

From Fragmented Policy to Integrated Action: A Multi-Sectoral Blueprint for Air Quality and Sustainability in India's Rural & Urban Communities

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Abstract

India's air quality crisis is severely impacting the country's resource management, posing a challenge closely linked to rapid urbanisation, demographic growth, and energy poverty. The most critical issue that is hardly ever mentioned is that of Indoor Air Quality (IAQ), where household air pollution (HAP) from the use of solid fuels (e.g., biomass) is responsible for the release of pollutants that lead to about 600,000 premature deaths per year, in general, in the countryside and among low-income communities. The research proposes a cross-sectoral solution scheme that would replace the reactive, city-centred approaches with systemic, airshed-level governance. Among the main measures are: Clean Fuel Transition and provision of targeted subsidies for LPG refill; carrying out Extended Producer Responsibility (EPR) to change waste (including plastics) handling accountability from consumers to producers; and changing the face of the city by means of Transit-Oriented Development (TOD) to facilitate the use of public and non-motorised transport instead of private vehicles. Apart from that, the paper supports the practice of ex-situ utilisation of agricultural residue as a bioresource and the introduction of convergence finance to effectively plan both public and private investments in the health, energy, and transport sectors. Therefore, measures such as institutional reform, market-based instruments, and transitioning to a people-centric, circular economy model will ultimately lead to a clean environment and enhanced community resilience.

Keywords: Air Quality Crisis, Indoor Air Pollution (IAQ), Extended Producer Responsibility (EPR), Multi-Sectoral Solutions, Convergence Finance.

Introduction

The increasing crisis of air quality in India ranks among the global, public health, and socio-economic challenges of the twenty-first century. The national air quality crisis is deeply embedded within the context of rapid urbanisation, demographic growth, and continued

reliance on polluting and high-emission energy sources (Melhim & Isaifan, 2025). Out of all the issues that come with the air quality crisis, perhaps the most neglected is the quality of air inside buildings (IAQ). It is, however, a vital concern tightly linked to the survival and the proper functioning of the human body. India and other developing countries indicate that the health burden related to Household Air Pollution (HAP) may exceed that of outdoor air pollution sources. In India, there are close to 600,000 deaths due to the premature nature of exposure to household and indoor air pollution, which is happening every year (Kankaria et al., 2014).

The leading cause of the crisis is energy poverty. Although improvements have been made in rural electrification and the use of clean fuels, nearly 55% of rural households still rely on solid biomass fuels as their primary cooking energy source (e.g., firewood, dung cakes, and crop residues) (Mondal et al., 2025). The use of solid biomass fuels, however, has health and environmental consequences. Various studies have emphasised that the concentration of PM_{2.5} (particulate matter with a diameter less than 2.5 micrometres) inside rural houses frequently surpasses 200 µg/m³ during the cold season of the year. This value is more than twice the one typically measured in city apartments (Singh et al., 2021). Long-term exposure to PM_{2.5} at this level may lead to various respiratory illnesses, cardiovascular problems, and adverse effects on children's growth and development. For instance, the risk of stunting in children under five significantly increases by 19% when they are chronically exposed to household air pollution (HAP), thereby indicating a connection between HAP and human capital development, as well as future productivity (Shi and Brasseur, 2020).

The air that we breathe in proximity to us is no better in India, as one can judge by the statements made above. An in-depth scientific study of Delhi, the city with a reputation for being the dirtiest in the world, determined the average PM_{2.5} concentration in the city to be 118 µg/m³ between 2010 and 2024, which is exceptionally high compared to the World Health Organisation (WHO) guideline limit of 5

µg/m³ (Sharma et al., 2018). Nevertheless, the issue is not solely about the average values. The most crucial point is direct exposure, namely, how individuals are near pollution sources, and the total time of exposure throughout their daily lives. This aspect reveals the existence of numerous unprivileged areas in terms of policy and execution.

In this way, the PMUY played a crucial role in providing numerous LPG connections to low-income families. However, the issue of the average refill rate remains, which is relatively low (approximately four cylinders per year, compared to the seven needed for a complete replacement of biomass fuels). The reason for continuing "fuel stacking" activity, that is, the combining of the usage of clean and traditional fuels by households, thus decreasing the expected health benefits, is explained by the fact that high refill prices and other factors, such as logistics, obstruct the purchasing of more clean fuel by these families (Patil et al., 2021).

Urban areas are not free from this contradiction either. While India has reaped some benefits from the large-scale use of Compressed Natural Gas (CNG) and tightened vehicle emission norms, a rise in car use—mainly due to the increased preference for large SUVs (Sports Utility Vehicles)—is primarily responsible for the failure of these measures. Additionally, transport planning that prioritises private cars over public and non-motorised modes of transport is a significant factor in the continued exposure to the menace (Rahman, 2025).

Adding to these problems are significant regional differences in air quality and related health issues. The states located along the Indo-Gangetic Plain—Delhi, Uttar Pradesh, and Bihar—have been recording significantly higher levels of PM_{2.5} than those in the south, such as Kerala, thus highlighting the enormous differences in the capacity of administration, enforcement, and infrastructure resilience. Additionally, since air pollution transcends administrative boundaries, partitioned and reactive control measures are largely ineffective. What is truly necessary is a prescient, joint-sectoral solution that considers the environmental, economic, and social aspects of the reform. This involves the shift toward market-based instruments,

such as Extended Producer Responsibility (EPR), which holds companies accountable for waste management throughout the product lifecycle. Additionally, it involves establishing convergence finance structures that can facilitate public-private partnerships across the entire airshed (Gupt, 2015).

In short, sustaining clean air and building community resilience in India necessitates the most profound interconnection of the transport, energy, industry, and waste management sectors. By reinforcing these connections, furthered by policy guided by science and the involvement of the local community, India can make the transition to fresher air, citizens' well-being, and inclusive urban-rural resilience.

The Multi-Sectoral Challenge and Systemic Solutions

Improving air quality requires combined measures that are necessary for all industries that contribute to pollution. There were six major causes pinpointed in recent studies, and each of them calls for a different kind of thorough change in the system:

Transport Emissions and Automobility

India is experiencing a significant surge in the number of cars owned. New registrations have been increasing approximately four times every 5–6 years since 2000, primarily due to a consumer trend towards larger and more polluting SUVs. This kind of automobility-centric planning not only leads to longer travel times but also to significant urban PM_{2.5} and NO_x pollution. For example, in Delhi, the development of the bus fleet has come to a halt, and 50% of the bus stations are experiencing long waiting times, which makes public transport less attractive (Usmanova et al., 2021).

Solutions: Going forward, the need for Multi-modal Integration is obvious. The integration should enable seamless connections between buses, metros, and paratransit services, facilitated by safe pedestrian access. The policy goal is that 50% of Delhi's population will be living in the areas influenced by transit by 2041. Moreover, the implementation of the Parking Management Area Plans

(PMAPs) provides an end to the secret subsidies given to the users of private vehicles. At the same time, the policies must take care of the enforcement of low-emission zones and provide incentives for the Electric Vehicle (EV) adoption (Mehmood et al., 2025).

Industrial Pollution and Dirty Fuels

Most pollution originates from small and medium-scale industries (MSMEs), which are often located in areas that lack compliance and regulation. They use high-emission dirty fuels such as coal, pet coke, or furnace oil.

Solutions: Firstly, a Clean Fuel Transition is the essential solution, a measure that entails discontinuing the use of high-emission fuels. Alongside this, a program for the installation of Emission Control Technologies (e.g., stack filters, scrubbers) and a financial Support provision for MSMEs to make clean energy solutions affordable and suitable for local industry clusters would be the right approach to tackling the issue (Bhuyan, 2024).

Waste Management Imperatives

Urban India has cities that are struggling due to uncollected garbage. The situation has also been confirmed by massive landfills, such as Okhla (46 acres) and Ghazipur (70 acres), which are not only reaching their maximum capacity but also polluting both the air and groundwater. Improper segregation of waste leads to the practice of open dumping and burning, which, in turn, causes ambient air pollution (Singh, 2019).

Solutions: According to the new provisions under the Swachh Bharat Mission 2.0, cities are required to set a target for diverting at least 80% of the waste currently sent to landfills by 2025. The primary point argued regarding the success of implementing the plan is the achievement of household-level source segregation and the adoption of policies for investing in bio-mining and legacy dumpsite remediation (Roychowdhury, Mehra, & Gupta, 2025). Additionally, there is a need to support waste management methods that are not dependent on the entire city, such as community-level composting and generating income through the sale of recyclables (Singh, 2019).

Construction and Demolition Waste

Rapid urbanisation has led to an increase in C&D waste generation at a level that has never been seen before. However, the majority of this waste is illegally dumped, which not only takes up land but also contributes to air pollution in the form of dust (Menegaki & Damigos, 2018).

Solutions: To address the issue of C&D waste, cities need to develop ward-level C&D waste strategies that emphasise source segregation and tracking. The success models in Delhi and Chandigarh show that more than 90% of such waste can be converted into recycled materials that are safe and useful for the building industry, such as bricks and aggregates (Menegaki & Damigos, 2018).

Indoor Air Pollution from Cooking Fuels

Rural and peri-urban households that rely on solid fuels such as wood, dung, and coal for cooking are exposed to extremely high levels of Indoor Air Pollution, which accounts for 20%–30% of India's total ambient air pollution burden (Balmes, 2019).

Solutions: The Ujjwala Yojana has facilitated LPG access; however, affordability and refill compliance remain the primary obstacles (Roychowdhury, Mehra, & Gupta, 2025). The solutions include Targeted Pricing to provide subsidies for fuel refills in low-income households and Behaviour Change Communication to inform the community about the health impacts and encourage them to switch to a more sustainable fuel (Balmes, 2019).

Agricultural Residue Burning

One of the primary reasons for the massive fires of agricultural waste in the Indo-Gangetic plains is the absence of alternative economies and the fact that the harvest period is extremely short. This situation has led to the burning of nearly 230 million tons of crop residues annually, which in turn has significantly worsened air quality in northern India during the winter season (Shinde et al., 2022).

Solutions: In-situ Management is the use of Crop Residue Management machines, combined with microbial decomposers, to incorporate straw into the soil. Ex-situ utilisation encompasses the complete process, from the

farm to the factory, necessary to produce industrial fuel pellets, bio-CNG, or bio-ethanol from biomass, thereby providing farmers with economic returns that discourage them from burning their fields (Shinde et al., 2022).

The Silent Crisis: Indoor Air Pollution

In numerous regions across India, the primary cause of people's ill health is not the haze that can be seen covering the cities but the smoke that is coming from inside the houses, particularly from those in rural areas and unplanned settlements. Daily, hundreds of millions of people breathe in polluted air due to the use of traditional cooking and heating methods, and more often than not, they are unaware of the risks they are exposed to. For babies, women, older adults, and people with diseases that last a long time, this pollution inside the house is a kind of emergency that they do not hear but which causes them to suffer immensely.

The latest estimates suggest that the number of deaths caused by air pollution inside homes (household (indoor) air pollution) in India is around 600,000 each year. A large part of these mortalities is due to respiratory infections in young children and chronic diseases in adults. The use of solid fuels—wood, dung, charcoal, and crop residues—for cooking and heating remains prevalent: in 2019–20, over 50% of rural households used biomass or other traditional fuels, despite a primary policy drive towards cleaner alternatives (Smith, 2000). The promotion of liquefied petroleum gas (LPG) through programs like Ujjwala has led to better accessibility. However, many families still “stack” fuel—meaning they use LPG when possible, but if they do not have LPG or it is too costly, they revert to using chulhas or woodfires.

The primary factor that makes indoor air pollution so lethal is its widespread and severe nature. The concentration of particulate matter (PM_{2.5}) is often several times that of the outside air when cooking takes place with a biomass stove, especially if the room is not ventilated (e.g., kitchens without chimneys, small windows, or sealed designs that protect against cold). In such cases, women and children are exposed to smoke for several hours each day as they are usually in the same room where cooking is going on; as a result, the occurrence of acute respiratory infections in

children under five and chronic lung disease in adults increases significantly (Balmes, 2019).

Consider, for instance, a standard rural kitchen in northern India: food is prepared using crop residue or firewood in the winter, with both doors and windows kept shut. The smoke remains for several hours after cooking, which is why the black residue can be seen on the walls and ceilings. Eyes are irritated. Breathing is difficult. Children are coughing. The weather is going to get worse—but there is no way to stop cooking. These are not just statistics; these are people's everyday experiences.

Nevertheless, progress has been made. The Ujjwala plan has facilitated the penetration of LPG; thus, by 2020, approximately 85% of Indian families have access to an LPG connection. However, usage varies across different areas: several households neither entirely depend on LPG nor use it, instead reverting to biomass during times of shortages or when experiencing financial burdens. The research on PMUY, led by Asharaf and Tol, indicates slight increases in LPG consumption, while traditional cooking methods remain prevalent in most regions, particularly among socially disadvantaged groups (Kumar et al., 2020).

Although considerable progress has been made, the problem remains significant. There is a strong link between indoor air pollution and increased asthma cases, higher chances of pneumonia, and other acute lower respiratory infections in children, as well as chronic obstructive pulmonary disease (COPD) and lung cancer in adults. The worse the ventilation is, the more these risks are magnified: houses that were not built with the proper airflow in mind or have sealed windows retain pollutants for a long time even after the cessation of combustion (Balmes, 2019).

If India wants to secure the health of its most vulnerable groups—women, children, and older people—then prioritising indoor air quality at the centre of any clean air plan would be the way to go. Access to clean cooking is one of the necessary conditions, along with better housing design, a clean-fuel supply that is both affordable and reliable, and public awareness. They should be seen as the pillars supporting the prevention of a silent but lethal crisis rather than optional components that can be left out.

Advanced Frameworks for Resource Efficiency and Circular Economy

The global shift towards sustainable development necessitates a comprehensive overhaul of the way we design, utilise, and manage resources. India's evolving environmental policy landscape is in line with this shift, as it implements sophisticated systems that support circularity, resource conservation, and nature restoration. Some of the most important initiatives include the Extended Producer Responsibility (EPR) system, the development of a bio-economy through the utilisation of agricultural residues, and urban ecological restoration utilising methods such as Miyawaki. On their own, these programs are not only reshaping the environmental management system but also preparing the ground for a clean economic future (Kumar et al., 2020).

Extended Producer Responsibility Mechanism Analysis

The Extended Producer Responsibility (EPR) framework is one of the most significant policy changes in waste management. The system no longer blames consumers and local governments, which are responsible for managing post-consumer waste; instead, producers are now accountable (Rafey & Siddiqui, 2021). Companies should be responsible for their products throughout their entire lifecycle, not just when they are disposed of.

The Plastic Waste Management (PWM) Rules of India provide legal backing to this concept by imposing a legal obligation on producers, importers, and brand owners to ensure that plastic waste is collected and processed in an environmentally friendly manner. In addition to this, producers are also required to cover the internal costs of waste management, and they are encouraged to practice eco-design, where design, recyclability, sustainability, and environmental friendliness are emphasised (Kewat & Kumar, 2025).

The EPR policy has an increasingly large scope of influence. For example, in 2023, the 2016 rules on hazardous and other wastes (management and transboundary movement) were changed to include EPR obligations for used oil, thus illustrating a step that extends the framework beyond plastics and packaging (Kewat & Kumar, 2025). This represents a significant step toward the

detailed management of the entire product lifecycle across multiple industries.

Moreover, companies such as Tata Steel and ITC Limited are already on board with such initiatives. They are, for instance, implementing closed-loop production systems that reduce material loss and increase recovery (Kumar et al., 2020). In their efforts to not only meet but exceed EPR mandates, such companies are also achieving innovation wins and operational cost savings by reintroducing waste materials into their production cycles.

Besides this, the emergence of plastic credits and financial trading mechanisms aimed at facilitating EPR compliance is another dimension full of potential. Resembling carbon credits, the instruments allow entities to invest in or purchase verified recycling outcomes to fulfil their obligations. By introducing market-based incentives into the environmental policy framework, this strategy fosters a community where sustainability is driven by both compliance and profit (Kumar et al., 2015).

Thus, EPR is no longer merely a regulatory tool. However, it is evolving into a mechanism that enables the market to function differently and potentially have a profound impact on the way industries approach waste management, which would, in turn, be beneficial for the environment through the encouragement of investments in recycling, segregation, and waste processing sectors.

The Bio-Economy: Ex-situ Utilisation of Agricultural Residue

India annually faces the recurring problem of burning agricultural residues, a practice primarily concentrated in the Indo-Gangetic plains. Such a practice is a significant contributor to seasonal air pollution and greenhouse gas emissions, with approximately 230 million tonnes of surplus crop residue generated annually (Kewat & Kumar, 2025).

To address this issue, environmental experts and government officials have developed a two-pronged policy that combines in-situ management and ex-situ utilisation. Through in-situ management, it is possible to utilise Crop Residue Management (CRM) machines, as well as microbial decomposers, that facilitate the process of returning crop straw to the soil, thereby improving soil

fertility and preventing pollution caused by it. Their effort, however, still falls short in places with a large volume of biomass or that suffer from a lack of access to equipment.

Thus, the ex-situ utilisation strategy holds a significant position in the waste-to-bioresources conversion process. The extra leftover can be reused in various ways, such as bio-CNG, bio-ethanol, fuel pellets for industry use, and even eco-friendly packaging and furniture materials. Besides the pollution mitigation effect, these applications can also contribute to energy diversification and rural income generation (Engelmann & Engels, 2001).

On the other hand, sustainable demand for these bio-based products is essential for long-term success. A farmer will only drop the habit of burning if the financial benefits of selling or using the crop residues are significantly higher than the additional costs of conventional disposal (Engelmann & Engels, 2001). To achieve this equilibrium, policies such as price incentives, procurement frameworks, and logistical infrastructure, including biomass collection centres and decentralised processing units, need to be in place.

Remarkably, establishing a bio-economy around agricultural residues is a circularity model that can be used to consume the waste that is produced by one cycle as an input for another productive cycle. This aligns with India's national objectives of energy transition, rural empowerment, and sustainable agriculture, as well as its contribution to reducing the country's total carbon footprint.

Scaling Ecological Restoration: The Miyawaki Technique and Urban Resilience

Urban areas, particularly metropolitan ones, such as Delhi, are confronted with the triple menace of pollution, heat stress, and ecological degradation. Consequently, the relative success of environmental engineering approaches, such as the Miyawaki afforestation technique, is being hailed as a scalable, nature-based solution in this context (Kumar et al., 2015).

The method created by Japanese botanist Akira Miyawaki is understood to be the one that entails the plantation of a wide range of native species in highly dense localities, thereby simulating the natural forests in both their structure

and function. This substantial plantation pattern deepens the velocity of ecological succession, leading to the natural development of the mature forests in 20-30 years, as compared to a hundred years or further facilitating the number of species becoming many more than those in the case of the conventional tree planting practices (Rafey & Siddiqui, 2021) (Gopal et al., 2023).

The Ministry of Environment, Forest and Climate Change (MoEFCC) has highlighted the value of the Miyawaki approach in situations involving space scarcity in urban areas, with special reference to the National Capital Region (NCR) (Engelmann & Engels, 2001). There are numerous instances where the approach has literally paid off—across India, more than 556 micro-forests have been created using this method. Among these, the large-scale reforestation project on mined-out land by Vedanta Sesa Goa, utilising the Miyawaki model, stands out as a remarkable instance (UNGCNI, 2025), thus transforming the previously destroyed lands into vibrant ecosystems.

Along with these densification micro-forests, there exist practices such as vertical greening, where vertical gardens are created by employing recycled plastic bottles as planters. Indeed, these setups not only achieve the goal of giving a new life to the plastic trash but also reveal their positive effects on the environment quantitatively. It has been found that such vertical gardens lead to a significant drop in local Air Quality Index (AQI) values—from 274 to as low as 78 in certain demonstration zones—besides that, they also provide passive thermal insulation, as they can reduce indoor temperatures by 5°C to 7°C (Pandey, 2016).

In addition to planting and greening, urban arboriculture is becoming an institutionalised practice, yet another significant leap forward. The inauguration of the world's first Tree and Plant Hospital, along with a Tree Ambulance service, marks a new standard in how professionals in tree care can help maintain the vitality of urban green cover, thereby ensuring its capacity to resist diseases, construction-related harm, and climate stress (Pandey, 2016).

Social empowerment through nature-based interventions of this kind demonstrates that urban sustainability is not solely a matter of infrastructure and technology. However,

it largely depends on reestablishing a link between nature and the urban fabric. By combining science with community involvement, metropolitan areas cannot only cease to be sources of pollution but also become living ecosystems capable of providing cleaner air, cooler microclimates, and enhanced well-being.

Policy, Governance, and Financial Alignment

Achieving a closed-loop and resource-efficient economy is not just a matter of technological innovation. It requires a concerted policy effort, tighter institutional control, and better integration of finances across various sectors. India's journey, particularly in addressing complex issues such as urban air pollution, reveals both the potential and limitations of its current governance systems. The story of how air pollution is controlled in Delhi, along with the general policy suggestions that result from it, thus constitutes an essential source of knowledge about the necessary changes in environmental policy, governance, and finance that need to be carried out simultaneously.

Case Study: Urban Airshed Management in Delhi

Delhi's efforts to achieve cleaner air are a model case of environmental change in Indian cities, marked by reform over nearly twenty years. The measures the city has taken are varied and groundbreaking, demonstrating how well-coordinated interventions across different sectors can lead to visible environmental improvements (George, 2025).

The compulsory switch to Compressed Natural Gas (CNG) for public transport vehicles, which led to a significant drop in tailpipe emissions in the early 2000s, is one of its most notable accomplishments. Additionally, the city has eliminated coal-powered plants in its vicinity. It has been very active in promoting the use of electric vehicles (EVs) through the introduction of incentives and the development of supportive infrastructure (George, 2025). Combined, these measures clearly demonstrate the city's potential to align local policy tools with far-reaching sustainability goals.

The impact has been quite substantial. Long-term air pollution monitoring at the oldest stations in Delhi reveals a 46% decrease in PM 2.5 levels, providing direct evidence of the air quality improvement achieved through local policy interventions. Nevertheless, the trend has not been

straightforward. The air quality in Delhi, in fact, has been relatively stable over the last couple of years, with occasional months of deterioration (Kumari et al., 2025).

The reasons for this are primarily outside the city's administrative jurisdiction. While Delhi has made efforts to improve the situation internally, it is still located in an airshed. This linked atmospheric system encompasses the districts of Haryana, Punjab, Uttar Pradesh, and Delhi. The practice of burning agricultural residues, emissions caused by industries, and dust resulting from building works in those areas are the main contributors to the capital's air pollution. These pollutants then travel to Delhi, where they counteract the local air quality progress that has been achieved (Kumar et al., 2015).

This fact underscores the importance of a policy lesson: air quality is a shared regional public good. Handling this issue properly requires concerted efforts not only within Delhi but also throughout the entire airshed area. The analytical consensus is that India needs to implement governance frameworks at the level of integrated airsheds, allowing for joint planning, monitoring, and enforcement across state borders. Such a strategy would represent a significant departure from the traditional city-based actions paradigm to an environmental federalism that is collaborative and data-driven.

Strategic Policy Recommendations for Systemic Accountability

Sustainable long-term environmental change must be based on systemic responsibility, institutional reform, and financial restructuring. The following strategic directions outline how governance systems can be modified to facilitate sustainable outcomes.

1. Reorienting Responsibility: From Consumers to Producers

A salient step towards systemic transformation is shifting the environmental load upstream—to producers and corporations driving material flows, rather than focusing on individual consumers. This can be achieved by implementing Extended Producer Responsibility (EPR) policies to hold producers accountable for post-consumer waste.

Through properly designed EPR systems, manufacturers must fund and organise collection, recycling, and disposal infrastructure for their products. This not only decreases the burden on municipal waste infrastructure but also promotes environmentally friendly design and material use at the manufacturing level. Incorporating such responsibility ensures that environmental costs are internalised within company decision-making, rather than being externalised to society (Rodrigues & Domingos, 2008).

2. Leveraging Economic Instruments to Internalise Environmental Costs

Although regulation continues to play a key role, sustainable long-term advancement requires a transition from traditional "command and control" structures to market-oriented environmental mechanisms. By placing a price on pollution, governments can realign economic incentives to achieve sustainable results.

Instruments such as carbon pricing, pollution taxes, and differentiated ownership levies can help capture the actual social cost of emissions and resource extraction. Designing systems of penalties set to surpass the cost of compliance can go a step further to discourage non-compliance and render environmentally responsible behaviour the economically prudent choice (Chan et al., 2020).

This economic reasoning ensures that environmental costs are no longer considered externalities, but rather measurable liabilities that impact both business strategy and consumer behaviour equally.

3. Behavioural Incentives and Demand-Side Strategies

Sustainable transformation also needs to influence consumer decisions and everyday behaviour. Fiscal rewards and penalties can act in the background to influence this. In addition to subsidies for green technologies, authorities can implement congestion pricing, offer tax rebates for green consumption, and provide low-impact mobility credits to promote sustainable consumption.

These "behavioural nudges" establish a social and economic environment in which environmentally friendly decisions are incentivised and harmful environmental behaviour becomes increasingly expensive. The focus is on empowerment, not enforcement, allowing citizens to act as

collaborators in the transition to sustainability (Creutzig et al., 2024).

4. Reinforcing Infrastructure and Regulatory Coherence

India's environmental governance often oscillates between crisis-driven enforcement and temporary bans, especially in response to acute pollution episodes. A more effective approach would be to institutionalise proactive, year-round frameworks that prioritise prevention over punishment.

This involves creating segregated waste collection systems, enhancing supply chain transparency, and guaranteeing coordinated monitoring across ministries and urban authorities. Notably, punitive action against individuals—such as fines imposed for default—should not be taken until sufficient infrastructure is in place. Without trustworthy systems of waste segregation, collection, and treatment, enforcement can become unfair and ineffective (Nilsson et al., 2012).

The ultimate target is regulatory coherence—where there is consistency of policy across sectors, such as transport, industry, housing, and the environment, which mutually support and do not negate each other.

5. Learning from Global Paradigm Shifts

Indian cities stand to gain enormously from emulating and learning from international urban sustainability models. Globally, world-class cities are reconfiguring automobile-dominated infrastructure and reclaiming public spaces to make cities more livable.

This transition to Transit-Oriented Development (TOD) combines urban planning and mobility planning, reducing vehicle emissions while enhancing accessibility. Similarly, the development of green corridors, pedestrian networks, and multimodal transport systems encourages healthier, more inclusive cities. By prioritising people and the environment over cars, cities can reduce pollution levels while enhancing the quality of life (Agbim, 2020).

6. Convergence Finance for Resilient Urban Systems

Of utmost importance among all these reforms is financial convergence—the convergence of public, private, and international finance towards common sustainability goals. Today, financing for transportation, energy, the

environment, and public health primarily operates in silos. To create climate-resilient urban systems, India requires converged financing models that aggregate resources and use them strategically. Convergence finance has the potential to align investments across different sectors, ensuring that urban sustainability efforts are well-funded and scalable.

The use of climate finance vehicles and innovative market-based tools, such as plastic credits and green bonds, has the potential to expand further the resource pool available for transformational projects. These financial innovations present opportunities for public–private partnerships and introduce transparency in the funding and tracking of environmental outcomes (Shi et al., 2022).

By integrating convergence finance into urban governance systems, cities are implementing a transition from piecemeal interventions to a system-based approach to building resilience—developing infrastructures that are economically viable, environmentally sustainable, and socially inclusive.

Conclusion

Creating cities that have clean air and communities that can withstand challenges in India is not a goal that can be achieved with short-term policies. It requires a systemic change in governance, economy, and society (Oliveira, 2013). Urban pollution, resource wastage, and poor environmental governance are primary issues that exacerbate one another, making it impossible for any single intervention to address them independently. According to the authors, these challenges would be met in the long term for air quality and resource efficiency only if they decide to shift policies from reactive, enforcement-based ones to market-driven, incentive-based mechanisms.

The forefront of this policy change is the concern over the growing use of Extended Producer Responsibility (EPR), an approach that shifts environmental accountability from consumers and municipalities to producers. EPR, by providing complete ownership of the product lifecycle from design to disposal, encourages cleaner production, eco-innovation, and circular material flows. This philosophical shift is an important one: instead of managing waste once it is already present, the policy framework aims

to eliminate trash at the design stage and internalise environmental costs in the corporate decision-making process (Creutzig et al., 2024).

At the same time, India's urban areas have an urgent need to transform their transportation systems so that they revolve around people rather than private cars. Indian cities have become increasingly congested, polluted, and inequitable due to rapid urbanisation and car-dependent development. To mitigate such effects, transit-oriented development (TOD) and multi-modal urban transport systems are becoming the main instruments of sustainable city planning. By linking land use with transport planning, these models do more than just reduce vehicular emissions; they also enable cities to become more inclusive and accessible. Restoring public spaces taken over by cars and encouraging walking, cycling, and mass transit can have a significant impact in reshaping urban life that is both environmentally sustainable and socially vibrant (Ibraeva et al., 2020).

However, no matter how effective the city-level plans are, they require corresponding governance and financial reforms to succeed. The problem of airshed management, which has been ongoing for a long time, for example, illustrates the inefficiency of fragmented policymaking. Pollution, in general, is indifferent to the administrative borders; hence, the fiscal and institutional response should also be beyond these borders. The idea of Convergence Finance presents an ideal solution here. It achieves this by coordinating investments across various sectors, including transport, energy, environment, and public health, within a single framework that enables synchronised action. By removing the funding silos and enabling resource pooling, convergence finance is instrumental in helping environmental priorities to be adequately financed, efficiently carried out, and regionally coordinated (Clark & Sunderland, 2018).

Ultimately, the key elements of a sustainable environment for India are people-centric design, technological innovation, and collective responsibility. The enhancement of local institutions, the empowerment of communities, and the encouragement of the private sector will be on par with the introduction of clean technologies in terms of their importance. The objective extends beyond air quality improvement and waste reduction; it is about

fundamentally transforming urban systems so that they become promoters of human well-being, equity, and resilience.

The reforms mentioned above, if implemented with long-term political will and cross-sector collaboration, have the potential to turn India's urban areas into leading examples of sustainable development not only locally but on a global scale—places where economic vitality coexists with ecological balance, and every citizen enjoys cleaner and healthier air (Thakur, 2025).

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