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Smart Cities, Silent Lungs: Reevaluating Environmental Justice In Guwahati's Urban Dreamscape From A Legal Lens

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ABSTRACT
This study explores the complex relationship between Guwahati's Smart City initiatives and the escalating challenge of air pollution, framed within the discourse of environmental justice and human rights. While India's constitutional and statutory provisions recognize the right to a clean environment, enforcement in rapidly urbanizing cities remains inconsistent. Guwahati, despite being a flagship Smart City, illustrates how infrastructural development and technological innovation often overshadow ecological safeguards and citizen well-being. Drawing on public perceptions, the research highlights widespread concerns about deteriorating air quality, health impacts, and the neglect of fundamental rights in urban planning. Comparative insights from global models, such as Copenhagen's integration of sustainable transport, green spaces, and participatory governance, underscore the potential pathways for reform. Jurisprudential perspectives - including Natural Law, Legal Positivism, and Environmental Justice Theory - further reveal the tension between codified law and lived realities. The study concludes that Smart City policies must transcend cosmetic modernization to embrace rights-based, participatory, and ecologically conscious frameworks, ensuring that urban progress does not come at the cost of human dignity or environmental sustainability.

1.1. INTRODUCTION

Cradled by the lush hills of the Eastern Himalayas and kissed by the mighty Brahmaputra, Guwahati is where tradition meets transformation. It's not just a city - it's an emotion wrapped in ancient legends, spiritual mystique, and a vibrant pulse of modernity. From the sacred serenity of Kamakhya Temple to the buzzing cafés of GS Road, Guwahati is a soulful blend of heritage and hustle.

As Assam's largest city and the beating heart of Northeast India, Guwahati stands tall- a crossroads of cultures, a cradle of connectivity, and a canvas of opportunity. Whether people are drawn by its spiritual energy, its academic vibrance, or the rhythm of its progressive skyline, Guwahati never just welcomes visitors- it embraces them.

Air pollution has become a severe environmental and public health crisis in Guwahati, exacerbated by rapid urbanization, increasing vehicular emissions, industrial activities, and unregulated constructions. As one of India's fastest-growing cities, Guwahati has been included in the Smart Cities Mission, a government initiative aimed at improving urban infrastructure, promoting sustainable development, and enhancing the quality of life. However, a critical question arises: Are Smart City initiatives effectively addressing rising air pollution while ensuring the protection of fundamental human rights, such as the right to clean air, health, and a sustainable environment?

The right to a clean and healthy environment is an essential component of human rights in India. Taking a guarantee under the Constitution of India, right to environment has spread its wings to occupy space under the Fundamental rights, Directive Principles of the State Policy as well as the Fundamental Duties. Despite these provisions, air pollution in Guwahati continues to rise, raising concerns about the enforcement of environmental rights.

From a legal standpoint, several environmental laws govern air pollution control in India, including:

- The Air (Prevention and Control of Pollution) Act, 1981, which empowers the government to regulate air quality.
- The Environment Protection Act, 1986, which provides a framework for controlling environmental hazards.
- The Motor Vehicles Act, 1988 (Amended 2019), which imposes stricter emission norms on vehicles.

However, the implementation and enforcement of these laws remain a challenge. Many Smart City projects focus on urban beautification and infrastructure development but often neglect environmental

sustainability and human rights concerns. The question remains: Are these policies truly effective in reducing air pollution and ensuring citizens' rights, or are they merely superficial advancements?

To understand how a Smart City can effectively combat air pollution while prioritizing human rights, we can look at Copenhagen, Denmark- one of the world's leading green cities. The city has successfully implemented:

- A robust public transportation system, including electric buses and extensive cycling infrastructure.
- Stringent air quality regulations, such as low-emission zones and bans on diesel vehicles.
- Sustainable urban planning, integrating green spaces to reduce pollution levels.
- Public participation initiatives, where citizens are actively involved in decision-making regarding environmental policies.

As a result, Copenhagen has significantly reduced air pollution while maintaining high living standards and protecting public health. Could Guwahati adopt similar strategies under its Smart City mission?

1.2. MATERIALS AND METHODS

1.2.1. Study Area and Objectives

The present study was conducted in Guwahati, the largest urban centre in Assam and a key city under India's Smart Cities Mission. The primary objective of the research was to evaluate whether the initiatives implemented under this mission adequately prioritize human rights, particularly in relation to air pollution, public health and environmental justice. Guwahati's rapid urbanization and rising environmental challenges made it an appropriate case for studying the intersection of development planning and citizen well-being.

1.2.2. Research Design

A descriptive research design was adopted to systematically capture public perceptions of Smart City interventions and their environmental implications. This design was selected for its effectiveness in identifying patterns, attitudes, and reported experiences without manipulating study variables. The study was cross-sectional in nature and focused on capturing a snapshot of public sentiment at a given time.

1.2.3. Sampling and Participants

The study population comprised residents of Guwahati. A total of 100 respondents participated in the study. Participants were selected using a non-probability convenience sampling technique, based on their availability and willingness to respond. This method was appropriate for exploratory research where generalizability was secondary to trend identification.

1.2.4. Data Collection Instrument

Data are collected using a structured questionnaire, designed to capture public perspectives on air pollution, Smart City policy outcomes, environmental rights, and urban health impacts. The questionnaire consisted exclusively of close-ended questions to allow for statistical aggregation and ease of comparison across responses. The survey was disseminated digitally through Google Forms, ensuring ease of access for participants across different localities in Guwahati.

1.2.4. Data Analysis

The collected data was analyzed using basic statistical tools, primarily frequencies and percentages, to summarize the responses and identify major trends. This quantitative approach facilitated objective analysis of citizen perceptions and allowed for the visualization of patterns in relation to various environmental and policy-related variables.

1.3. The Legal Framework

International legal frameworks recognize the right to clean air as part of fundamental human rights. The Universal Declaration of Human Rights (UDHR) (1948), while not explicitly mentioning environmental rights, establishes the right to life and security, which many legal scholars interpret as including the right to a pollution-free environment.[1] Similarly, the International Covenant on Economic, Social, and Cultural Rights (ICESCR), 1966 mandates states to take necessary steps to improve environmental hygiene and control pollution.[2] In the year 2021, the United Nations Human Rights Council (UNHRC) passed a resolution officially recognizing the right to a clean, healthy, and sustainable environment as a fundamental human right, urging nations to strengthen their legal commitments to environmental protection.

[1] Article 3, Universal Declaration of Human Rights
[2] Article 12, ICESCR

The Stockholm Declaration, 1972 was the first international agreement that linked human rights with environmental protection, emphasizing that individuals have a responsibility to safeguard the environment for future generations.[3] More recently, the Paris Agreement, 2015, a legally binding treaty under the United Nations Framework Convention on Climate Change (UNFCCC), indirectly addresses air pollution by urging nations to reduce greenhouse gas emissions.[4] However, while these international instruments set high standards, their implementation varies across countries, with enforcement often depending on national priorities and governance capacities.

Several countries have successfully enacted strict air pollution control laws, integrating legal enforcement with technological advancements and urban planning. The United States Clean Air Act, 1970 remains one of the most robust environmental laws, granting the Environmental Protection Agency (EPA) the authority to set and enforce air quality standards.[5] The European Union (EU) Ambient Air Quality Directive (2008/50/EC) mandates member states to maintain air quality within specified limits, imposing penalties on non-compliant industries and governments.[6] In China, the Air Pollution Prevention and Control Action Plan, 2013 introduced stringent regulations on industrial emissions, backed by real-time pollution monitoring systems and heavy fines for violations.[7] These legal frameworks demonstrate that strong governance, scientific monitoring, and legal accountability are essential for effective air pollution management.

India's constitutional and statutory framework strongly emphasizes environmental protection. Article 21 of the Indian Constitution guarantees the right to life, which has been interpreted by the Supreme Court to include the right to a clean and pollution-free environment. Additionally, Article 48A under the Directive Principles of State Policy, directs the state to protect and improve the environment. Also, under Article 51A(g), a Fundamental Duty has been imposed on citizens to safeguard natural resources. But, enforcement of these provisions remains a challenge, particularly in rapidly expanding urban areas like Guwahati.

India has enacted several laws specifically aimed at controlling air pollution. The Air (Prevention and Control of Pollution) Act, 1981, empowers the Central and State Pollution Control Boards (CPCB & SPCBs) to regulate and monitor air quality.[8] However, weak enforcement mechanisms and lack of stringent penalties often limit its effectiveness. The Environment Protection Act, 1986, provides a broader legal framework for tackling pollution, allowing authorities to impose restrictions on industrial emissions.[9] The Motor Vehicles Act, 1988 (Amended in 2019) introduced stricter emission norms, including the transition to Bharat Stage (BS-VI) standards, but vehicular pollution remains a significant issue in cities like Guwahati.[10]

The Indian judiciary has played a crucial role in reinforcing environmental protection laws, often stepping in where executive enforcement has been weak. In MC Mehta v. Union of India (1986), the Supreme Court ordered the closure of highly polluting industries in Delhi, emphasizing that the right to a clean environment is essential for a dignified life. Similarly, in Vardhaman Kaushik v. Union of India (2016), the National Green Tribunal (NGT) imposed restrictions on diesel vehicles older than 10 years in Delhi, recognizing vehicular emissions as a major contributor to air pollution. In Gaurav Kumar Bansal v. Union of India (2021), the Supreme Court directed the government to take immediate action against stubble burning, a key factor in worsening air quality in northern India. However, while these landmark rulings

[3] Report on the United Nations Conference on Human Environment, Stolkholm, June, 1972, available at https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/ConferencesMeetings/Documents/A%20CONF.48%2014%20Rev.1.pdf

[4] The Paris Agreement available at https://unfccc.int/process-and-meetings/the-paris-agreement

[5] Overview of the Clean Air Act and Air Polution, United Nations Environmental Protection Agency available at https://www.epa.gov/clean-air-act-overview

[6] Air Quality Management in the European Union Member States, The World Bank available at https://documents1.worldbank.org/curated/en/099032825105033140/pdf/P180441-f62f559d-4365-4692-a29c-9ce651261f2b.pdf

[7] Jin Y, Andersson H, Zhang S. Air Pollution Control Policies in China: A Retrospective and Prospects. Int J Environ Res Public Health. 2016 Dec 9;13(12):1219. doi: 10.3390/ijerph13121219. PMID: 27941665; PMCID: PMC5201360.

[8] The Air (Prevention and Control of Pollution) Act, 1981, Central Pollution Control Board, https://cpcb.nic.in/air-pollution/

[9] The Environment (Protection) Act, 1986, available at https://www.indiacode.nic.in/bitstream/123456789/4316/1/ep_act_1986.pdf

[10] The Motor Vehicle (Amendment) Act, 2019

have been instrumental in tackling air pollution in metropolitan areas, cities like Guwahati have not received the same level of judicial attention or policy urgency.

1.4. Jurisprudential perspectives

The recognition of the right to a clean and healthy environment within the ambit of Article 21 of the Indian Constitution is a prime example of judicial dynamism rooted in Natural Law Theory. This theory posits that law must align with universal moral principles such as justice, equity, and human dignity. Landmark decisions like Subhash Kumar v. State of Bihar[11] and M.C. Mehta v. Union of India[12] exemplify how the Indian judiciary has interpreted the right to life to include environmental rights, reinforcing the belief that clean air is intrinsic to a life of dignity. In doing so, the courts have echoed natural law ideals by ensuring that the Constitution serves not only as a legal text but also as a moral compass.

In contrast, Legal Positivism, which maintains that the validity of law lies in its proper enactment and enforcement by legitimate authorities, offers a critical lens through which to examine India's statutory framework on air pollution. Although laws such as the Air (Prevention and Control of Pollution) Act, 1981, and the Environment (Protection) Act, 1986, provide comprehensive tools for pollution control, their implementation often falls short, especially in tier-2 cities like Guwahati. Smart City projects, though ambitious in scope, tend to emphasize technological innovation and infrastructural development while neglecting ecological and human rights dimensions. This disconnection between codified law and its ground-level efficacy highlights a central critique of positivism- laws, without meaningful execution, fail to achieve justice.

Furthermore, the issue must be situated within the framework of Environmental Justice Theory, which stresses equitable access to environmental goods and protection from environmental harms, irrespective of socioeconomic status. The public perception in Guwahati, as captured in the study, reveals widespread dissatisfaction with air quality and scepticism toward Smart City initiatives. This perception reflects a failure to uphold environmental justice, especially when the burdens of pollution disproportionately affect vulnerable populations. The Indian judiciary has partially addressed this through the Public Trust Doctrine, which views natural resources as a shared inheritance held by the state in trust for future generations. Failing to safeguard these resources, therefore, constitutes not just administrative negligence but a violation of fiduciary duty. For Smart City policies to align with constitutional values, they must embrace a jurisprudence that is environmentally conscious, socially inclusive, and rights-based.

1.5. Aspect of Urbicide

Urbicide no longer arrives with bombs; it creeps in on bulldozers. In Guwahati, the so-called march toward modernization wears the mask of "Smart City" reforms yet leaves behind a trail of erasure. Not of buildings alone, but of breath, memory, and belonging. Urban redevelopment has turned into a kind of architectural amnesia, sacrificing wetlands for parking lots, choking green lungs for concrete façades, and silencing neighbourhoods in favour of glitzy high-rises. What the community witnessing is not just urban growth, but a slow-motion assassination of the very soul of the city.

Beneath the gloss of innovation lies an ecological apocalypse. Trees once standing sentinel over generations are being cut down with chilling indifference. Hills are being levelled like forgotten relics, and the mighty Brahmaputra is now flanked by dust and decay. Guwahati's air hangs heavy- not just with pollutants, but with betrayal. Smart City projects boast sensors and apps but fail to protect the simplest algorithm of survival: clean air. In the name of progress, nature is being bulldozed into silence.

The social scars of urbicide run just as deep. Slums are demolished under the guise of beautification; street vendors are swept away like urban clutter. Who decides what is 'smart'? Certainly not the communities evicted, the voices ignored, the traditions overwritten by sterile architecture. When a city stops being lived in and starts being engineered for a privileged few, it ceases to be a home - it becomes a showroom. Guwahati, once a mosaic of heritage and humanity, risks becoming a museum of misplaced priorities.

Legally and morally, this is a crisis of conscience. Rights without air are just words on paper. When Smart City plans exclude environmental safeguards, bypass public consultation, and ignore the most vulnerable, they betray both the Constitution and common sense. This is urbicide by design- planned, polished, and passed off as development. It is time we asked: is a city truly smart if it kills what makes it human?

[11] AIR 1991 SC 420.

[12] (1997) 2 SCC 353 (Taj Mahal case)

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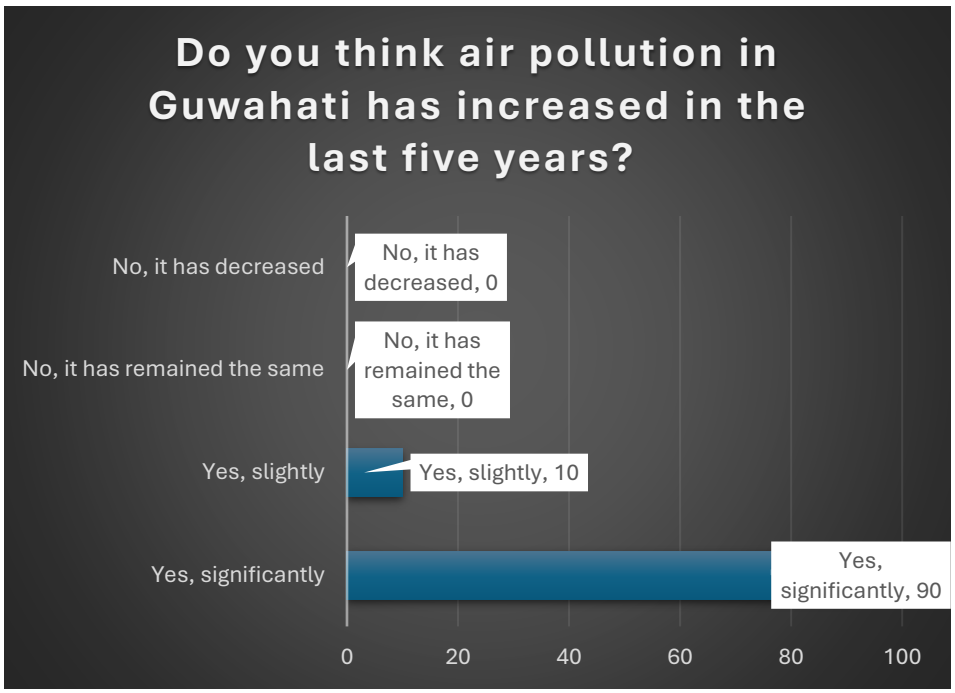
1.6. RESULTS AND DISCUSSION

Results

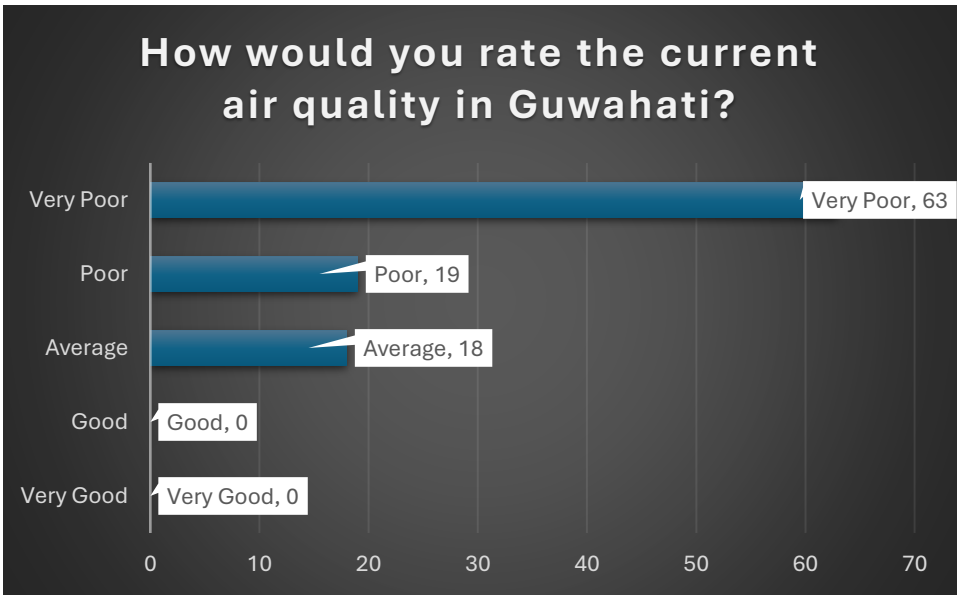
a. Status of air pollution in Guwahati in the last 5 years

The chart paints a clear and rather alarming picture of public sentiment in Guwahati - 90% of respondents felt that air pollution has increased significantly in the past five years, while the remaining 10% said it has increased slightly. Not a single person believed that the air quality has either improved or even stayed the same. This overwhelming consensus reveals a growing sense of environmental anxiety among citizens. It's a strong indication that despite the push for Smart City development and urban growth, the issue of clean air seems to be falling through the cracks. For the people living and breathing in Guwahati every day, the numbers are nott just statistics – they are a reflection of lived reality.



b. Current air quality in Guwahati

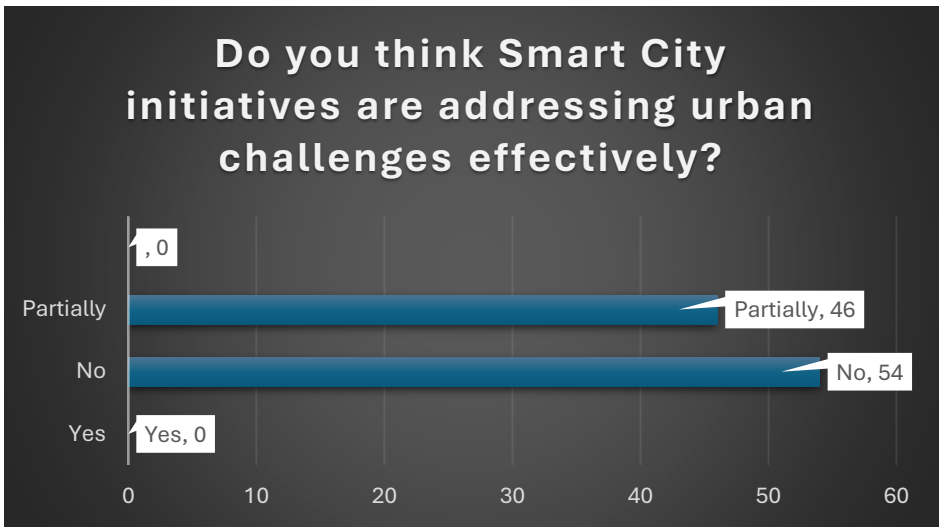
The public perception of Guwahati's air quality, as reflected in this chart, is overwhelmingly grim. A staggering 63% of respondents rated the air quality as very poor, while an additional 19% found it simply poor. That means over 80% of citizens surveyed felt the air they breathe daily is below acceptable standards. Only 18% considered it average, and notably, no one thought it was good or very good.



This tells a powerful story—people are not just aware of the deteriorating air conditions, they are living it, feeling it, and likely suffering because of it. In a city striving toward smart urban development, this widespread dissatisfaction signals a deep disconnect between progress and public well-being. It is not just a wake-up call; it is an urgent cry for action where clean air must become non-negotiable.

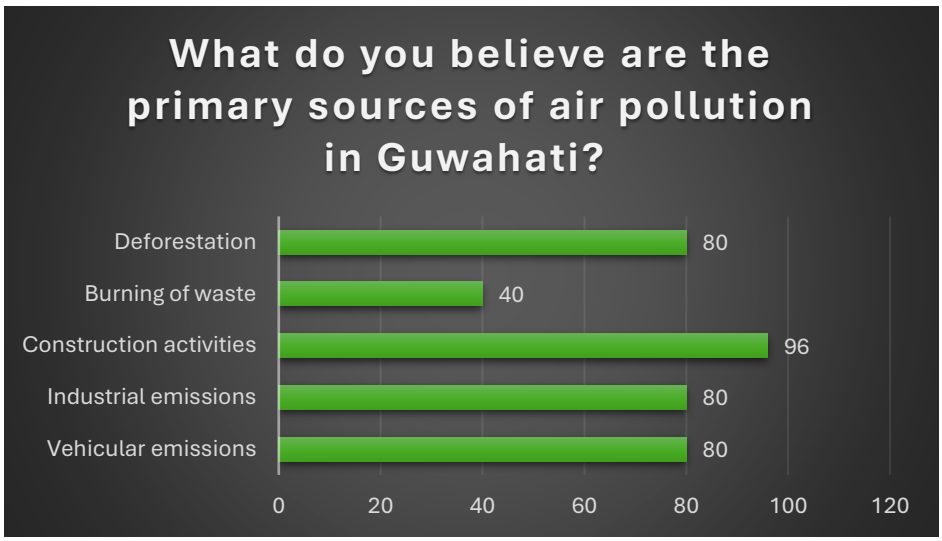
c. Whether Smart City initiatives are addressing urban challenges effectively

The responses to whether Smart City initiatives are effectively addressing urban challenges in Guwahati reflect a mixed - but largely sceptical - public sentiment. A majority of 54% of the respondents believe that these initiatives are not delivering on their promises. Meanwhile, 46% felt that the impact has been partial - indicating some positive outcomes but far from comprehensive solutions. Notably, none of the participants gave a full vote of confidence by selecting Yes, which paints a concerning picture. This lack of public endorsement suggests that while infrastructural and technological improvements may be visible, the initiatives might be falling short in terms of tangible improvements in quality of life, particularly in areas like air pollution, waste management, and urban mobility.



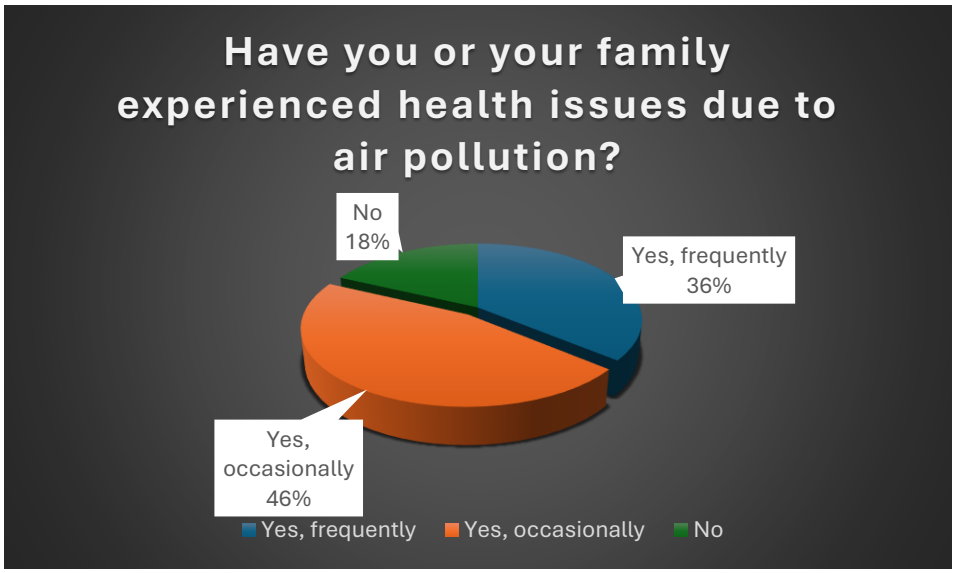
d. Primary sources of air pollution in Guwahati

The bar diagram offers a compelling glimpse into public perception of the leading sources of air pollution in Guwahati. A striking 96 out of 100 respondents identified construction activities as the most significant contributor - an overwhelming majority that reflects the pace and intensity of urban development in the city. Following closely behind, vehicular emissions, industrial emissions, and deforestation were each cited by 80 respondents, highlighting the cumulative impact of modernization and infrastructural expansion on air quality. Interestingly, burning of waste garnered the least attention, with only 40 mentions, suggesting that while it is a visible pollutant, it is perceived as less impactful compared to the broader, more systemic sources.



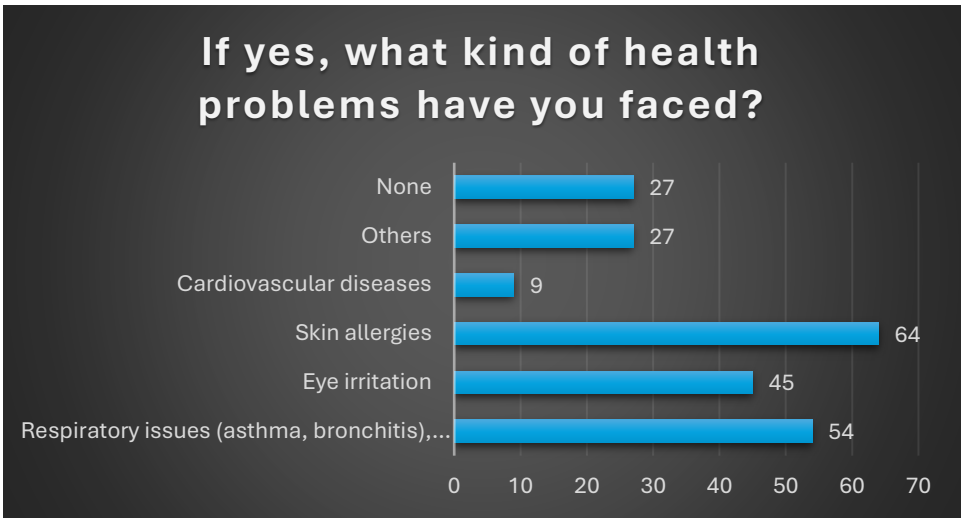
e. Health issues due to air pollution

The pie chart paints a rather sobering picture of how air pollution is affecting public health in Guwahati. A staggering 82% of respondents admitted to having experienced health issues due to air pollution—36% frequently and 46% occasionally. These figures speak volumes about the tangible impact of deteriorating air quality on day-to-day well-being, with respiratory problems, allergies, and other pollution-related ailments likely affecting a broad section of the population. Only 18% of respondents reported no health issues, underscoring the pervasiveness of this environmental crisis. This data adds a deeply human dimension to the discussion on air pollution, highlighting that beyond numbers and percentages, it is families and individuals who bear the brunt of inaction.



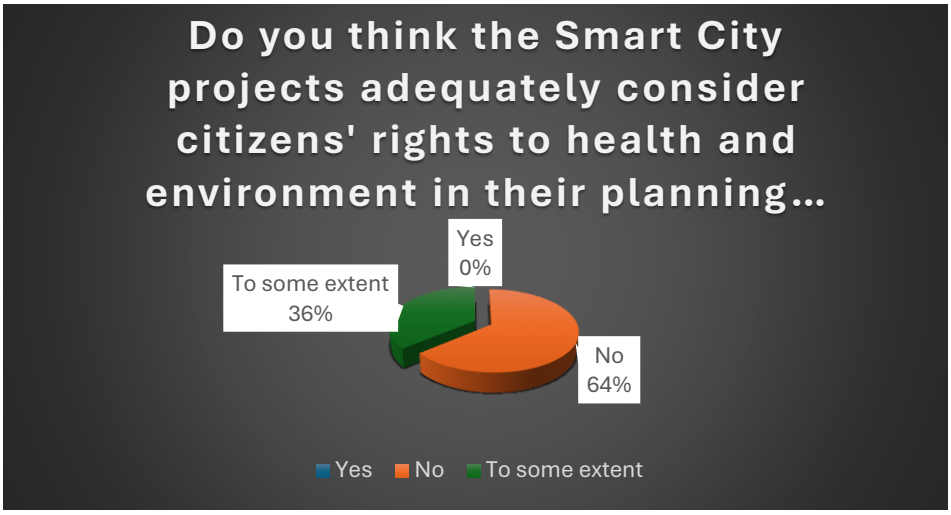
f. Kinds of health problems faced

The data on health issues linked to air pollution in Guwahati reveals a troubling reality. Among respondents who reported being affected, skin allergies emerged as the most common ailment, cited by over 60 individuals. Close behind were respiratory issues, such as asthma and bronchitis, along with eye irritation - both affecting more than 50 individuals each. These symptoms are not only uncomfortable but can escalate into chronic conditions if exposure persists. Smaller but significant number of respondents (around 25–30) reported no health issues or marked "Others", suggesting a range of unlisted or less common problems. Cardiovascular diseases were mentioned by a minority, yet their inclusion is alarming, given the long-term risks associated with polluted air. The clustering of multiple symptoms - like those reporting combinations of respiratory issues, skin allergies, and eye irritation - shows just how multifaceted and severe the health impacts of air pollution can be. This isn't just an environmental issue; it's a full-blown public health concern that urgently demands attention.



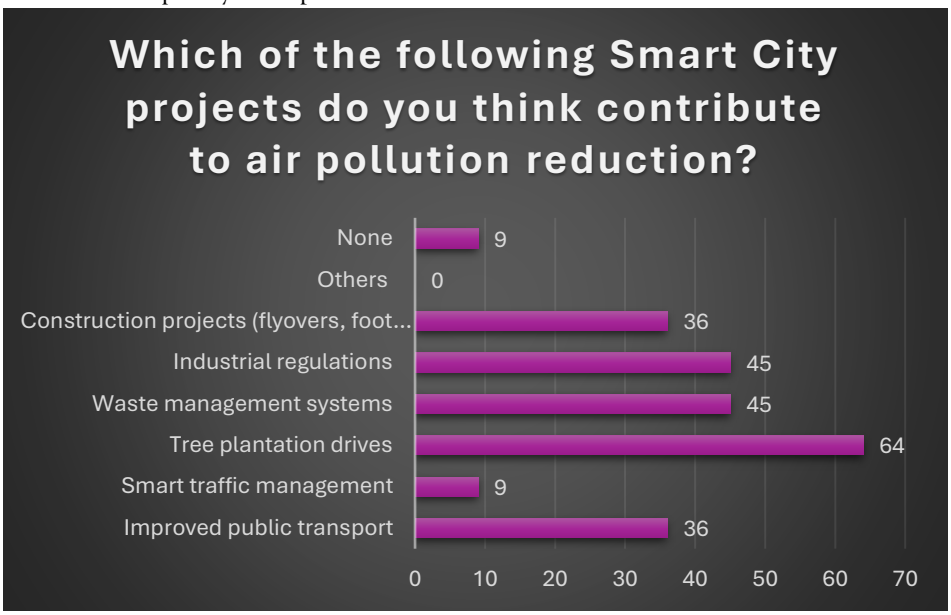
g. Concern for citizen's right to health and environment

The pie chart highlights a significant lack of public confidence in the Smart City projects' commitment to safeguarding citizens' rights to health and the environment during planning and execution. A majority of 64% respondents expressed outright scepticism, indicating that these essential rights are largely overlooked, while 36% felt that such concerns are addressed only to some extent, pointing to partial or inconsistent efforts. Most notably, no respondents (0%) believed that these rights are adequately considered, reflecting a profound disconnect between the intended goals of Smart City initiatives and the public's lived experiences or perceptions. This data suggests an urgent need for more inclusive, transparent, and rights-based approaches in urban development to truly align with the values of sustainability and social responsibility.



h. Smart City projects that contribute to air pollution reduction

The bar chart reveals public opinion on which Smart City initiatives are perceived to contribute most to air pollution reduction. Tree plantation drives emerged as the most recognized effort, with 64 respondents acknowledging their role in improving air quality, underlining the continued value placed on natural solutions. Industrial regulations and waste management systems were also strongly supported, each with 45 responses, reflecting the public's awareness of systemic and infrastructural contributors to pollution. Construction projects and improved public transport received moderate support (36 responses each), suggesting mixed views on their effectiveness, possibly due to concerns about emissions during construction or the quality of implementation.

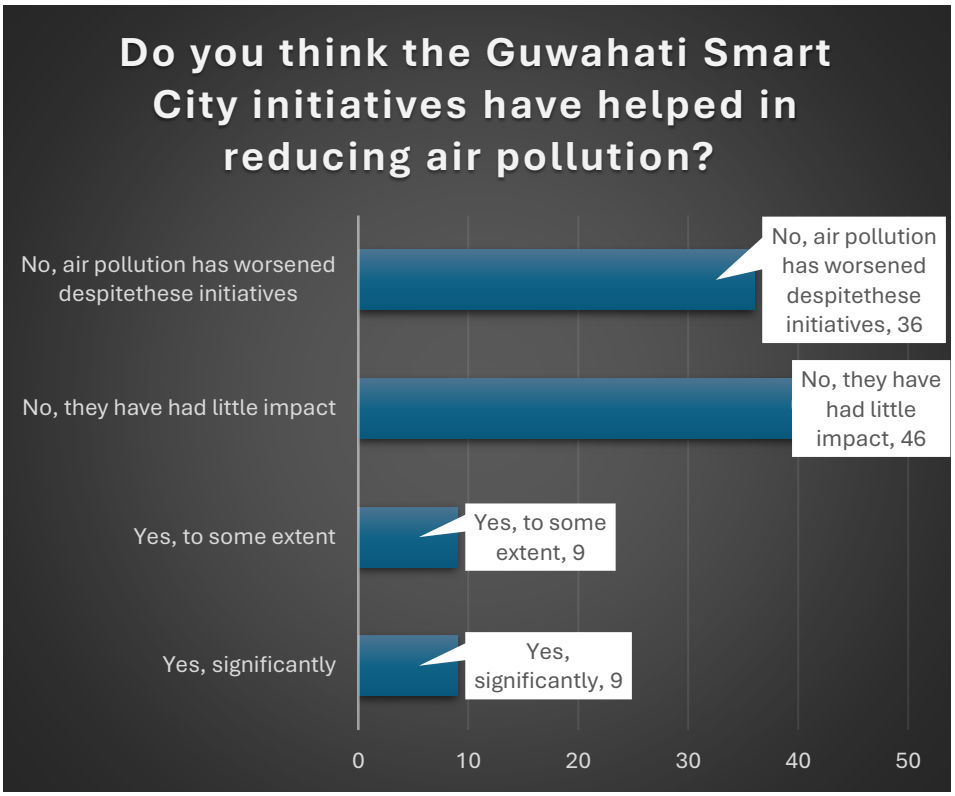


Surprisingly, smart traffic management and "None" each garnered just 9 responses, indicating either limited faith in their impact or underwhelming execution. "Others" received no votes, pointing to a

consensus around the listed options. Overall, the data underscores a preference for green and regulatory interventions over purely technological or infrastructural approaches when it comes to addressing urban air pollution.

i. Whether Guwahati Smart City initiatives have helped in reducing air pollution

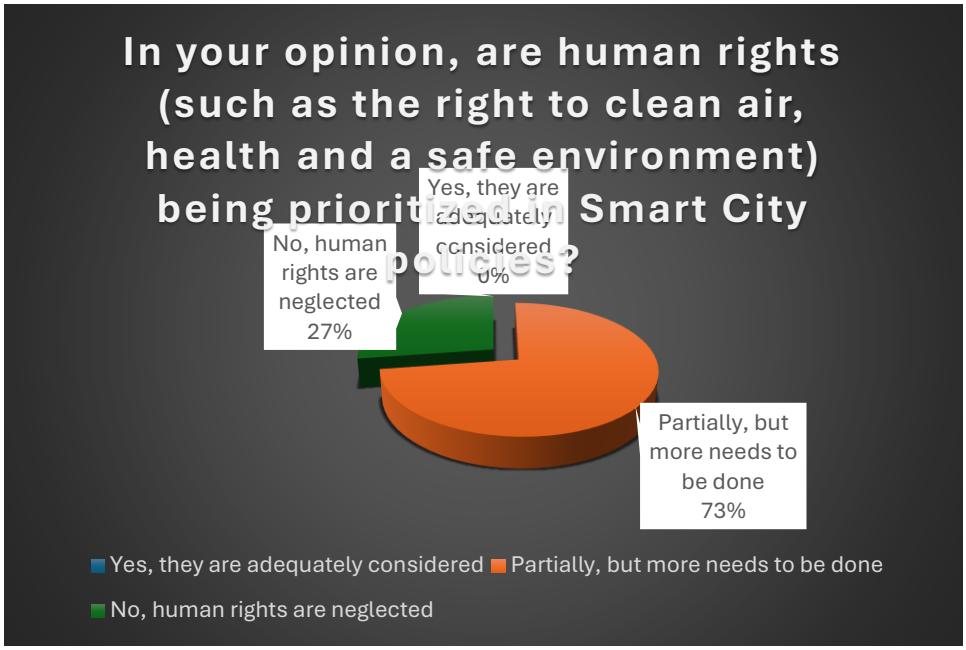
The chart presents a telling picture of public perception regarding the impact of the Guwahati Smart City initiatives on air pollution reduction. A majority of respondents- 46%- believe these initiatives have had little impact, indicating widespread scepticism about their effectiveness. Another 36% feel that air pollution has actually worsened despite the interventions, further highlighting a sense of disillusionment and possibly pointing to implementation gaps or counterproductive outcomes. Only 9% each think the initiatives have helped either significantly or to some extent, underscoring a stark lack of confidence in the current trajectory of Smart City efforts in Guwahati. Collectively, these responses suggest a growing public demand for more impactful, transparent, and accountable urban environmental strategies that go beyond tokenistic or superficial interventions.



j. Whether human rights (such as the right to clean air, health and a safe environment) being prioritized in Smart City policies.

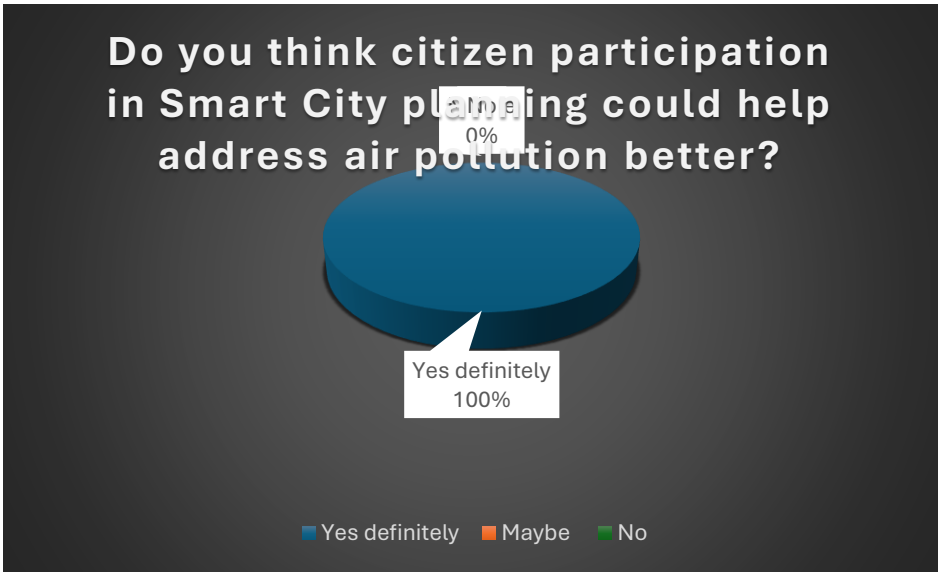
The pie chart presents public opinion on the prioritization of human rights - specifically the rights to clean air, health, and a safe environment - in Smart City policies. The data reveals a significant concern among respondents regarding the inadequate consideration of these rights. A dominant 73% of participants believe that human rights are only partially addressed, indicating that while some efforts may be visible, much more needs to be done to fully integrate these rights into Smart City planning. Meanwhile, 27% feel that human rights are outright neglected, pointing to a stark lack of attention in policy frameworks.

Notably, no respondents (0%) felt that human rights are adequately considered in Smart City initiatives. This overall perception underscores a pressing need for policymakers to reassess their approach to urban development by embedding human rights more robustly into the fabric of Smart City strategies.



k. Whether citizen participation in Smart City planning could help address air pollution better.

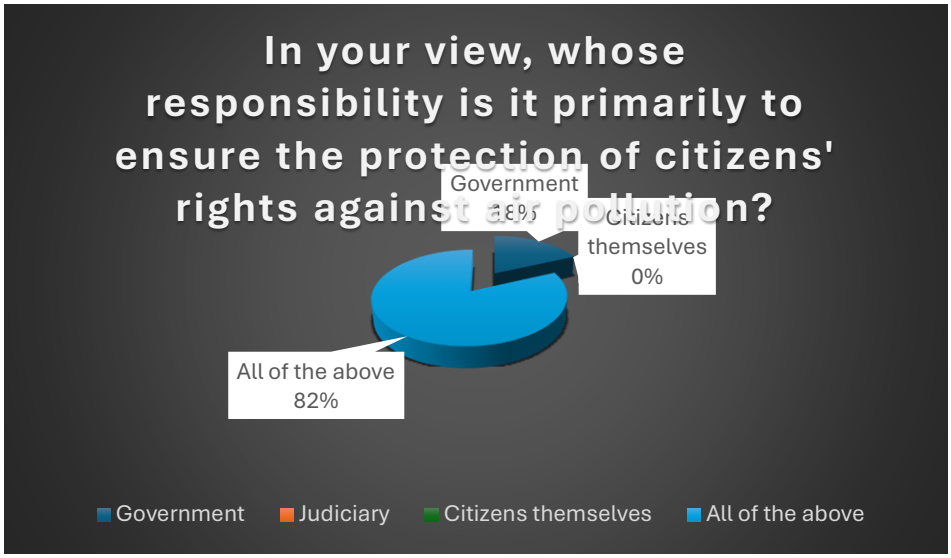
The pie chart illustrates a unanimous perspective on the role of citizen participation in Smart City planning with regard to addressing air pollution. An overwhelming 100% of respondents answered "Yes definitely," affirming their belief that involving citizens more actively in planning processes can significantly contribute to better solutions for air pollution. Not a single respondent selected "Maybe" or "No," indicating a strong consensus on the value of inclusive governance. This data highlights the public's trust in participatory approaches and suggests that Smart City initiatives should place a stronger emphasis on community engagement. By integrating local voices and experiences, policymakers can design more effective, sustainable, and context-sensitive interventions to combat air pollution.



l. Whose responsibility is it primarily to ensure the protection of citizens' rights against air pollution?

The pie chart explores public opinion on who holds the primary responsibility for protecting citizens' rights against air pollution. A significant majority - 82% of respondents - believe that this duty is a shared responsibility among the government, judiciary, and citizens themselves, highlighting the need for a multi-stakeholder approach. Meanwhile, 9% assign the responsibility specifically to the government, and another 9% to the judiciary. Notably, none of the respondents believe that the responsibility lies with citizens alone. This data underscores the public's perception that combating air pollution and safeguarding related rights is a collective effort requiring coordination and accountability across

institutions and society at large. It reinforces the importance of integrated frameworks where legal enforcement, policy-making, and civic participation work hand-in-hand.



m. Whether government should introduce stricter penalties for air pollution violations (e.g., fines for industries, vehicular emissions and waste burning).

The pie chart demonstrates unanimous public agreement on the need for stricter penalties for air pollution violations. All respondents (100%) answered "Yes" to the question of whether the government should impose tougher measures—such as fines for industrial emissions, vehicular pollution, and waste burning. No one selected "No" or "Not sure," underscoring a clear and collective demand for stronger enforcement and accountability mechanisms. This strong consensus suggests that citizens perceive existing regulations as insufficient and are calling for more decisive governmental action to curb pollution and protect environmental health. The data advocates for urgent policy reforms with robust punitive frameworks to deter pollution and uphold public well-being.

DISCUSSION

The findings from this study reveal a profound gap between the developmental narrative of Guwahati's Smart City Mission and the lived environmental realities of its citizens. Despite significant infrastructural investments under the urban renewal framework, the initiatives appear to lack measurable outcomes in environmental governance. A resounding 90% of respondents reported a significant increase in air pollution over the last five years, while 63% rated the current air quality as "very poor." This widespread perception of environmental deterioration reflects not only empirical exposure to pollution but also a rising sense of ecological disenfranchisement (Chakraborty & Mukherjee, 2021).

From the perspective of environmental justice theory, this outcome is deeply concerning. It reinforces the argument that environmental harms are unequally distributed, often exacerbating vulnerabilities among

urban populations (Bullard, 2000). The dominant sources of pollution—namely, construction activity (96%), vehicular and industrial emissions (80%), and deforestation (80%)—signal that air quality decline is linked to structural patterns of growth rather than isolated or incidental causes. Such insights mirror national trends wherein cities undergoing rapid urban transformation experience sharp increases in particulate matter and other harmful emissions (Balakrishnan et al., 2019).

Public health impacts were similarly alarming. A significant 82% of respondents reported pollution-related ailments, including skin allergies, respiratory distress, and eye irritation. These self-reported health effects are consistent with medical research associating high PM2.5 exposure with increased morbidity and long-term chronic illness in India's urban centres (Ghosh et al., 2022). Notably, only 18% of respondents indicated no health impacts, affirming the pervasive nature of pollution-related suffering and the failure of existing air quality management protocols.

What is particularly striking is the perceived disconnect between Smart City policies and environmental rights. Zero respondents believed that their right to clean air, health, or a safe environment was adequately prioritized. This reflects a critical weakness in the rights-based foundation of Guwahati's urban planning. Under Article 21 of the Indian Constitution, the right to life has been interpreted to include the right to a pollution-free environment (Divan & Rosencranz, 2001). However, as the findings suggest, statutory recognition alone is insufficient—effective implementation, transparency, and accountability are essential. From a jurisprudential lens, this gap may be attributed to a legal positivist tradition that equates legality with formal enactment, without addressing execution or lived justice (Austin, 1832/1995). In contrast, a natural law approach—such as that reflected in landmark judgments like Subhash Kumar v. State of Bihar—grounds environmental protection in broader principles of dignity and justice. For Smart City strategies to be genuinely transformative, they must be informed by this ethical-legal intersection, embedding environmental safeguards into the heart of urban governance.

The study also reveals strong support for participatory approaches. An overwhelming 100% of respondents agreed that citizen participation could lead to more effective air pollution mitigation. This aligns with contemporary models of urban planning that advocate for co-production, deliberative democracy, and collaborative governance (Fung, 2006; Sennett, 2018). Moreover, 82% of participants viewed the responsibility for protecting air quality as a shared duty between the state, judiciary, and civil society—suggesting a readiness for multi-stakeholder environmental stewardship.

Finally, the uniform call for stricter penalties for polluters (100%) highlights both public frustration and a demand for regulatory reform. While the Air (Prevention and Control of Pollution) Act, 1981, and the Environment (Protection) Act, 1986, provide a legislative framework, enforcement remains inconsistent (Sharma & Sengupta, 2020). Citizens clearly desire a more proactive and punitive regulatory regime to address industrial emissions, vehicular pollution, and illegal waste burning.

1.7. Cost of Health Burden: Estimating Economic Loss

Air pollution imposes direct and indirect economic costs through healthcare expenditures, lost productivity, and reduced quality of life. To quantify this:

Let:

- PPP = Total urban population of Guwahati (approx. 1.2 million)
- AAA = % population affected by pollution-related health issues (from your data: 82%)
- CCC = Average annual cost of treatment per person for respiratory and related ailments (conservatively estimated at ₹6,000 per person)
- LLL = Productivity loss per working adult per year due to illness (estimated at ₹10,000 for those affected)

The Total Economic Burden (TEB) can be calculated using the formula:

Total Economic Burden (TEB)=(P×A×C)+(P×A×L)

Substituting values:

= (1,200,000×0.82×6000)+(1,200,000×0.82×10,000)

=₹5,90,40,00,000+₹9,84,00,00,000=₹15,74,40,00,000 or ₹1,574.4 Crores annually

1.8. **Interpretation and Conclusion:**

Guwahati suffers an estimated annual economic loss of ₹1,574.4 crores due to health-related consequences of air pollution. This conservative estimate captures only the immediate, measurable effects such as treatment costs and productivity losses. It does not account for long-term impacts like chronic illnesses (e.g., cardiovascular or neurological conditions), developmental delays in children, loss of life years, or degradation of environmental services—suggesting that the actual burden may be substantially higher.

In summary, the results underscore an urgent need for Smart City planning in Guwahati to transcend superficial metrics and prioritize environmental sustainability, human rights, and inclusive governance. Without this recalibration, the city risks perpetuating a model of development that is technologically smart but ecologically blind.

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