flue gas characteristics.

2. Industries were directed to designate and train CEMS personnel to communicate with the vendor to effectively address device issues.

3. All CEMS data files stored at the Industry PC are encrypted to minimize the risks due to CSV tampering.

4. GPCB developed an Action Framework for regulating Industries based on CEMS data. Auto-generated SMS/Emails were sent, followed by regulatory notices and one-on-one meetings, which saw improved data availability, and greater awareness.

Details of the Intervention



Duration of implementation
3 years (2019-2022)



Implementing authority
Gujarat Pollution Control Board (GPCB)



Source of funds
GPCB in coordination with researchers from the University of Chicago, Yale University and The Abdul Latif Jameel Poverty Action Lab (J-PAL)



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5 CHANDIGARH

Road Dust and Construction & Demolition

Complete Construction and Demolition Management Ecosystem

Chandigarh is an urban conglomerate and a growing commercial hub in the region. With the increasing urbanization, the real estate and housing sector has also seen a big boost. With an increasing number of constructions to meet the housing demand, lots of construction and demolition waste is also generated, which is again a major contributor to the increasing PM10, thereby adversely impacting the air quality of the region.

The Government of India has notified Construction & Demolition Waste Management Rules 2016, wherein construction building materials, cement debris, stones, etc. are required to be processed and reused.

A complete C&D waste management ecosystem is developed and operated by the Municipal Corporation Chandigarh, at a cost of Rs.2.5 Crores. This includes construction, financing, and running of the C&D waste processing plant, setting up collection centers across the city, and establishing a public helpline for door-to-door collection of construction waste.



Problem(s) Addressed

Illegal dumping and disposal of C&D waste, tracking and monitoring the same was a challenge.

No proper covering of construction materials at construction sites adding to the issue.

No proper collection vehicles or systems in place for citizens, which adds to the illegal dumping of waste across Sites.

On May 15, 2019, the Municipal Corporation of Chandigarh established a C&D waste processing plant with a capacity of 150 TPD in its industrial area. The facility is designed for stacking,



Impacts of the Intervention

22
Operational C&D waste collection points



1.2 lakh MT
C&D waste processed

2
Waste to Wonder parks set up

Currently, there are 22 operational C&D waste storage collection points, with plans to expand this number to 37. The overall processing capacity for C&D waste is approximately 100 TPD.

Various BIS & IRC codes have been enforced by the municipal corporation. These norms strictly prescribe use of C&D Processed material in different works. Enforced strict enforcement and penalization is ensured at domestic and commercial construction sites.

Sharp reduction in the quantum of C&D waste reaching landfills. The generators can deposit their C&D waste at any of the 22 allocated collection points, from which the C&D plant's collecting vehicles collect and transport the waste to processing plant.

Transformation due to the intervention

Rs. 15 lakh
Monthly income through sale of recycled C&D waste products

Chandigarh's C&D Waste Management Policy 2022 has been enforced to curb illegal dumping and disposal

The Construction & Demolition (C&D) Waste Processing Plant in Chandigarh has revolutionised the city's waste management, curbing illegal dumping, reducing construction-related environmental impacts, and promoting material recycling. The plant has processed over 1.20 lakh metric tons of waste into valuable products like pavers and bricks, generating Rs. 15 lakhs monthly.

The "Waste to Wonder" parks and stringent construction site regulations have further solidified Chandigarh's environmental efforts, making this project a model for sustainable urban development, supported by the National Clean Air Programme (NCAP) and Swachh Bharat Mission (SBM).

Details of the Intervention

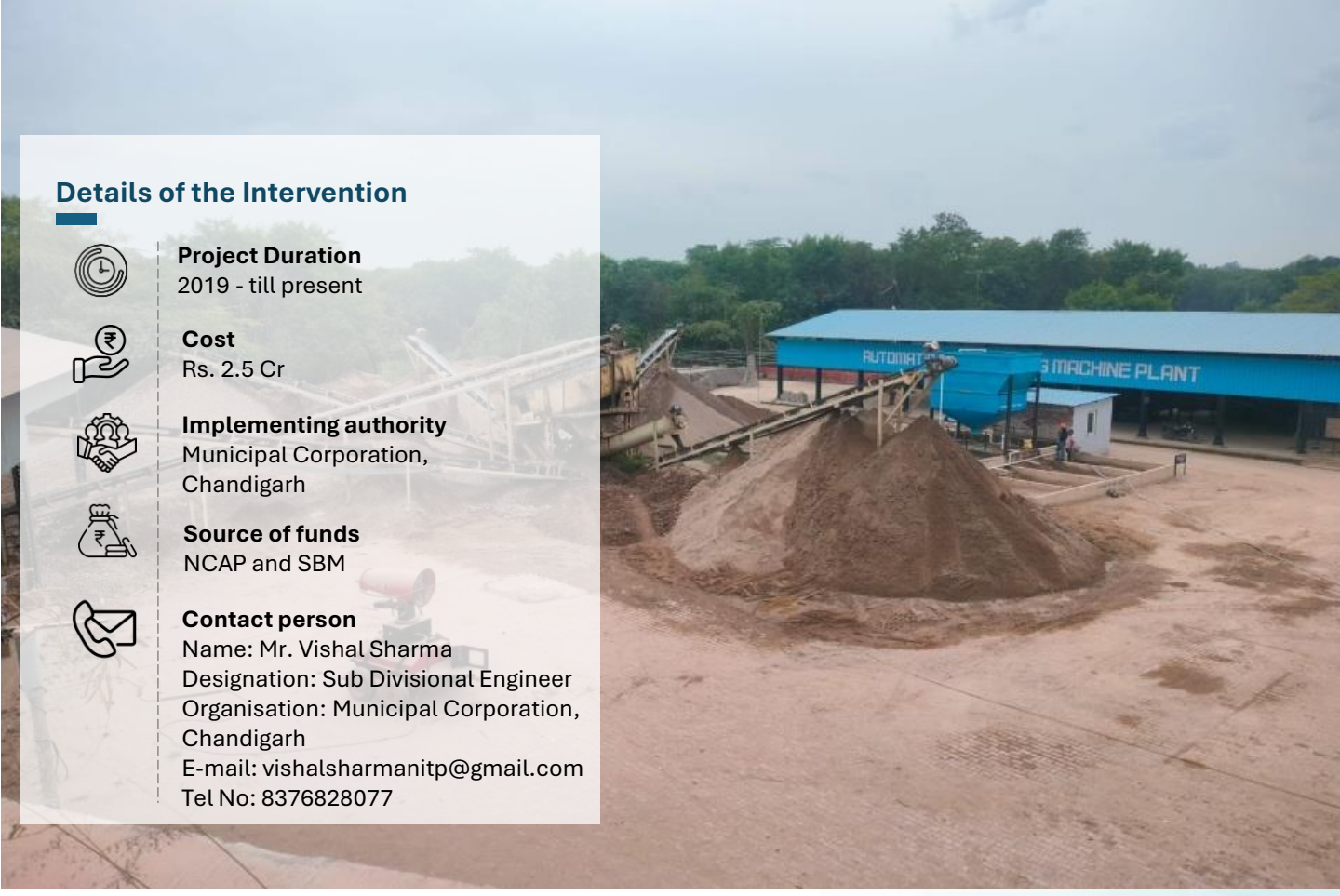
Project Duration
2019 - till present

Cost
Rs. 2.5 Cr

Implementing authority
Municipal Corporation, Chandigarh

Source of funds
NCAP and SBM

Contact person
Name: Mr. Vishal Sharma
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Tel No: 8376828077



Challenges

1. Processing of waste emits a lot of dust pollution and noise pollution.
2. Lot of wastewater is produced during the washing of aggregates.
3. Proper utilization of recycled products is a challenge.
4. Proper collection and processing is a challenge and requires proper monitoring and operational SOPs.

Strategies to Resolve Challenges

1. ETP is in place to treat the effluent and reuse it in the process/curing purposes.
2. Market has been created for the sale and utilization of recycled products.
3. Additional dumping sites are notified across the city to avoid illegal dumping.
4. Social media-based outreach and call centre were set up for C&D waste-related complaints and requests.

6 INDORE

Road Dust and Construction & Demolition

Efficient Use of Mechanical Road Sweeping Machines

To address the issue of road dust and improve air quality, the Indore Municipal Corporation implemented the use of Mechanical Road Sweeping Machines for effective road dust management. A total of **27 MRS (6 different types) machines** run in two shifts and cover **800 km** of road length daily with the use of recycled water, covering major roads, intersections, and squares across the city.

Street sweeping in Indore is a scheduled activity and is done at least twice a day in commercial areas and once a day in residential areas to overcome the issue of road dust along with cleaning roads.

These sweeping machines work with the help of a broom attached to a smart cart and transfer the waste to the cart also no motor or battery is required in the operation. These machines move slowly on the roads at an average speed of around 8 km per hour to brush on roadside sand and suck it up with the vacuum. The collected dust is disposed at designated places or does not re-enter into the environment. The inert waste collected during the sweeping operation is processed at the 100 TPD C&D waste processing plant.

For manual sweeping, Indore Municipal Corporation has deployed a team of **Safaimitras** supervised by Darogas at the ward level. Morning and evening sweeping are done according to the beat system. Each Safaimitra works on their assigned beat and is monitored by ward darogas.

By investing in mechanical road sweeping, Indore has taken a significant step toward creating a healthier environment for its residents and meeting national and international air quality standards.





Problem(s) Addressed

In Indore, road dust is the major source of Air Pollution. Earlier the roads within the Indore Municipal Corporation limits were cleaned manually resulting in high dust generation and causing deterioration of local air quality.

Impacts of the Intervention

1. Reduction in road dust re-suspension and improvement in air quality
2. The use of mechanical sweepers, combined with regular water spraying, continuous cleanliness drives, and innovative waste management, has made the city dust-free and helped in maintaining its status as the cleanest city in the country for the 7th time in Swachh Survekshan 2023.
3. Creation of about 320 jobs, re-employing many former manual sweepers and rag pickers.
4. A study conducted at the largest medicine market in the city revealed that there is a decline in sales of respiratory-related medicines.





27
Machines operating across **800** km daily

320
Jobs created

Transformation due to the Intervention

The implementation of Mechanical Road Sweeping Machines in Indore has substantially improved road dust management, reducing air pollution and enhancing the city's overall air quality.

With 27 machines operating across 800 km daily, the initiative has replaced manual sweeping and supported the city's cleanliness mission. The project has also created about 320 jobs. This intervention, combined with regular water spraying and innovative waste management practices, has solidified Indore's status as the cleanest city in India, contributing to public health improvements and sustainable urban living.



Challenges

1. Lack of understanding of the machine maintenance status.
2. During this monitoring, it was observed that some MRS machines were not meeting the required specifications.
3. There were no designated silt disposal sites.
4. Gaps were identified in the sweeping operations.
5. Drivers experienced challenges in inputting the data.
6. There are a limited number of well-trained operators/drivers who understand machine maintenance.

Details of the Intervention

Cost
Rs. 30 Cr p.a.

Implementing authority
Indore Municipal Corporation

Source of funds
15th Finance Commission, Swachh Bharat Mission (SBM) 2.0

Contact person
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Designation: Additional Commissioner & Nodal Officer (NCAP)
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Email: sbmindore09@gmail.com
md@mybmtc.com
Tel.: +918826237948



Strategies to Resolve Challenges

1. Around 3831 km of roads in the city is end-to-end paved along with blacktopping and maintained potholes free for effective dust collection through mechanical road sweeping.
2. Standard Operating Procedures (SOPs) were prepared for the operation and monitoring of the Brush and recommended replacing the Brush/Broom after usage length of 1000 Kms.
3. An SOP was designed for proper and regular machine maintenance.
4. Allocated two disposal sites for dust collected from MRS machines.
5. To better monitor the sweeping operation cameras were placed overhead these machines and its data was integrated with the Integrated Command and Control Centre (ICCC) control for monitoring.
6. Workshops are conducted for proper training and capacity building of all the operators/drivers.
7. The height of the central divider of the major roads is raised to ensure effective dust sweeping and the creation of green buffer zones along the traffic corridors.

7

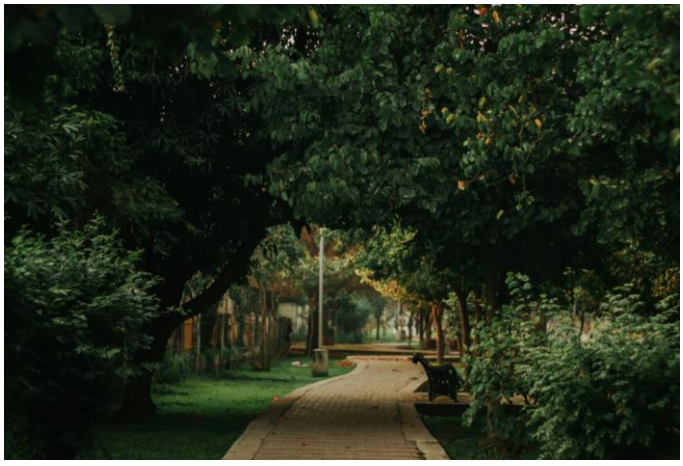
AHMEDABAD

Waste and Biomass

Transformation of Waste to Green Spaces: The Bopal Ecological Park

The city of Ahmedabad has encountered significant environmental challenges, particularly related to air pollution and waste management. To address these issues, the Ahmedabad Municipal Corporation (AMC) launched an initiative to convert an 8,000-square-meter dumpsite in the Bopal area of Ahmedabad into a thriving ecological park.

This project, known as the Bopal Ecological Park, is part of the city's broader strategy to improve air quality and enhance the urban environment. By transforming a site once emblematic of environmental degradation into a lush green space, the initiative stands as a model of sustainable urban development.



Problem(s) Addressed

Before the intervention, the Bopal area of Ahmedabad had significant environmental issues due to the presence of dumpsite, such as:

- **Air Pollution** resulting from the burning of waste. Also, pollution from other air polluting sources, such as road dust, construction activities, domestic emissions and industrial processes.
- **Environmental, odor nuisance & Public health risk.**


Before


After

Challenges

The implementation of the Bopal Ecological Park faced several challenges:

1. **Waste Management:** Processing the vast amount of waste (approximately **3 lakh tons**) at the landfill was a complex and resource-intensive task. Ensuring that the site was properly cleared and prepared for the ecological transformation required careful planning and execution.
2. **Funding and Resources:** The project required substantial financial investment, with a total implementation cost of **Rs. 5.46 crore** towards development of the park. Securing these funds and managing the budget effectively was crucial to the project's success.

Strategies to Resolve Challenges

To overcome these challenges, the following strategies were employed:

1. **Advanced Waste Processing Techniques:** The AMC utilized **state-of-the-art** scientific technologies, including biomining, to efficiently process the waste. This approach ensured that the site was ready for the ecological transformation in a record time.
2. **Funding:** The project was financed through the **15th Finance Commission Grant**, ensuring that adequate resources were available for both the development and maintenance of the park. The involvement of AMC's Solid Waste Management Department and Parks & Gardens Department further supported the project's sustainability.

Details of the Intervention

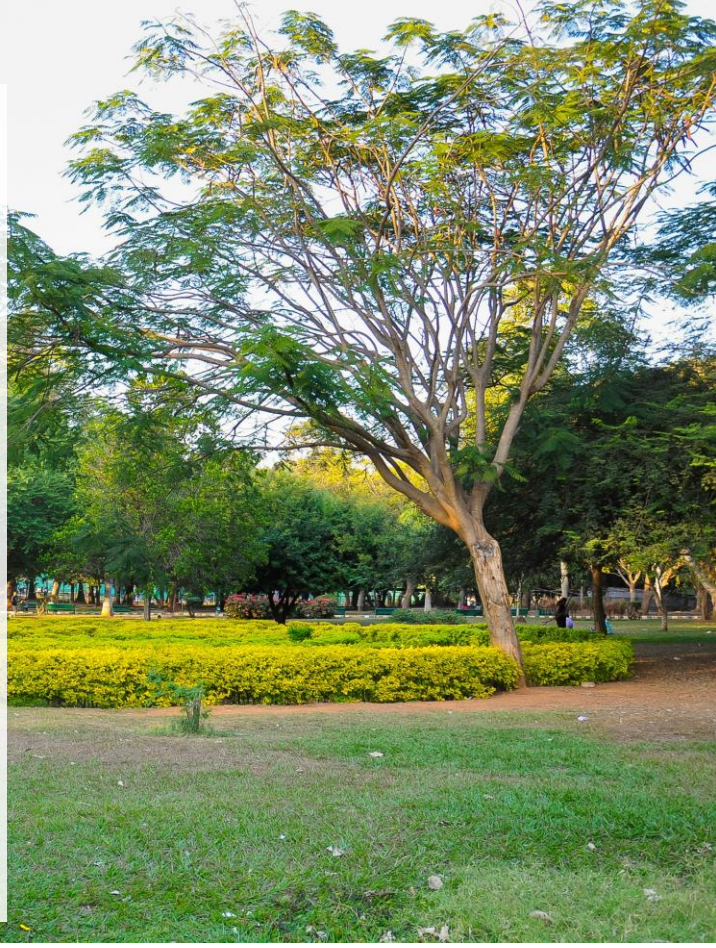
Duration of implementation
1 year

Cost
Rs. 5.46 Cr

Implementing authority
- Solid Waste Management Department of Ahmedabad Municipal Corporation
- Parks & Gardens Department of Ahmedabad Municipal Corporation

Source of funds
15th Finance Commission

Contact person
Name: Dr. Bhavin Solanki
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Email: mohahmedabad@ahmedabadcity.gov.in



Impacts of the intervention

The development of the Bopal Ecological Park has favourably impacted the environment and the local community:

1. **Reduction in Air Pollution:** The annual average concentration of PM_{10} in the area has reduced to **89 µg/m³ (2022-23)**.
2. **Creation of green space:** The increased greenery is benefiting residents within a 1 square kilometer radius and contributing to improving the local air quality.
3. **Increasing Biodiversity:** Over **900 trees**, comprising **128 exotic** and **endangered** species, have been planted, transforming the area into a thriving ecological habitat.
4. **Educational and Recreational Benefits:** The park has become a hub for botany students and researchers, offering a unique opportunity to study rare plant species. It also provides the local community with a serene space for recreation, including walking trails, meditation areas, and an open gym.
5. **Increased Environmental Awareness:** The project has raised public consciousness about the importance of environmental preservation and cleanliness, encouraging residents to adopt more sustainable practices.

Transformation due to the intervention

The Bopal Ecological Park in Ahmedabad represents a remarkable transformation of an 8,000-square-meter landfill into a thriving green space, significantly improving the local environment and air quality.

8

LUCKNOW

Road Dust and Construction & Demolition

Development of an Audit-Based Payment System for MRS in the Smart City 311 App

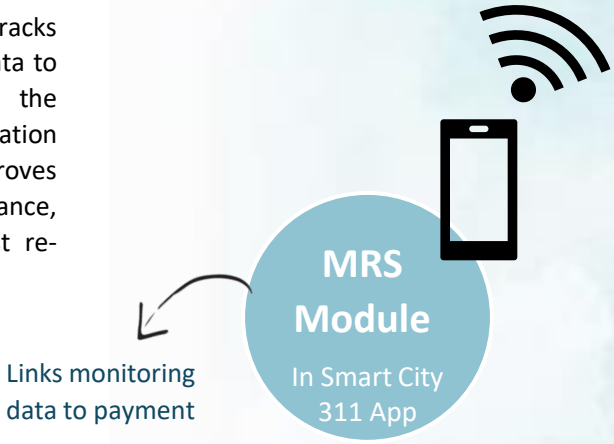
Lucknow, the capital city of Uttar Pradesh is one of the 131 non-attainment cities in the country. The emission inventory and source apportionment studies revealed that road dust re-suspension as one of the major contributor to PM_{10} and $PM_{2.5}$ emissions. The estimated PM_{10} and $PM_{2.5}$ emissions from road dust re-suspension in Lucknow city is 116,733 kg/day and 28,242 kg/day, respectively.

The Mechanized Road Sweepers (MRS) machine is an effective solution to control road dust re-suspension. It comprises of vacuum systems equipped with brooms, holding bins, water sprinklers, vacuum nozzles, filters, and suction inlets.

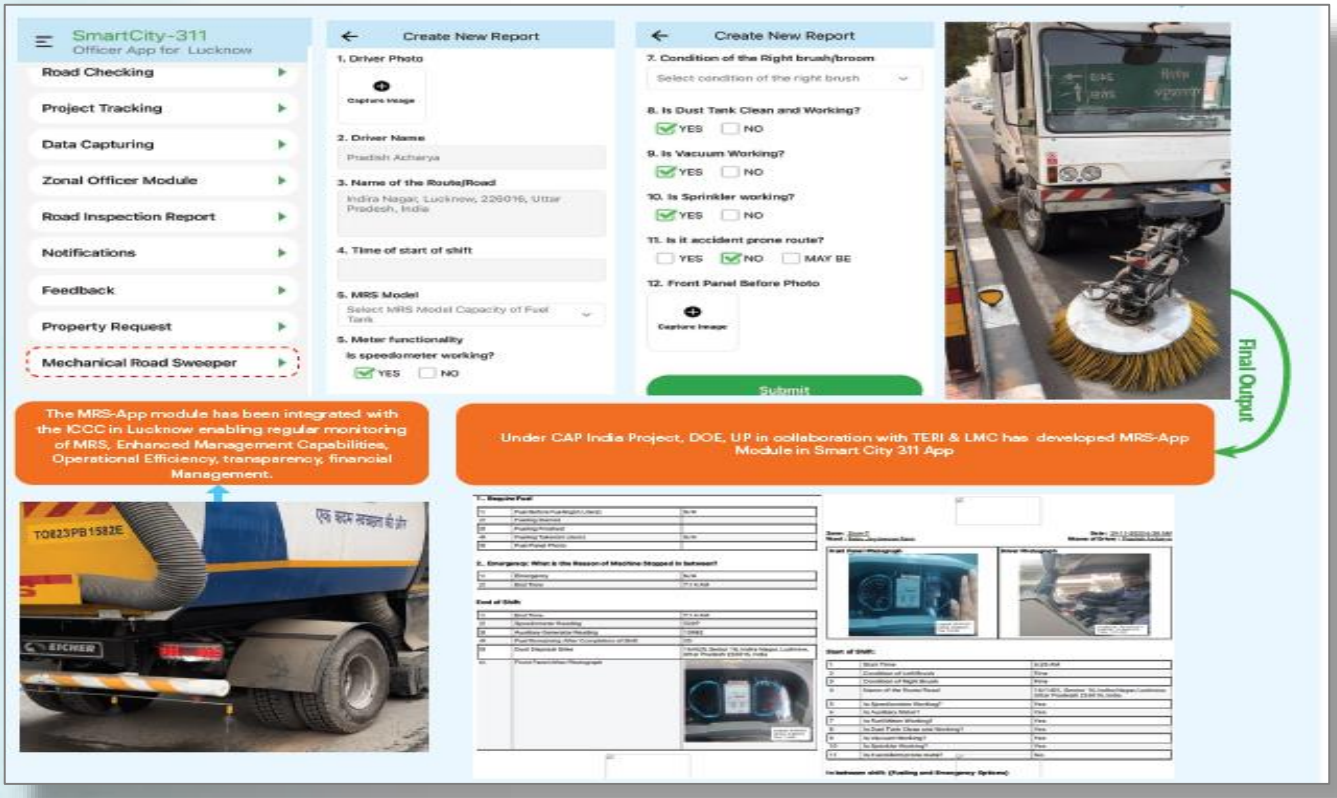
To assess its on-ground efficacy, the Directorate of Environment (DoE), UP, and Lucknow Municipal Corporation (LMC) have jointly developed a MRS Module in the Smart City 311 App to monitor the MRS operations on a daily basis. The payment of vendor/drivers and workers operating MRS is linked on the app to ensure accountability and transparency.

Problem(s) Addressed

The system provides daily oversight of the Mechanized Road Sweepers (MRS) operations. It successfully tracks on-ground efficacy and by linking the monitoring data to the payment of vendors, drivers, and workers, the intervention ensures accountability and proper operation of the MRS machines. This approach not only improves transparency but also encourages better performance, leading to a more effective solution to road dust re-suspension.



Audit-based Payment System for Mechanized Road Sweepers



Impacts of the intervention



Efficient road dust collection and reduction in air pollution: The intervention effectively monitors and manages the performance of mechanized road sweepers, which helps to control road dust resuspension (90% reduction in silt content by 2030) and subsequently reduce PM_{10} and $PM_{2.5}$ emissions upto 36%.

Transformation due to Intervention

The integration of an audit-based payment system for Mechanized Road Sweepers (MRS) within Lucknow's Smart City 311 App has revolutionized road dust management by enhancing the monitoring and efficiency of MRS operations. The project aims to achieve significant reductions in PM_{10} and $PM_{2.5}$ emissions, contributing to cleaner air and better public health. This innovative approach exemplifies the use of technology in achieving sustainable urban development goals.

Challenges

1. Lack of understanding of the machine maintenance status.
2. During this monitoring, it was observed that some MRS machines were not meeting the required specifications.
3. There were no designated silt disposal sites.
4. Gaps were identified in the sweeping operations.
5. Drivers experienced challenges in inputting the data.
6. There are a limited number of well-trained operators/drivers who understand machine maintenance.

Strategies to Resolve Challenges

1. Standard Operating Procedures (SOPs) were prepared for the operation and monitoring of the brush, recommending replacement after 1,000 km of usage.
2. An SOP was designed for proper and regular machine maintenance.
3. Two disposal sites were allocated for dust disposal from MRS machines.
4. To better monitor the sweeping operations, cameras were installed on these machines, and the data was integrated with the Integrated Command and Control Centre (ICCC) for monitoring.
5. Workshops are conducted for the proper training and capacity building of all operators/drivers.

Details of the Intervention

Duration of implementation
1 year

Cost
Rs. 0.4 Cr

Implementing authority
- Lucknow Municipal Corporation (LMC)
- Directorate of Environment (DoE), UP

Source of funds
National Clean Air Programme (NCAP)

Contact person
Name: Ms. Divya Singh
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9

Guwahati

Waste and Biomass

Introduction of Electric Vehicles for Solid Waste Management

Solid waste management in Guwahati is a critical issue due to rapid urbanization and population growth. The city's waste disposal systems struggle to keep up with the increasing volume, leading to environmental pollution and health hazards. Inefficient waste segregation, lack of infrastructure, and limited public awareness further adds to the problem of unscientific dumping and burning of municipal waste.

Addressing these challenges is essential for sustainable urban development in Guwahati. Thus, under this initiative 120 e-tricycles were procured by Guwahati Municipal Corporation for collection of the waste and regular removal of other garbage from municipal drains. The e-cycles have been deployed in 60 wards of the city.



120
E-tricycles



Problem(s) Addressed

Collection of municipal solid wastes.

Impacts of the Intervention

1. 120 e-tricycles were procured for collecting the solid waste and desilting of the municipal roads & 143 drains. The e-cycles are deployed in 60 wards of the city.
2. Improvement in air quality and reduction in GHG emissions.
3. These sleek e-tricycle can collect waste from narrow lanes, which has resulted in reduction in incidences of biomass burning.


Isha
ENGINEERS
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CLEAN
GUWAHATI
GREEN
GUWAHATI
WET


GMC



Transformation due to the Intervention

These e-tricycles, designed to navigate narrow lanes efficiently, contribute to significant improvements in air quality and reductions in greenhouse gas (GHG) emissions. Their deployment has also led to a decrease in biomass burning incidents, as the e-tricycles effectively manage waste in areas previously difficult to access. The integration of these eco-friendly vehicles supports the city's broader environmental goals.

Challenges

1. Limited availability of charging infrastructure.
2. Hilly terrain and narrow streets in some parts of the city could affect the stability and maneuverability of EVs.
3. The lack of trained personnel to handle and maintain EVs.



Strategies to Resolve Challenges

1. Expand Charging Infrastructure: Invested in building a widespread network of fast-charging stations, especially in strategic locations like waste management hubs and along major routes.
2. Vehicle Customization: Designed and customized EVs to suit the city's terrain and narrow streets, ensuring they can handle the specific challenges of hilly terrain.
3. Training Programs: Implemented training programs for municipal workers to ensure they are skilled in operating and maintaining EVs, thus reducing downtime and increasing efficiency.

Details of the Intervention

Project Duration
5 Years

Cost
Rs. 6.69 Cr

Implementing authority
Guwahati Municipal Corporation (GMC)

Source of funds
NCAP and SBM

Contact person
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10 BHUBANESWAR

Innovative Approach

Low Emission Zone at Ekamra Kshetra

The city of Bhubaneswar is taking significant strides towards a greener and more sustainable future by identifying **Integrated Low Emission Zone (LEZ)** and implementing action plan to reduce air pollution, enhance public health, and improve the overall quality of life for its residents.

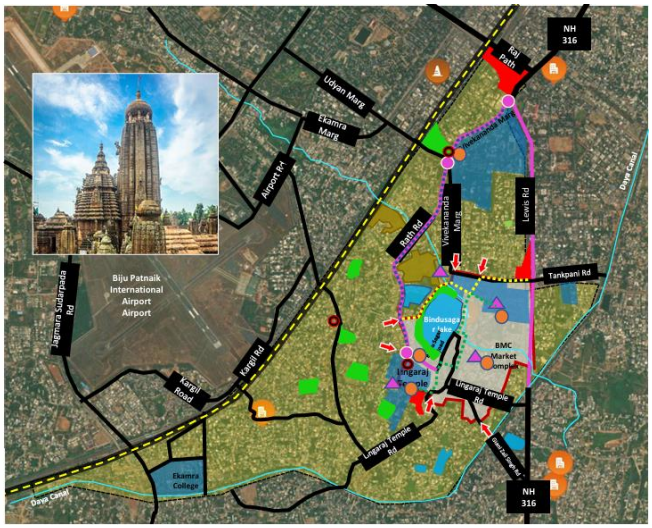
Establishment of low-emission zone in ongoing at Ekamra Kshetra around Lingaraj Temple covering an area of 4.5 sq. km. The City Development Plan (CDP) for Bhubaneswar, 2030 divides the Ekamra Kshetra heritage zone into three parts. The outer core covers an area of 2 sq. km., the central core covers an area of 2 sq. km. and the inner core which covers an area of 0.5 sq. km. As per the LEZ plan, certain activities in the area will be regulated to improve the air quality such as restriction on vehicular movement, encouraging eco-friendly transportation and an urban toll scheme.

The integrated approach combines technological innovations, public awareness campaigns, and policy measures, making it a model for other cities aiming to combat urban pollution and embrace sustainable development.

Problem(s) Addressed

Identified Hotspots exceeding PM levels and mitigating actions taken to reduce the PM levels.

Stringent regulations at high public footfall areas, to curb air polluting such as vehicular emissions, Road dust, Wood burning, Solid waste, DG sets, and C&D waste



Impacts of the Intervention

1. Improved air quality: Expected 69% reduction in particulate concentration from current levels.
2. Development of green buffer zone.
3. Reduction in noise pollution due to decrease in plying of vehicles and restriction on activities.
4. Improved Aesthetics of the heritage zone.
5. Introduction of renewable energy systems and related measures.
6. Better facilities for tourists.

Challenges

1. **Coordination Across Multiple Agencies**
2. **Engaging Stakeholders** and balancing the diverse interests and concerns of various groups.
3. **Effective Citizen Participation & building trust**
4. **Ground implementation challenges in the heritage zone**

Strategies to Resolve Challenges

1. Stakeholder involvement from the beginning and Multi-agency coordination
2. Trust-building exercises with citizen and public representatives
3. Convergence with other programs

Transformation due to the Intervention

The LEZ will improve traffic management and provided better amenities for tourists, transforming the heritage zone into a cleaner and more organized space.

Details of the Intervention

Duration of implementation
Ongoing

Implementing authority
Bhubaneswar Municipal Corporation, Bhubaneswar Development Authority

Source of funds
National Clean Air Programme (NCAP)

Contact person
Name: Shri Balwant Singh
Designation: Vice Chairman
Organisation: Bhubaneswar Development Authority
Email: bdabbsr1983@gmail.com
Tel.: 0674-2396437





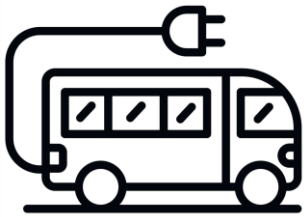




11 NAGPUR

Vehicles

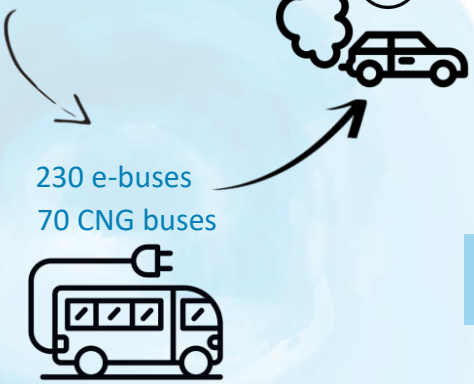
Greening Nagpur's Urban Mobility: The Shift to CNG and Electric Buses



In response to the increasing vehicular emissions from road vehicles, CNG and e-buses were introduced in Nagpur in 2019. Presently, the city has 230 e-buses and 70 CNG buses in operation, which are helping to reduce vehicular emissions. CNG buses have led to an estimated reduction of 3.2 kg/d of PM and e-buses have contributed to a reduction of 9.5 kg/d of PM, collectively improving air quality in the city. The initiative aims to replace 25% of diesel-based buses with electric buses by 2025.

Buses have been procured under various convergence schemes of NCAP. The Nagpur Municipal Corporation procured 40 buses under FAME-II, 40 buses from Smart City funds, and 144 buses from the NCAP/XVFC funds.

Nagpur Municipal Corporation



230 e-buses
70 CNG buses

3.2 kg/d of PM reduction – CNG buses
9.5 kg/d of PM reduction – e-buses

Problem(s) Addressed

- **Air Pollution** from diesel-driven buses
- **Noise Pollution** from diesel buses


महिला करीता
महिला करीता
Electra
.nagpur


ZERO EMISSION



Challenges

1. Establishing necessary infrastructure such as CNG refueling stations and electric charging station points
2. Costs for establishing a charging network for E-buses.
3. Electric buses face challenges related to battery range and charging times. The limited range can affect route planning and scheduling, especially on longer routes or during peak hours.
4. The operation and maintenance of CNG and electric buses require specialized knowledge and skills.
5. Electric buses require big land parcels to develop depots for charging and maintenance. Therefore, identifying and allocating suitable land parcels for developing depots and developing upstream grid infrastructure presents a challenge in urban areas.
6. The energy efficiency of electric buses can be lower during peak hours due to the overcrowding of passengers.
7. Given the early stage of e-bus adoption in India, production capacity is currently low, posing challenges related to high-volume supply orders and timely delivery of electric buses.



Strategies to Resolve Challenges

1. Nagpur overcame financial challenges by utilizing financial incentives under the FAME scheme which provided subsidies that brought down the initial upfront cost of procuring these buses.
2. Focussed on building a comprehensive network of CNG and electric charging stations across the city, including fast charging stations, to support the new fleet.
3. Training programmes for drivers, technicians, and maintenance staff to develop the necessary expertise for operating and maintaining the new buses for ensuring smooth operation.
4. Collaborated with domestic manufacturers to boost local production capacity, ensuring a steady supply of electric buses despite initial limitations.
5. Implemented real-time monitoring and route optimization systems to manage passenger loads and improve energy efficiency during peak hours.
6. Worked closely with urban planning authorities to identify and secure land for developing depots and charging infrastructure, overcoming land availability challenges.
7. Collaborated with utility companies to upgrade the power grid, ensuring it could support the increased demand for electric bus charging stations.

Details of the Intervention

Duration of implementation
6 years

Cost
Rs. 119.98 Cr

Implementing authority
Nagpur Municipal Corporation

Source of funds
National Clean Air Programme (NCAP), 15th Finance Commission, Smart City Mission and FAME II

Contact person
Name: Dr. Sandeep Narnaware
Designation: Consultant A, NCAP
Organisation: CPCB posted at Nagpur Municipal Corporation
Email: cgecbncapsandeep@gmail.com
Tel.: +91 9637730785



Impacts of the Intervention

1. **Reduction in Air Pollution:** The operation of CNG and electric buses has resulted into reduction of particulate matter emissions from the transportation sector.
2. **Decarbonize urban mobility** through the electrification of the public bus fleet.
3. Electric buses, in particular, have contributed to a reduction in the city's **carbon footprint.**
4. There has also been **a reduction in noise pollution** caused by buses as electric buses have lower noise levels compared to diesel and CNG buses.
5. These new e-buses have been specially designed to be accessible to differently-abled citizens. Electric bus fleet named "Tejaswini" is exclusively launched for women.

Transformation due to the Intervention

The introduction of 230 e-buses and 70 CNG buses has significantly reduced vehicular emissions, especially particulate matter, supported decarbonization efforts, and improved ambient noise quality. The project has also enhanced public transport accessibility, particularly for differently-abled citizens.

12 INDORE

Public outreach

Public Awareness Campaigns on Pollution Sources and Control Measures

Indore is a fast-urbanizing, metro in Madhya Pradesh and faces significant air pollution challenges, primarily due to road dust, vehicular emissions, industrial activities, and biomass/garbage burning. Public awareness campaigns play a crucial role in controlling air pollution by educating the public about the causes and consequences of polluted air and encouraging behavioral changes that reduce emissions.

These campaigns can increase awareness of the sources of air pollution, such as vehicle emissions, industrial activities, and burning of fossil fuels, and promote practices that minimize pollution, like using public transportation, reducing energy consumption, and supporting clean energy initiatives. Raising awareness can empower the community and individuals to make informed decisions that help reduce air pollution and improve the overall quality of life in Indore.

By informing citizens about the health risks associated with air pollution and providing practical steps for mitigation, public awareness campaigns foster a collective sense of responsibility and encourage community action. A campaign named **“Bhatti Free Market”** where the Hotel/ Marriage Gardens/ Restaurants and Industries were encouraged to shift from conventional fuels like wood and coal for their Tandoors to cleaner fuels like LPG/CNG or electricity etc. Many such campaigns were organized with the engagement of the Traffic Police Department, Student Volunteers, and NGOs to educate commuters to conserve energy (fuel) and reduce air pollution while idling at traffic signals.





Problem(s) Addressed

1. **Mass awareness**: Information for the public regarding the effects of air pollution and awareness about the health effects of waste and biomass burning.
2. **Replacing Tandoors with cleaner alternatives**: The city is famous for its crowded markets, such as Sarafa Bazaar and Chappan Dukan, which are always bustling with people, vendors, and vehicles. These markets are popular for their street food, which is cooked using conventional dirtier fuels. The congestion in these markets also contributes significantly to air pollution due to vehicle emissions, dust, and waste from various market activities.

Impacts of the Intervention

1. Two of the very famous Street food markets viz. Chappan Dukan and Meghdoot Choupati Market are declared as **Bhatti Free**.
2. **102 industries** have shifted to clean fuel technology and several restaurants shifted to electric tandoor.
3. Campaigns such as “Red Light ON, Engine Off” focused on switching off vehicle engines at red light junctions, which helped in reducing vehicular exhaust, being conducted at regular intervals.
4. Using Cycles for day-to-day, short commutes is a common practice amongst the people of Indore.
5. Indore Municipal Corporation Celebrated **International No Car Day 2023.**



Red Light ON



Engine Off

Transformation due to the Intervention

The public awareness initiatives in Indore have led to a significant reduction in air pollution, with campaigns like "Bhatti Free Market" and "Red Light ON, Engine Off" driving behavioral change and the adoption of clean energy. The shift to cleaner fuels by industries and the increased use of cycling and public transport reflect the community's growing commitment to sustainability. These efforts have successfully transformed Indore into a model for effective urban pollution management, despite initial challenges in public engagement.




सर्वेक्षण 2023
NATIONAL CLEAN AIR PROGRAM
"इंटरनेशनल डे ऑफ़ क्लीन एयर फॉर ब्लू स्काय"
के उपलक्ष्य में आयोजित
RED LIGHT ON
इंजन OFF
- अभियान -
स्वच्छ शहर की वायु को बनाएँगे और भी स्वच्छ
इंदौर रहेगा स्वच्छ वायु में भी नंबर 1



Challenges

1. Difficulties in engaging and involving the public in awareness initiatives.
2. Resistance to changing long-established practices.



Strategies to Resolve Challenges

1. **Community Fairs**: Set up interactive booths with activities and demonstrations on air pollution and its effects.
2. **School Programs**: Implemented curriculum and activities related to air quality in schools to educate children and involve parents too.
3. **Influencer Partnerships**: Collaborate with local influencers and celebrities to reach the broader audience.
4. **NGOs and Environmental Groups**: Partnerships with organizations that have expertise in environmental issues to co-host events and distributed educational materials.
5. **Public Transportation Initiatives**: Promote car-free days and incentivize the use of public transport, biking, or walking.

Details of the Intervention



Implementing authority
Indore Municipal Corporation



Source of funds
Swachh Bharat Mission (SBM) 2.0 and 15th Finance Commission Funds



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13 GORAKHPUR

Waste and Biomass

Optimizing Solid Waste Management through Strategic Garbage Transfer Stations

The Gorakhpur Municipal Corporation faced significant challenges in waste management due to an inefficient door-to-door waste collection system. The city deployed 247 waste collection vehicles, which were parked at night on the outskirts, leading to delays in morning operations. These delays resulted in the accumulation of waste in unauthorized areas, causing public health hazards and environmental issues.

To address these challenges, the Gorakhpur Municipal Corporation established two Garbage Transfer Stations, each with a capacity of 200 tons per day (TPD). This initiative aimed to streamline waste collection, improve operational efficiency, and reduce the environmental impact associated with improper waste management and waste burning.

The creation of the Garbage Transfer Stations was completed within 18 months, with operations beginning in March 2023.

Problem(s) Addressed

Vehicular Emissions: Inefficient waste collection and transportation led to multiple trips by small vehicles, contributing to increased air pollution.

Inefficient Waste Management: The frequency of trips to distant disposal sites resulted in delays and the accumulation of waste in open areas.

Open Waste Burning: To mitigate foul odors from open waste dumps, citizens resorted to burning waste, exacerbating air pollution.

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Impacts of the Intervention

1. **Air Quality Improvement:** 62% reduction in PM10 levels due to decreased open waste burning and optimized transportation, leading to lower emissions.
2. **Emission Reduction**: Reduction in CO2 and other greenhouse gases (GHGs) due to fewer waste transportation trips.
3. **Environmental Benefits:** Improved waste segregation and recycling have reduced the volume of waste sent to landfills, thereby lowering methane emissions.
4. **Energy Savings:** Enhanced transportation efficiency has reduced fuel consumption, contributing to overall energy savings.
5. **Operational Efficiency:** Consolidated waste management operations have streamlined processes, making waste handling more efficient and environmentally friendly.
6. **Behavioral Change:** Increased public awareness and participation in waste segregation at the source.
7. **Societal Impact:** Creation of new job opportunities for both men and women in the region.
8. **Replication Potential:** The success of these transfer stations offers a replicable model for other cities facing similar challenges.



Transformation due to the Intervention

1. **Operational Efficiency & reduced garbage burning:** The consolidation of waste management operations has streamlined processes, making waste handling more efficient and environmentally friendly. Thus, instances of garbage burning have been reduced.
2. **Behavioral Change & Public Trust:** Increased public awareness and participation in waste segregation at the source.
3. **Replication Potential:** The success of these Transfer Stations offers a model that can be replicated in other cities facing similar challenges.





Challenges

Public Resistance: Initial resistance arose from residents concerned about odors and environmental impacts near the Garbage Transfer Stations, fearing potential negative effects on their quality of life and local environment.

Logistical Challenges: The project encountered traffic congestion around construction sites and frequent equipment breakdowns, which delayed progress and posed safety risks.

Financial Sustainability: The high operational costs raised concerns about the long-term viability of the stations, necessitating careful financial planning to avoid future financial strain on the municipality.

Details of the Intervention

Project Duration
1.5 years

Cost
Rs. 23 Cr

Implementing authority
Gorakhpur Municipal Corporation

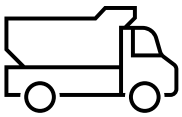
Source of funds
Swachh Bharat Mission Urban and NCAP

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14 BHOPAL

Waste and Biomass

CNG-powered Vehicles for Door-to-Door Waste Collection



Bhopal, the capital of Madhya Pradesh, is recognized as one of the greenest cities in India. However, like many urban areas, it faces various sources of air pollution. According to the Emission Inventory and Source Apportionment Study, the top contributors to PM10 emissions are Road Dust (62.2%), Transport (13.0%), Construction & Demolition (12.1%), and Open Waste Burning (2.9%). For PM2.5 emissions, the leading sources are Road Dust (37.7%), Transport (29.3%), Construction & Demolition (7.6%), and Open Waste Burning (6.7%).

To address this, an intervention has been introduced involving the adoption of CNG-powered vehicles for door-to-door waste collection. This initiative, funded by UNIDO, NCAP, and the XV-FC grant, aims to replace 250 diesel-powered collection vehicles with CNG vehicles by the end of December 2024. Currently, 145 of these CNG vehicles have been procured and are in operation.

CNG (Compressed Natural Gas) is a cleaner fuel that emits fewer harmful pollutants, helping to reduce overall pollution levels in the city and contribute to a healthier environment for its residents.

Problem(s) Addressed

1. **Air Pollution:** Diesel-powered vehicles are contributors to air pollution.
2. **Disrupted SWM services:** The number of operational vehicles available in the fleet was always subject to their effective maintenance and due to the high costs associated there were delays in the same which led to disruption in the overall SWM services.


सूखा कचरा



Challenges

1. **Limited Infrastructure:** Lack of sufficient CNG refueling stations could restrict and impact daily operations.
2. **Cost constraints:** CNG vehicles often have higher capital costs compared to petrol and diesel vehicle.
3. Lack of awareness and training for operators and mechanics regarding the operation and maintenance of CNG vehicles.
4. **Safety Concerns** from the high-pressure gas tanks.



Strategies to Resolve Challenges

1. Bhopal Municipal Corporation has collaborated with an Agency (THINK GAS) to facilitate CNG Stations at various locations in Bhopal therefore ensuring effective operations and availability of vehicles.
2. Utilized UNIDO grants and subsidies to offset the higher initial costs of purchasing CNG-powered vehicles.
3. Developed comprehensive training programs for drivers and mechanics to familiarize them with the specifics of CNG vehicle operation and maintenance.
4. Conducted campaigns to educate the public and potential users about the benefits and safety of CNG vehicles.
5. Implemented and enforced stringent safety standards for CNG vehicles and refueling stations.
6. Mandated regular inspections and maintenance checks to ensure the integrity of CNG tanks and fueling systems.

Details of the Intervention

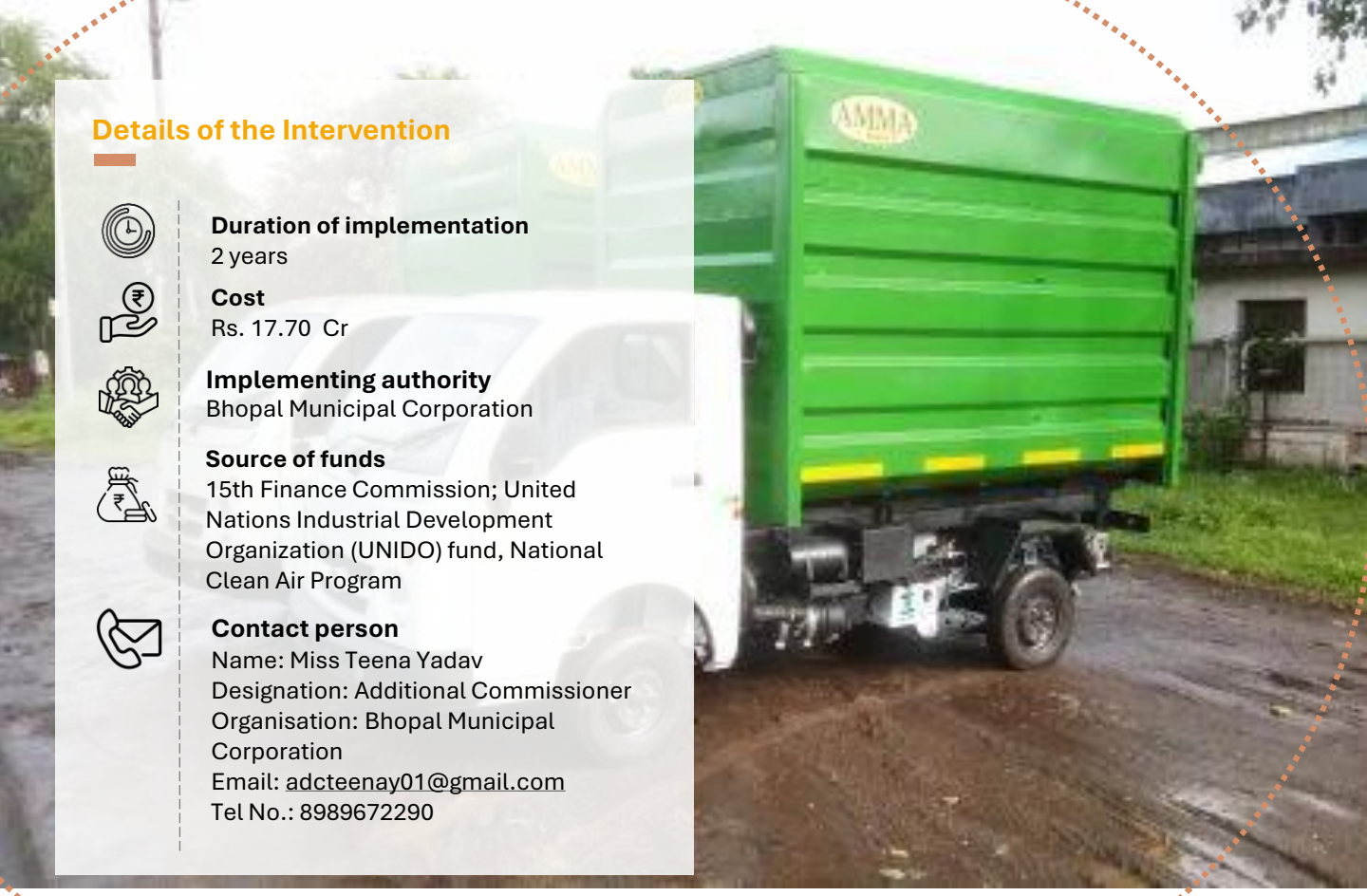
Duration of implementation
2 years

Cost
Rs. 17.70 Cr

Implementing authority
Bhopal Municipal Corporation

Source of funds
15th Finance Commission; United Nations Industrial Development Organization (UNIDO) fund, National Clean Air Program

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Impacts of the intervention

1. Air quality improvement as CNG-driven vehicles are cleaner and produce fewer emissions.
2. CNG vehicles tend to be less cost intensive in terms of O&M, resulting in lower financial implications on local authorities.
3. Given the low operations cost and ease of maintenance, more vehicles are available for SWM services, and there by fewer disruptions in the service value chain leading to effective waste management in the City.

Transformation due to the intervention

1. All the vehicles are running on the designated routes and are on time.
2. Bhopal Municipal Corporation is focused on transitioning the entire fleet to cleaner fuels, thus further improvements in air quality are anticipated.
3. These vehicles not only make waste collection more efficient but also contribute to a cleaner and healthier atmosphere.

15 VADODARA

Dust

Revitalizing Urban Spaces: Development of Urban Forests Using the "Miyawaki Technique"

Vadodara, a prominent city in Gujarat, has launched an urban forestry initiative to combat the detrimental effects of rapid urbanization. Employing the innovative **Miyawaki Technique**, the Vadodara Municipal Corporation has undertaken a project to develop dense, **native forests** in underutilized urban spaces across the city.

This project aims to improve air quality, reduce the urban heat island effect, enhance local biodiversity, and provide green, recreational spaces for residents. With a target to establish 75 urban forests within 12 months, this initiative marks a significant advancement toward creating a more sustainable and livable urban environment.

Problem(s) Addressed

Vadodara has faced increasing environmental challenges due to its rapid urban growth:

Rising Air Pollution: The city has seen an increase in PM_{10} concentration, from 95 µg/m³ in FY 2020-21 to 121 µg/m³ in FY 2021-22. This rise in air pollution has been a major concern for public health and overall quality of life.

Urban Heat Islands: The spread of concrete structures and reduction in green cover have intensified urban heat, raising the city's temperature, and contributing to climate-related stresses.

Loss of Biodiversity: The rapid pace of urbanization has resulted in the loss of natural habitats, leading to a decline in local biodiversity and the ecological resilience of the city.

These challenges emphasized the need for a sustainable intervention that could address multiple environmental issues simultaneously.


Before


After

Impacts of the Intervention

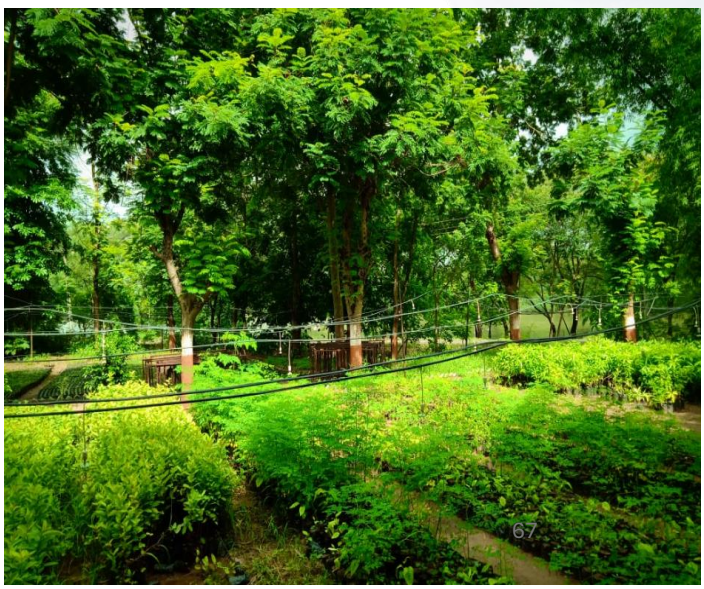
The urban forestry project in Vadodara has resulted in significant positive changes:

1. **Air Quality Improvement:** The establishment of urban forests has led to a 9% reduction in PM_{10} concentration in FY 2022-23, contributing to cleaner air as compared to FY 2021-22.
2. **Greening of Urban Spaces:** By creating dense forests using a mixed plantation of **3,000 trees** across **38 native species** in the area around **Chhani Lake**, the project has transformed previously underutilized areas into vibrant green spaces.
3. **Enhanced Biodiversity:** The introduction of diverse native species has helped restore local ecosystems, supporting a wider range of flora and fauna and contributing to the city's ecological balance.
4. **Community Benefits:** These urban forests have improved the environmental conditions and also serve as recreational & educational spaces for the community, fostering a strong connection between residents and their natural environment.

Transformation due to the Intervention

1. Development of urban forest comprising of mixed plantation of 3000 trees belonging to 38 native species, through the Miyawaki technique has been undertaken in one plot having an area of around 1000 sq m, along the Chhani Lake.
2. 72 Urban forests are completed out of 75 targeted forests.
3. Given this success, Vadodara Municipal Corporation is processing 2.5 Lakh tree plantations at traffic corridors, open areas, gardens, community places, schools, and housing societies.







Details of the Intervention

Project Duration
1 year

Cost
Rs. 2.25 Cr

Implementing authority
Vadodara Municipal Corporation

Source of funds
-

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Challenges

1. **Project Scale and Timeline:** The ambitious goal of creating **75 urban forests** within a year required meticulous planning, coordination, and resource management.
2. **Funding and Resource Allocation:** The project, with a budget of Rs. 2.25 Crores, necessitated careful financial management to cover both capital and operational expenditures.
3. **Public Engagement and Awareness:** Encouraging public participation and raising awareness about the importance of urban forests were essential for the project's success but posed significant challenges.

Strategies to Resolve Challenges

1. **Efficient Project Management:** The project was executed within the planned 12-month period, with the development of **72 out of the targeted 75** urban forests completed on schedule. The use of the Miyawaki Technique, known for its ability to accelerate forest growth, was instrumental in achieving these results.
2. **Strategic Plantation Efforts:** In addition to the primary urban forests, the project also involved planting 2.5 lakh trees in various traffic corridors, open areas, gardens, community places, schools, and housing societies, thereby enhancing the overall green cover across the city.
3. **Public Outreach and Education:** The initiative included efforts to engage the local community through awareness campaigns, workshops, and educational programs to highlight the benefits of urban forests and encourage community stewardship.

16 JODHPUR

Road Dust

Improving Road Infrastructure for Dust Control



Jodhpur faces a persistent issue of dust resuspension, which is aggravated due to its arid climate and construction activities. Addressing this challenge necessitates a combination of sustainable urban planning and consistent maintenance efforts. Effective intervention includes paving of roads, application of dust suppressants, and improving vehicle emissions controls.

Problem(s) Addressed

Unpaved and excavated roads, along with dust suspension due to vehicular movement, are significant sources of dust particles in Jodhpur.

Impacts of the intervention

1. **The reduction of road dust has improved air quality, with particulate matter in the air decreasing by 23% in FY 2021-22.**
2. **Societal benefits** include enhanced quality of life and increased property values.
3. **Energy savings** through more efficient vehicle operation on smoother, dust-free roads.
4. **Implementing proper pedestrian infrastructure** along 42 km of dust-generating roads
5. Approximately **41 km** of roads were repaired and are being maintained
6. Around **9 km of road widening in the city area** has been completed to alleviate traffic congestion and enhance vehicle efficiency on smoother, dust-free roads. Widened roads and reduced traffic congestion, has contributed to further reductions in vehicular emissions.

Challenges

1. **Public Opposition:** Resistance from local communities due to concerns over displacement or changes in the local environment.
2. **Land Acquisition:** Acquiring land for road widening can result in legal disputes and issues related to displacement.
3. **Maintaining the Infrastructure:** Long-term maintenance of newly paved or widened roads may strain local budgets.

Strategies to resolve challenges

1. Ensured transparency and clear communication with communities to address their concerns.
2. Implemented specific mitigation measures to address specific local issues.
3. Conducted thorough legal diligence before land acquisition to prevent disputes.
4. Integrated sustainable design practices to minimize long-term maintenance needs.
5. Prioritized road maintenance activities, developing operational guidelines, improving planning, effectively utilization of available resources, etc.

Details of the Intervention

Project Duration
1 year (FY 2022-23)

Cost
Rs. 46.55 Cr

Implementing authority
Municipal Corporation, Jodhpur

Source of funds
National Clean Air Programme

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17

BAREILLY

Road Dust and Construction & Demolition

Unicorn Stories/ Swachh Pawan-Sandesh



The MoEFCC has identified Bareilly as a non-attainment city due to poor air quality. In response, Bareilly implemented a strategic approach, collaborating with IIT Kanpur and other stakeholders to identify key pollution sources, such as road dust and vehicular emissions, and accordingly adopted interventions to mitigate the same.

Measures like **end-to-end pavement construction, sidewalk development, mechanized sweeping followed using anti-smog guns, pavement improvements, and green belt development initiatives** were identified and funded through various schemes, including the National Clean Air Programme (NCAP). These efforts resulted in significant air quality improvements, with 349 out of 354 monitoring days showing good air quality. The city continues to focus on sustainable solutions and collaborative efforts for future progress.



Problem(s) addressed

Bareilly faced significant challenges in addressing and mitigating key sources of pollution, including road dust and vehicular emissions. The need for a strategic, collaborative approach involving expert institutions like IIT Kanpur and various stakeholders was critical in developing and implementing effective measures to improve air quality. The city needed to overcome these challenges to achieve sustained air quality improvements and ensure long-term environmental sustainability.

Impacts of the intervention

1. The initiatives undertaken in Bareilly to improve air quality had significant and far-reaching impacts. The city has been able to implement targeted interventions. These efforts have transformed Bareilly from a non-attainment city, with high pollution levels, into one that is steadily improving its air quality.

2. One of the most notable impacts of the initiative is the reduction in PM levels, particularly through the **end-to-end pavement** of roads and **mechanized road sweeping followed by Anti-Smog gun**. These measures have directly addressed the issue of road dust, which was identified as the major contributor to air pollution. By ensuring that roads are properly paved and regularly swept, the amount of dust in the air has significantly decreased, leading to better air quality in the city.

3. The adoption of **modern technologies**, such as advanced air quality monitoring tools, have also played a crucial role in this transformation. These tools have allowed for more accurate tracking of pollution levels, enabling more effective and timely responses to pollution hotspots. Additionally, the development of green corridors, cycle tracks, and afforestation projects have contributed to a more sustainable urban environment, reducing the overall carbon footprint and promoting healthier lifestyles among residents.

Transformation due to the Intervention

1. The cumulative effect of these initiatives is evident in the city's improved air quality data. With 349 out of 354 monitoring days registering as "good air quality" days, Bareilly is making significant strides toward achieving attainment status. This progress reflects not only the success of the current strategies but also the potential for future advancements as the city continues to build on its achievements.

2. Overall, the initiatives have improved the air quality in Bareilly and set a precedent for other cities facing similar challenges, demonstrating that with the right approach, substantial environmental improvements are achievable.



Challenges

1. **Data Gaps:** One of the foremost challenges is the gap in scientific input, particularly concerning the identification and quantification of specific pollutants. Accurate data is crucial for developing targeted mitigation strategies.
2. **Requirement of Interdepartmental Coordination:** Interdepartmental communication gaps often lead to delays in implementation and inefficiencies.
3. **Capacity Building:** Another significant challenge is the need for capacity building among the staff involved in air quality management. Limited technical knowledge and skills can impede the effective implementation of advanced mitigation strategies and the use of new technologies.
4. **Requirements of Task Force:** While the establishment of a Task Force is crucial, ensuring that it operates effectively requires careful planning and resource allocation. The absence of a dedicated task force or its inadequate functioning can slow down the implementation of strategies.
5. **Development of Mitigation Strategies:** The development of effective mitigation strategies is a complex task that requires a deep understanding of the pollution sources, available technologies, and socio-economic factors.



Strategies to Resolve Challenges

1. **Collaboration with academic and research institutions** (*Bareilly has already partnered with IIT Kanpur*) for the Emission Inventory and Source Apportionment Study, which provides a strong foundation.
2. Establishing a **dedicated Air Quality Task Force** with representatives from all relevant departments can enhance coordination. **Regular review of progress** was conducted to assess progress towards goals and to address challenges, and ensure that all departments are aligned in their efforts.
3. Regular training programs and workshops were organized to build the technical capacity of staff across all departments.
4. Formation of a robust **Air Quality Task Force** was prioritized.
5. Development of localized, **data-driven mitigation**: These strategies are based on scientific studies, such as the Source Apportionment Study, and tailored to the unique environmental and socio-economic context of Bareilly.





Details of the Intervention

Project Duration
2 years (2022-23 & 2023-24)

Cost
Rs. 270.11 Cr

Implementing authority
Nagar Nigam Bareilly

Source of funds
NCAP, SBM 2.0, Smart City Mission, and others

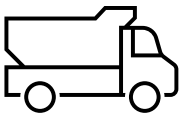
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18 VADODARA

Waste and Biomass

Transforming Waste to Resource: The Bio-Remediation Project



The Atladara dumpsite, located in the centre of Vadodara, had long posed significant environmental and public health challenges due to its close proximity to residential areas and central location. Recognizing the urgent need for remediation, the Vadodara Municipal Corporation initiated Gujarat's first Zero-Residue model bio-remediation project at this site. This innovative project aimed to address the severe pollution caused by leachate leakages and to reclaim & repurpose the land for sustainable use. The project transformed the abandoned dumpsite into a model of environmental restoration and resource efficiency, setting a precedent for urban waste management across the state.

Problem(s) Addressed

The Atladara dumpsite represented a significant environmental and public health hazard for Vadodara:

1. **Leachate Pollution**: The absence of a bottom lining at the site resulted in leachate flow, which severely polluted the **Vishwamitri River** and contaminated the city's groundwater resources. This pollution posed a threat to human health and adversely affected local ecosystems, particularly the habitat of the threatened mugger or marsh crocodile.
2. **Public Health Hazards:** Leachate leakage and frequent fires at the dumpsite have caused substantial health risks for the thousands of residents living within 300 meters of the site.

These issues emphasized the urgent need for a comprehensive remediation strategy to address the environmental and health impacts of the dumpsite.

Impacts of the Intervention

The bio-remediation project at Atladara has provided significant positive impacts:

1. **Environmental Benefits:** The Vadodara bio-remediation initiative has been instrumental in safeguarding the Vishwamitri River ecosystem which is a home to the threatened reptile species mugger or marsh crocodile (protected under Schedule I of the Indian Wildlife (Protection) Act, 1972) by effectively eliminating leachate from the former dumpsite.

2. The reclamation of the dumpsite land has allowed for afforestation efforts and the establishment of a plastic waste processing plant. These initiatives have led to the reduction of 166.2 thousand tons of methane (CH_4) and 4.1 million tons of carbon dioxide (CO_2), resulting in a notable reduction in GHGs and improving air quality.

3. **Societal Benefits:** Elimination of the dumpsite has removed the risks of pestilence and other public health hazards, greatly improving the quality of life for residents in the vicinity. The project has repurposed the land for urban development, supporting the city's growth in a sustainable manner.

Details of the Intervention

Project Duration
1.5 Years

Cost
Rs. 33.26 Cr

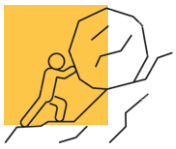
Implementing authority
Vadodara Municipal Corporation

Source of funds
NCAP, SBM 2.0, Smart City Mission, and others

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Before


After



Challenges

The project encountered several challenges during its implementation:

1. **Absence of Bottom Lining:** The lack of a bottom lining at the dumpsite was a major challenge, facilitated uncontrolled leakage of leachate. This not only contaminated the soil and water but also complicated the remediation process.
2. **Environmental Hazards:** The presence of fires and other hazardous conditions at the dumpsite posed significant risks during the remediation process, requiring careful management and mitigation strategies to ensure the safety of workers and nearby residents.



Strategies to Resolve Challenges

1. **Advanced Bio-Remediation Techniques:** The project was meticulously planned and executed within a timespan of 18 months using advanced bio-remediation techniques to treat the waste and eliminate leachate. The project adhered to a zero-residue model, ensuring that all aggregates produced were either recycled, reused, or repurposed.
2. **Third-Party Assessment and Transparency:** A third-party assessment was conducted to ensure the project's adherence to principles of testing, traceability, technology, and transparency. This rigorous oversight helped in maintaining project's integrity and effectiveness, ultimately leading to its success.

19 JABALPUR

Waste and Biomass

Scientific Disposal of MSW through Waste to Energy Plant

'Waste-to-Energy' is a method of scientifically disposing municipal solid waste and addressing air pollution problem that may arise from waste burning. The Municipal Corporation of Jabalpur planned to establish a Waste to Energy (WtoE) Plant at Village Kathoda, Jabalpur, which is based on Mass Burning Technology.

Municipal Corporation Jabalpur signed a Concession Agreement for 20 years with M/s Essel Jabalpur MSW Pvt Ltd (SPV of M/s Essel Infra Projects Mumbai) as Design, Build, Operate, and Transfer Model (DBOT). M/s Essel Jabalpur MSW Pvt. Ltd. started work to process the 600 MT Municipal Solid Waste generated from Jabalpur City on Mass Burning (Waste to Energy Technology) with a technology partner by M/s Hitachi Zosen. As per the Concession Agreement Municipal Corporation will receive Rs.20.70/MT royalty from Concessionaire. The generation of electricity from 600 MT is proposed to be 11.5 MW, out of which 9.2 MW electricity will be supplied on MPEB Grid with a Power Purchase Rate of 6.39 /unit.

Problem(s) addressed

Improper management and unscientific disposal of municipal solid waste (MSW) can cause environmental and public health issues. Burning of waste unscientifically can lead to air pollution and cause health problems due to the emission of toxic fumes.

Impacts of the intervention

1. **Reduction in Landfill Use:** A huge portion of waste is diverted from landfills to the WTE plant, reducing land use and mitigating environmental impacts like groundwater contamination.
2. **Energy Recovery:** The plant converts waste into electricity
3. **Reduced Pollution:** Modern WTE plants are equipped with advanced emission control systems, reducing the release of harmful pollutants.
4. **Revenue Generation:** The plant generates revenue by selling electricity produced from waste and is a sustainable model. The waste-to-energy plant processes more than 550 tons of waste a year and generates about 11.5 MW of electricity annually.
5. **Cost Savings:** Reduced landfill usage can lead to long-term savings in waste management.
6. **Public Health Improvement:** Reduced reliance on landfills can lead to better air and water quality, improving public health.
7. **Waste** in reduced by 90% in volume, leaving only stabilized ash to be stored at landfill site.



Transformation due to the intervention

1. Regular collection and disposal of approx. 550 TPD quantity of municipal solid waste helps in reduction of open garbage burning.
2. Approximate 11.5 MW of electric power is generated during the process
3. In waste to energy plant, the air pollution control devices are installed for controlling the air pollutants
4. Waste to energy plant also contributes to reducing greenhouse gases.



Challenges

1. Waste Supply: The plant requires a continuous supply of waste to operate efficiently, which may require adjustments in waste collection and sorting practices.
2. Decomposing organic waste in landfills produces methane, a potent greenhouse gas, that contributes to climate change, and due to a lack of proper collection and transportation system, adequate waste arrives at the plant.
3. Due to the lack of adequate waste disposal at the plant, its operational efficiency is also impacted.
4. Accumulation of waste in landfills can result in unpleasant odors, pest infestations, and the emission of harmful leachates and gases.
5. Bringing awareness among residents, especially on waste segregation at source and burning of waste in open spaces was a big challenge.
6. High cost of setting up WtoE plant and availability of space for setting up plant

Strategies to resolve challenges

1. The Municipal corporation has a dedicated team of wards Incharge, SOP (as prescribed under SBM-U), and safaikarmis who ensure proper collection and segregation of waste.
2. Modern WTE plants are equipped with advanced emission control systems, reducing the release of harmful pollutants.
3. Various IEC activities at a mass scale at the local level to make residents aware of the negative impact of waste burning and throwing waste in open spaces.
4. The Central Government Scheme provided subsidies and grants to offset the high upfront costs of setting up plants.
5. Through consultation with local representatives and officials of Jabalpur Municipal Corporation, the land was identified and allotted for the plant.

Details of the Intervention

Cost
Rs. 178 Cr

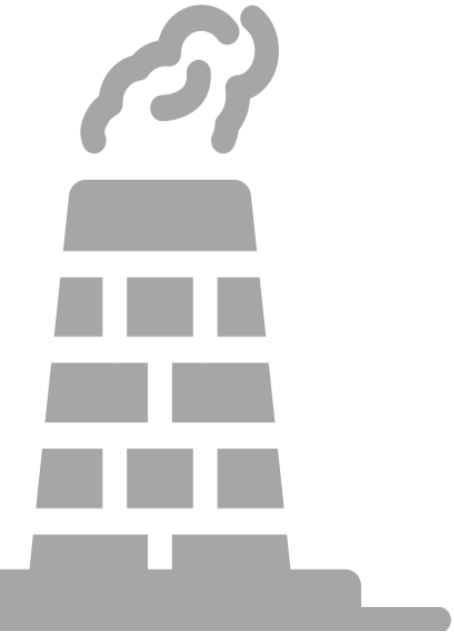
Implementing authority
- Jabalpur Municipal Corporation (JMC)
- Implementation Agencies- (JMC and Essel). JMC provided Land, cost-bearing Essel (contractor)

Source of funds
Jabalpur Municipal Corporation land and rest construction cost ESSEL (private contractor) - PPP model-based project.

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Industry

GeoAI: An effective tool for monitoring and Regulating Brick Kiln



In Bihar, a initiative has been implemented to combat air pollution caused by traditional brick kilns, which have been a major source of environmental degradation and public health concerns in the region. The operation of these brick kilns typically involves the burning of coal and other materials, leading to the release of significant amounts of particulate matter (PM), sulfur dioxide (SO_2), and other harmful pollutants.

Traditional brick kilns are often difficult to regulate, however, the introduction of GeoAI (Geospatial Artificial Intelligence) technology is useful in addressing this challenges.

GeoAI technology combines satellite imagery, machine learning algorithms, and geospatial analysis to identify and monitor the location and operational status of brick kilns across large areas. This technology enables real-time monitoring of brick kiln emissions, allowing authorities to pinpoint non-compliant kilns and prioritize them for regulatory action.

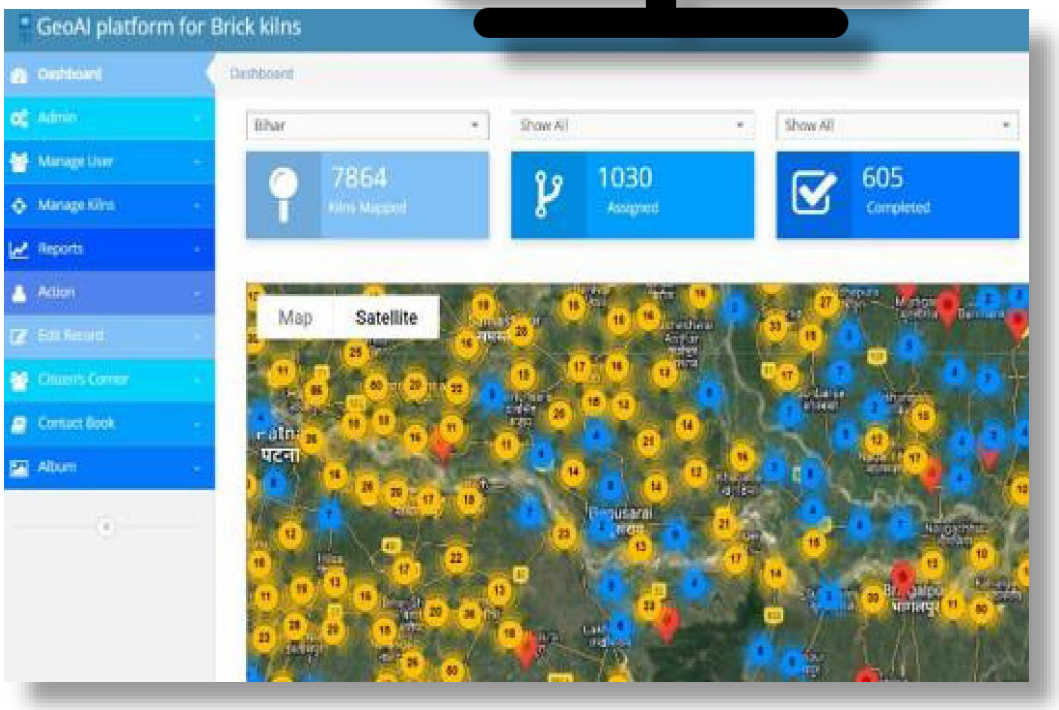
The initiative, a collaborative effort between the Bihar State Pollution Control Board (BSPCB) and the United Nations Development Programme (UNDP), has already demonstrated significant environmental and public health benefits. By using GeoAI technology, the project has made it possible to systematically identify and assess the environmental impact of brick kilns, leading to more effective enforcement of regulations and the promotion of cleaner production practices.

This initiative leverages GeoAI technology, an innovative solution for monitoring and regulating brick kilns to ensure compliance with environmental standards. The project, a collaborative effort involving the Bihar State Pollution Control Board (BSPCB) and the United Nations Development Programme (UNDP), has led to significant environmental and public health benefits.

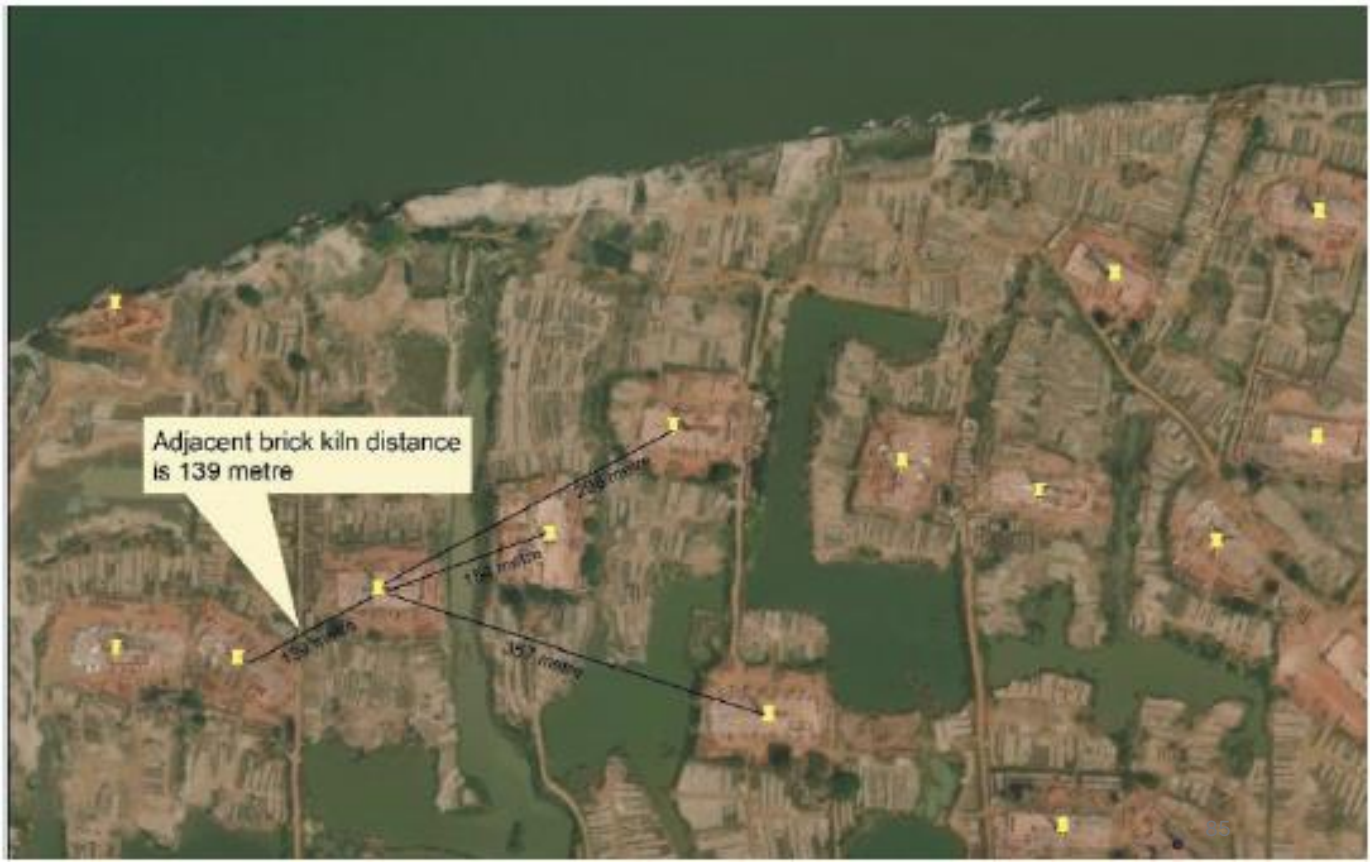
Problem(s) Addressed

Brick kilns contribute significantly to air pollution with emissions spreading downwind and causing respiratory ailments among workers and residents. Despite mandates from the Central Pollution Control Board (CPCB), only 70% of brick kilns have adopted the more environmentally friendly zigzag technology. Additionally, many kilns suffer from low fuel efficiency and improper ash layer management, resulting in high emissions.






N
Image © 2017 DigitalGlobe
195 m
2003
Google Earth
Imagery Date: 11/15/2014 26°52'56.24" N 75°57'09.16" E elev 359 m eye alt 1.20 km


Adjacent brick kiln distance is 139 metre



Details of the Intervention

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Impacts of the Intervention

The initiative has led to significant improvements:

1. Transitioned 1,000 brick kilns to green technology, specifically zigzag kilns.
2. Transition to zigzag kilns resulted in a 20% reduction in coal consumption, a 75% reduction in black carbon emissions and suspended particulate matter, and a 20% reduction in specific energy consumption.
3. An annual reduction of 500,000 tons of CO_2 emissions.

Transformation due to Intervention:

1. GeoAI successfully identified over 9,000 brick kilns in Bihar.
2. 1,655 kilns were classified as high-risk and 1,013 brick kilns were prioritized for inspection.

21 ELURU

Waste and Biomass

Implementation of LPG-Fired Crematoriums

Eluru City, situated in the West Godavari district of Andhra Pradesh, India, is rapidly evolving as a significant urban hub. With a steadily increasing population, the city faces growing demands for various essential municipal services, one of the most critical being the provision of adequate cremation facilities. Traditionally, wood-fired crematoriums have been used to meet these needs; however, they contribute to significant environmental concerns, primarily high levels of emissions. Recognizing the urgent need to address these environmental challenges, the Eluru Municipal Corporation has initiated the installation of **LPG-fired crematoriums**.

This modern alternative to traditional crematoriums is designed to offer a more controlled and eco-friendly approach to cremation, significantly reducing the emission of harmful pollutants such as particulate matter, carbon monoxide, and volatile organic compounds. The shift to LPG-fired systems is not only a response to the increasing demand for cremation services but also a proactive measure to enhance the city's environmental sustainability and improve the overall quality of life for its residents.

Problem(s) addressed

1. Traditional wood-fired crematoriums are significant contributors to air pollution, releasing harmful substances such as particulate matter (PM), carbon monoxide, volatile organic compounds (VOCs), ash, and residues into the environment. The combustion of wood emits large quantities of carbon dioxide and other pollutants, which pose serious health risks when inhaled.

2. In Eluru, the continuous smoke from biomass burning at these crematoriums has been a major issue, particularly in residential areas. Each crematorium has been found to adversely affects the health of approximately 5,000 individuals living nearby. These emissions degrade air quality, affecting respiratory health and impacting overall environment.

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Before



After



Impacts of the intervention

1. **Lower Emissions:** LPG (liquefied petroleum gas) burns more cleanly than wood, producing fewer pollutants such as particulate matter and carbon monoxide, thereby reducing overall air pollution in the area.
2. **Efficient Combustion:** More efficient combustion of LPG results in reduced smoke and ash production. This means that less particulate matter and other pollutants are released in the atmosphere, thereby reducing its adverse impact.
3. **Reduced Environmental Impact:** LPG facilitates mitigation of environmental impact of cremation, making it a more sustainable option compared to traditional wood burning.
4. **Reduction in Bottom Ash:** LPG utilization has led to an approximately 80% reduction in the generation of bottom ash by weight.

Transformation due to the intervention

The eco-friendly LPG based crematorium emit less smoke and reduce wood consumption for the last rites.

Challenges

1. **High Initial Costs:** LPG-based crematoriums require significant upfront investment for equipment and installation.
2. **Regulatory Compliance:** Ensuring that the crematorium adheres to all environmental and safety regulations can be challenging.
3. **Public Acceptance and Sensitivity:** There was resistance from local communities due to cultural and environmental concerns.
4. **Technical and Operational Challenges:** Managing the technical aspects of LPG systems and ensuring their efficient operation posed difficulties.

Strategies to resolve challenges

1. **Funding:** Funds from the National Clean Air Programme (NCAP) and Swachh Bharat Mission 2.0 (SBM 2.0) were utilized for the installation of the crematorium.
2. **Regulatory Compliance:** Collaboration with regulatory bodies ensured adherence to all environmental regulations. Necessary permits and certifications were also obtained.
3. **Community Engagement:** Engaged with community leaders, conducted public consultations, provided information about the benefits and safety measures, and proactively addressed concerns.
4. **Professional Expertise:** Experienced professionals were hired for installation and maintenance. Training was provided for operators, and a robust maintenance schedule was established to ensure reliability.

Details of the Intervention

Project Duration
1.5 years

Cost
Rs. 1.52 Cr

Implementing authority
Municipal Corporation, Eluru

Source of funds
15th Finance Commission Funds

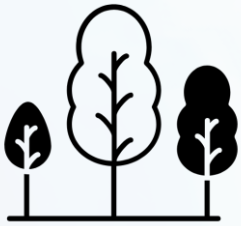
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22 THOOTHUKUDI



Miyawaki Forest: Phytoremediation

Thoothukudi, identified as non-attainment city under the National Clean Air Program, faces significant environmental challenges driven by extensive industrial activities, urban congestion, and increased vehicular usage. Additionally, the city is grappling with rising temperatures, due to lack of sufficient green cover in Thoothukudi's urban landscape. The conventional approach to urban planning has often overlooked the importance of integrating green spaces, which play a crucial role in regulating temperature, improving air quality, and providing a buffer against the adverse effects of climate change. The lack of adequate vegetation leads to the urban heat island effect, where built-up areas experience significantly higher temperatures than their rural counterparts, further worsening the city's environmental conditions. Immediate action is necessary to deploy effective solutions to address the environmental and public health crises in Thoothukudi.



Problem(s) addressed

The reclamation of the 52-acre land at Tharuvaikulam, which was previously a dump yard, under biomining schemes, marks a significant step towards environmental restoration and sustainability.

Before

After



Impacts of the intervention

1. The innovative response of local corporation, employing the Miyawaki method for forest plantation, represents a transformative approach to mitigate air pollution and revitalizing urban green spaces. With escalating air pollution driven by industrial emissions, increasing vehicular traffic, and dense urbanization, Miyawaki forest plantations is a strategy to address these environmental challenges.
2. The Miyawaki method involves planting a variety of native species in a small area, which encourages the trees to compete for light and grow upwards rather than outwards, resulting in a dense, multi-layered forest. This rapid growth and high density benefit urban areas lacking green spaces, offering a quick and effective way to enhance urban biodiversity and improve air quality.
3. Potential Impacts includes,
    - Reduction in air pollution
    - Enhanced Particulate Matter Capture
    - Microclimate Regulation
    - Carbon Sequestration



Challenges

1. **Site Preparation and Soil Quality:** The 52-acre land at Tharuvaikulam, previously used as a dump yard, likely suffers from degraded soil quality, contamination, and lack of nutrients, making it unsuitable for planting without significant remediation.
2. **Selection of Native Species:** Identifying and sourcing a diverse range of native species suitable for the Miyawaki method can be challenging, especially given the specific environmental conditions of Thoothukudi.
3. **Water Management:** Thoothukudi's climate, characterized by rapid seasonal shifts, poses challenges in maintaining adequate water supply for the newly planted trees.
4. **Long-Term Maintenance and Monitoring:** Ensuring the long-term survival and growth of the Miyawaki forest requires ongoing maintenance and monitoring, which can be resource-intensive.

Strategies to resolve challenges

1. Soil Testing and Remediation: Conducted comprehensive soil testing to identify contaminants and nutrient deficiencies.
2. Collaboration with Local Botanists and Ecologists: Engaged with local experts to identify species that are native, resilient, and capable of thriving in the local climate.
3. Drip Irrigation Systems: Installed efficient drip irrigation systems to minimize water wastage and ensure consistent watering.
4. Establishing a Maintenance Plan: Developed a comprehensive maintenance plan that includes regular watering, weeding, and monitoring of plant health.

Details of the Intervention

Duration of implementation
6 months

Cost
Rs. 30 Lacs

Implementing authority
Thoothukudi City Municipal Corporation

Source of funds
15th Finance Commission

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Dust

Greening Ludhiana: The Tree ATM Campaign

In the rapidly urbanizing landscape of Ludhiana, environmental degradation has become a critical concern, threatening the city's livability and the health of its residents. In response to these challenges, the **"Tree ATM Campaign"** has been launched as a initiative under the broader **"Wake Up Ludhiana"** mission by the Ludhiana, Municipal Corporation.

This campaign is a tree-planting exercise involving strategic intervention designed to counteract the adverse effects of unchecked urbanization and industrialization. By leveraging technology and community engagement, the campaign introduced a novel approach to environmental restoration: a mobile "Tree ATM" that delivers free saplings directly to the doorsteps of Ludhiana's residents.

This method simplifies the process of tree planting, making it accessible to all and ensuring widespread participation. The initiative is crucial in addressing the dual crises of escalating air pollution and diminishing green cover, both of which have been exacerbated by the city's rapid development. By empowering residents to contribute to the city's green infrastructure, the Tree ATM Campaign not only enhances urban sustainability but also fosters a collective sense of responsibility towards the environment, paving the way for a greener, healthier Ludhiana.

Problem(s) Addressed

Ludhiana, like many rapidly urbanizing cities, faces significant environmental challenges. The city's rapid industrial growth and urban expansion have led to several environmental issues:

1. **Increased Air Pollution:** The industrial and vehicular activities deteriorate air quality.
2. **Reduction in Green Spaces:** Urbanization has led to the loss of green cover, exacerbating the urban heat island effect and diminishing the overall livability of the city.

These challenges have had a profound impact on the health and well-being of the city's residents, necessitating immediate and innovative interventions to restore the ecological balance.





Impacts of the Intervention

The Tree ATM Campaign has had several positive impacts:

1. **Air Quality Improvement:** By increasing the tree cover, the campaign helped to curb pollutants, resulting in cleaner air and a healthier environment for the residents.
2. **Societal Benefits:** The creation of green spaces not only enhanced the aesthetic appeal of the city but also provided recreational opportunities, promoted mental well-being, and strengthened the community's connection to the environment
3. **Climate Benefits:** The expansion of green cover prevented the urban heat island effect, leading to cooler urban temperatures and improved local climate conditions.
4. **Sustainability:** The use of geo-tagging and mobile app monitoring ensured the long-term survival and maintenance of the planted trees, contributing to the sustainable development of the city.



Transformation due to the Intervention

The Tree ATM campaign has transformed Ludhiana by significantly increasing green cover, engaging the community in environmental stewardship. The initiative has encouraged a culture of sustainability and environmental responsibility among residents, helping to create a more livable and environmentally friendly city.



Challenges

Despite its success, the Tree ATM Campaign faced several challenges:

1. **Public Adoption:** Encouraging residents to actively participate in the campaign and take responsibility for the saplings was initially difficult. Many people were reluctant to commit to the long-term care of the trees.
2. **Securing Funds:** The financial sustainability of the campaign was another major challenge. Ensuring sufficient resources to support the distribution, planting, and monitoring of the saplings required significant funding.



Strategies to resolve challenges

To overcome these challenges, the campaign implemented the following strategies:

1. **Fostering Community Involvement:** Residents who received saplings were required to sign an undertaking to care for the trees, instilling a sense of ownership and responsibility. This approach has helped increase public participation and commitment.
2. **Strategic Partnerships:** Funding for the campaign was secured through partnerships with NGOs, local businesses, and community groups. These collaborations provided the necessary resources to sustain and expand the initiative.

Contact person



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24 AHMEDABAD

Dust

‘Mission Three Million Trees’ Campaign



Under the National Clean Air Programme (NCAP), the Ahmedabad Municipal Corporation (AMC) launched comprehensive greening initiatives named as “Mission Three Million Trees” Campaign. A key component of these efforts involved the establishment of urban dense forests across various AMC plots in the city, utilizing the Japanese Miyawaki technique. This method, known for its efficiency in rapidly creating dense, native forests, was strategically implemented to increase the urban green cover.

The primary objective was to improve air quality through nature-based solutions. Additionally, these green spaces contribute to the aesthetic enhancement of the urban landscape, promoting a healthier and more visually appealing environment for residents.

Problem(s) addressed

According to the Ahmedabad source apportionment study done by Gujarat Environment Management Institute (GEMI) with support from Gujarat Pollution Control Board (GPCB), road dust is the highest contributing source for PM concentration (36%) followed by domestic sources (34%), construction activities (16%), industries and crematorium (12%) and line sources/vehicles (2%).


Before


After

Impacts of the Intervention

1. **Air Quality Improvement:** The introduction of urban forests has led to an improvement in air quality. The plants in these forests effectively curb pollutants and sequester CO2

2. **Aesthetic Appeal:** The initiative has enhanced the aesthetic appeal of the city and positively impacted public health. Furthermore, the project has successfully raised public awareness about the crucial role of green spaces in mitigating air pollution and creating a healthier urban environment.

3. **Urban Transformation:** The cityscape experienced a significant transformation, characterized by the integration of lush green walls and tree-lined streets. This transformation contributed to a more aesthetically pleasing and environmentally sustainable urban environment.

4. **Community Engagement:** The initiative fostered increased community participation in greening efforts, demonstrating a collective commitment to environmental sustainability.



Challenges

1. **Manpower Requirement:** Securing a sufficient workforce to plant three million trees within 100 days is a substantial logistical challenge. This necessitates a robust recruitment and training plan to ensure adequate personnel are available and equipped for the task.
2. **Maintenance Challenges:** Maintaining the growth of three million trees requires a dedicated and well-resourced maintenance team. This includes regular watering, pruning, and addressing potential pests or diseases.
3. **Land Acquisition:** Acquiring suitable land for a plantation of this scale within urban areas can be a complex and time-consuming process. Limited availability of suitable land, competing land uses, and regulatory hurdles are common obstacles.

Details of the Intervention

Project Duration
3 months

Cost
Rs. 30.87 Cr

Implementing authority
Ahmedabad Municipal Corporation (AMC)

Source of funds
National Clean Air Programme (NCAP)

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Strategies to Resolve Challenges

1. Launched an extensive recruitment campaign targeting local communities, especially in areas with high unemployment. Collaborate with local employment agencies, educational institutions, and NGOs to attract a large pool of volunteers and temporary workers.
2. Established dedicated maintenance teams for different sections of the plantation, with clear schedules for watering, pruning, and pest control.
3. Worked closely with local government authorities to identify and secure land that can be allocated for the project.

25 SURAT

Vehicles

City-level Electric Vehicle Policy

As part of the Smart City Program and Solar City Program, Surat City aims to become the "First EV Smart City of Gujarat" by providing robust support for the adoption of Battery Electric Vehicles (EVs) and the establishment of related charging infrastructure. Gujarat already boasts the highest adoption rate of battery-operated two-wheelers in India, making it an attractive proposition for industries to invest in EVs. In alignment with this vision, Surat introduced the "Surat City Electric Vehicle Policy - 2021" in October 2021 to promote green mobility.

The Government of India has formulated a roadmap under the National Electric Mobility Mission Plan 2020 to facilitate this paradigm shift in road transport. As part of this plan, the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME) pilot scheme was launched to promote electric and hybrid vehicle adoption through incentives, charging infrastructure, and R&D, aiming to reduce emissions, lower fuel dependence, and boost EV manufacturing in India. This was followed by the launch of FAME-II in 2019 with a significantly larger budget to enable demand and infrastructure creation to support the transformation of mobility. Additionally, the Phased Manufacturing Program was introduced to promote indigenous manufacturing of EVs and their components, providing a strong push to EV production in India. The gradual shift to EVs is crucial for ensuring an energy-secure future and a cleaner environment. The reliance on Internal Combustion Engine (ICE) vehicles imposes a significant burden on the country, making it imperative to reduce dependency on fossil fuels. The adoption of EVs in road transport contributes to various objectives, including pollution reduction, enhanced energy security, and, when combined with a low-carbon power generation mix, reduced greenhouse gas emissions.



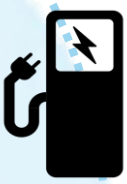
















Problem(s) Addressed

The Surat Municipal Corporation (SMC) introduced the Electric Vehicle Policy-2021 for Surat City, based on the principle that establishing EV infrastructure will drive the adoption of electric vehicles.

The policy outlines the installation of 500 public electric charging stations across the city by 2025, with 50 stations already installed and operational. Through this policy, the SMC aims to address the following areas:

- Development of Public/Private EV Charging Station Infrastructure
- Promotion of Electric Vehicle Adoption
- Adoption of Electric Vehicles within the SMC
- Creation of a Database for Public and Private EV Charging Stations
- Encouragement of Startups and Innovation in the EV Sector
- Information, Education, and Communication (IEC) Activities to Raise Awareness

Impacts of the Intervention

1. **Improved Air Quality:** The adoption of EVs has resulted in a 20-30% reduction in vehicular pollution, specifically in particulate matter (PM) concentrations.
2. **Optimized Noise Levels:** Electric vehicles produce minimal noise due to the absence of fuel combustion, leading to quieter roads and reduced noise pollution, especially in congested areas.
3. **Job Creation:** The implementation of EV policy has created new employment opportunities within the city.
4. **Environmental Benefits:** The transition to EVs has significantly reduced carbon footprints and other air pollutants, contributing to a cleaner environment.
5. **Elimination of Toxic Tailpipe Emissions:** EVs eliminate harmful tailpipe emissions, such as Nitrogen Oxides (NOx), Carbon Monoxide (CO), and Hydrocarbons (HC), thereby improving overall air quality.
6. **Lower Operating Costs:** EVs offer lower running costs compared to traditional internal combustion engine vehicles, making them a more economical alternative.
7. **Zero Tailpipe Emissions:** The transition to EVs ensures zero tailpipe emissions, further augmenting environmental sustainability.

Transformation due to the Intervention

1. **Environmental Improvement:** The intervention has driven substantial environmental benefits, including reduced air pollution and noise levels, aligning with global sustainability goals.
2. **Economic Growth:** The establishment and development of EV infrastructure has stimulated economic growth by creating new jobs and attracting increased investment in the EV sector.



Challenges

1. **Environmental Impact of EV Batteries:** The production and disposal of EV batteries present environmental challenges that need to be addressed.
2. **High Energy Demand:** The transport sector accounts for 18% of India's total energy consumption, equivalent to 94 million tons of oil equivalent (MTOE). If current trends continue, this demand could reach 200 MTOE by 2030.



Strategies to resolve challenges

1. **Diversification of Energy Sources:** Encourage the use of renewable energy sources to power EVs, reducing dependence on imported crude oil and enhancing energy security.
2. **Innovation in Battery Technology:** Invest in research and development of sustainable battery technologies, focusing on minimizing environmental impacts during production and disposal.
3. **Infrastructure Expansion:** Continue the development of comprehensive EV charging infrastructure to support the increasing number of electric vehicles on the road.
4. **Policy Support:** Strengthen policies that promote the adoption of EVs, including incentives for consumers and manufacturers, to accelerate the transition to cleaner transportation.
5. **Public Awareness Campaigns:** Conduct extensive IEC activities to educate the public about the benefits of EVs and encourage their adoption, aligning with climate change commitments

Details of the Intervention

Duration of implementation
3 Years

Cost
Rs. 20.78 Cr

Implementing authority
Surat Municipal Corporation

Source of funds
15th Finance Commission and Other

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