



GOVERNMENT POLICY RESPONSES TO CLIMATE CHANGE IN DELHI

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ABSTRACT

Climate change represents a significant and complex issue for urban sustainability. The projected increase in megacities will strain cities such as Delhi facing extreme environmental stressors such as health-threatening air pollution, acute water scarcity, and intensifying urban heat island effect conditions - a situation exacerbated by rapid, uncontrolled urbanisation, social inequity, and weak institutions. This study critically evaluates the challenge of climate change in Delhi, focusing explicitly on the scope, structure, and efficacy of the responses of government policy. It evaluates broad national and state-scale frameworks, including the National Action Plan on Climate Change (NAPCC) and Delhi State Action Plan on Climate Change (SAPCC), in addition to a number of sector-specific interventions such as the Graded Response Action Plan (GRAP), the Delhi Electric Vehicle Policy (2020), and the Yamuna River rejuvenation initiatives. Using qualitative analysis based on secondary data and study of policy documents, this paper assesses the major obstacles to implementation, including fragmentation of institutions, inadequacies of resources, and limited public engagement. While Delhi's policy architecture shows a strong correlation to advance national goals, the gap between top-down policy development and implementation on-the-ground is a real challenge. The study presents policy recommendations which stress the importance and need for integrated governance systems, participatory planning, infrastructure investment, and sustained behaviour change.

Keywords: Climate Change, Delhi, Air Pollution, State Action Plan on Climate Change (SAPCC), Electric Vehicle Policy, Yamuna Restoration

INTRODUCTION

Climate change has developed into a significant and unmistakable world challenge. A consequence of climate change entails threats to ecosystems, human health, economic growth, and social equity. Climate change has gone from being an environmental concern that was distant to one that has obvious and immediate impacts. The impacts of climate change, are immediate and observable and are evidenced in extreme weather, temperatures, precipitation,

and public health outcomes. The impacts of climate change can often be seen within cities in the so-called developing countries of the Global South due to overpopulation, unsustainable use of resources, ineffective infrastructure, and lack of resources to address the impacts. The city of Delhi, India is arguably the most climate change vulnerable of the world's megacities, whose climate change impacts overlap with rapid urban growth and the urban poor's vulnerabilities.

In the last few decades, as a result of the country's economic liberalization, infrastructural growth, and ever-increasing number of rural migrants, Delhi has witnessed unprecedented urbanization. Between the arrival of people, economic growth, and urbanization, Delhi has altered its political and economic footing, however, the effects of rapid urbanization and growth are now (in part) manifest via uncontrollable land uses, uncontrolled building development, and unmanaged depletion of the natural environment. The outcome has been catastrophic, as summer 'average' temperatures are an uncommonly high and frequent phenomena with temperatures regularly exceeding 45°C, and heatwaves are common (especially over the summer months) due to those able to afford during the heat, without paying the due costs on vulnerable populations, including.

Background

These environmental stressors, along with unequal socio-economic standing and challenging governance structures, make Delhi especially vulnerable to climate change issues that are multidimensional. Urban poor communities, especially people living in informal settlements, are also disproportionately impacted, as these communities are often without adequate housing, clean drinking water and health services. These impacts from climate change heighten their vulnerabilities, increasing exposure to vector-borne diseases, malnutrition and livelihoods insecurity.

Awareness of these vulnerabilities has prompted national and state governments to begin to establish climate adaptation and mitigation policies. The Government of India established the National Action Plan on Climate Change (NAPCC), which began in 2008, with eight mission areas related to energy efficiency, renewable energy, habitats, water resources and utility knowledge. For the government of Delhi, this plan informs the State Action Plan on Climate Change (SAPCC). The SAPCC outlines a series of actions which are scaled and sector-based, with specifics on air quality, urban greening, sustainable transport, as well as improved water governance.

Research Objective

- To Study climate change impacts in Delhi
- To study climate change in Delhi with a specific focus on Air pollution, urban heat and water pollution.
- To identify the policy implementation challenges in Delhi governance.
- Examine the Delhi State Climate Change Action Plan's role.
- To study the role of public awareness campaigns and citizen participation in support of climate control in Delhi.

1. LITERATURE REVIEW

An assessment of Delhi's climate risk was planned for the Delhi administration. As a component of Delhi's State Climate Change Action Plan. There were some highly weak areas He was recognized by him. These weak areas were identified through many Counseling with various governments. Developing and modifying SAPCC to Delhi. There are some areas that are currently expected to be delicate and sensitive to the effects of climate change, Delhi health, water resources, energy, agriculture, forest and biodiversity, urban planning and transportation were recognized. These climate weaknesses constantly affect Natural and human resources directly or indirectly.

Health: -In Delhi, the intensity and frequency of frequency was observed Monsoon and temperature extreme heat stress increases Disorders and infectious diseases. Citizens of Delhi are at risk of stress related heat Scorching Diseases like cataract, dry eyes, skin disease and respiratory disorders General. In Delhi, about half of its total population lives in informal settlements like JJ Cluster (quarrel), slum area, unauthorized colonies and settled colonies (Delhi Government, 2010), which may be unsafe Health effects due to climate change. Harmful solid particles in Delhi Acid rain in the atmosphere, breathing problem, lung failure etc.

Water Resources: - Adequate availability of freshwater is one of the most Valuable resources but water scarcity is prominent in Delhi. Growing population And the rising temperature created heavy water tension and demand in Delhi. Whereas The increasing intensity of rainfall in the city can increase the run-off of the surface, which causes Decreased infiltration and spring recharge. So we saw a lack of water Quality was supplied by the Jal Board in Delhi. While there are many parts of the city Floods for floods during high intensity rainfall period. Recently this frequency has increased.

Transport: - Delhi's transport sector is responsible for about 30% greenhouse Gas (CO₂, CH₄ and SO₂) emissions. This is due to the rate of increase in number The population of vehicles is more four times higher than the rate of growth. In Rising GHG causes global warming and turns Delhi into heat island. Where roads And the bridges are severely affected by in the increase in intensity of bridges where they grow The tendency of GHGS emissions is also corrosive and can damage the infrastructure. Where Excessive rainfall incidence increases road accidents in Delhi

Air pollution: - Air pollution is a complex issue due to the presence of numerous known and unknown contributing factors. Pollutants enter the environment through both natural processes and human activities, including industrial operations, vehicle emissions, and domestic sources levels of suspended particulate matter, exceeding permissible limits for several consecutive years

2. RESEARCH METHODOLOGY

The research adopted a mixed method strategy with an emphasis on qualitative elements. Secondary data were used from agency reports from the Central Pollution Control Board (CPCB), Delhi Pollution Control Committee (DPCC), Ministry of Environment, Forest and Climate Change (MoEFCC), and NITI Aayog. The review of academic literature provided additional context and allowed for a fair and critical assessment. A qualitative approach was

also applied when a systematic appraisal of key policy drivers, namely, the National Action Plan on Climate Change (NAPCC), Delhi State Action Plan on Climate Change (SAPCC), and Delhi's Electric Vehicle Policy, and problem-specific developments like the Graded Response Action Plan (GRAP) and the Yamuna Action Plan, were conducted. Using a qualitative approach also provided the researcher with an opportunity to conduct in-depth assessments of the various climate governance approaches for the city level and the implementers (or inhibitors), as well as strengths, gaps in implementation, or potential improvements.

Research Hypothesis

- Problems with governance and interagency collaboration have hampered the impact of the Delhi State Action Plan on Climate Change (SAPCC) on climate-related concerns like air pollution, urban heat, and water pollution.
- Public awareness campaigns significantly influence individual behavior and community participation, leading to measurable improvements in climate change mitigation efforts in Delhi.

3. CLIMATE CHANGE IMPACTS IN DELHI

As a sprawling urban agglomeration and the political and administrative capital of a developing nation, Delhi is increasingly vulnerable to the multiple and widening impacts of climate change. As a megacity with more than 30 million residents (and many more in a series of surrounding urban districts) and a region where the urban population is the fastest growing in India due to unregulated rural to urban migration, it is a peninsula of environmental stress. In addition to unrestrained urban sprawl, industry, and a big loss of green cover and natural wetlands, in the last forty years, combined with ageing infrastructure and inconsistent environmental law, the urban environment of Delhi has become depleted in its capacity to absorb and respond to climate shocks.

The interrelationship of these anthropogenic pressures has increased the risk that Delhi will be exposed to a variety of climate driven hazards. Importantly, the climate based challenges exist mainly, and most acutely, in three different but interrelated dimensions: i) air pollution and health, ii) chronic water risk and urban drought, and iii) an exacerbated urban heat island (UHI) effect. Each of these stressors is driven by systemic governance failures, land use conflicts, and precarious patterns of consumption, and none of these stressors will be diminished by current governance strategies or changes to land use outside of addressing the control of greenhouse gas and other related emissions, which will only be partially overcome with cooler temperatures and less erratic weather and ecosystem degradation.

Air pollution in Delhi has reached severe levels, with particulate matter (PM_{2.5} and PM₁₀) concentrations consistently breaching safe limits and contributing to a public health emergency. Simultaneously, the city's water crisis—driven by over-extraction of groundwater, contamination of surface water sources like the Yamuna River, and poor rainfall distribution—has created conditions resembling an urban drought. The urban heat island effect further compounds these issues by creating localised pockets of extreme heat, particularly in densely built and poorly ventilated areas, increasing the risk of heat-related illnesses and energy consumption for cooling.

3.1. Air Pollution and Public Health

Delhi is consistently ranked as one of the world's most polluted cities, with particulate matter (PM_{2.5} and PM₁₀) that exceed the World Health Organization's (WHO) safe limits. The WHO [2021], suggests that the city's air quality index (AQI) is very often classified as "very poor" to "hazardous" levels, particularly in the winter months. The contributors to air pollution in Delhi include vehicle emissions, dust from construction and demolition, industrial emissions, and seasonal burning of biomass (stubble burning happens in neighbouring states, such as Punjab and Haryana).

These pollutants have serious implications for respiratory and cardiovascular health. Research has shown that long-term exposure to air pollution in Delhi results in excessive cases of asthma, chronic obstructive pulmonary disease (COPD), ischemic heart illness and pre-mature death. A report from the Centre for Science and Environment (CSE) [2020] stated that people in Delhi face a life expectancy reduction of approximately 6 to 9 years due to prolonged exposure to air pollution. The poorest, children and older people tend to be affected most by the health impacts of air pollution, illustrating inequality in public health.

3.2. Water Scarcity and Urban Drought

Delhi is increasingly facing conditions akin to an "urban drought," characterized by acute water scarcity despite being ideally located with the Yamuna River nowhere nearby. This crisis emanates from a combination of factors. First, increased groundwater extraction continues to lead to decreasing water tables, especially in the periphery, where urban land uses have outpaced water infrastructure. Second, surface water contamination is another serious environmental concern; more than 70% of the Yamuna River, along its course in Delhi, is biologically dead, as a direct result of not only untreated sewage but also industrial waste.

Irregular and shifting patterns of monsoon rains caused by climate change also reduce natural recharge of aquifers because the wetlands are developing have all been encroached on or lost to urbanization. Thus, Delhi is increasingly reliant on water in semi-arid areas of Haryana and Uttar Pradesh to provide for its water supply, which generates disputes between these states, as well as governance and monitoring difficulties. The general water crisis primarily affects low-income households and informal settlements, and many of them label themselves as "deprived of a reliable supply of clean and safe drinking water".

3.3. Urban Heat Island Effect

The Urban Heat Island (UHI) effect is escalating in Delhi, where urban and built-up areas exhibit greater temperatures compared to rural or peri-urban areas. Many inter-related factors lead to the UHI effect: surfaces and materials (like asphalt and concrete) impede water absorption, the loss of vegetation, the heat generated from motor vehicles, and a variety of urban design applications.

Satellite imagery and climatological data show that certain areas of Delhi, such as densely built neighbourhoods or commercial areas, are registering temperature anomalies (+ 4 - 6°C) above those of surrounding areas. Higher temperatures result in higher energy consumption from air conditioning, higher greenhouse gas emissions, and greater heat exhaustion/heat stroke incidences especially for outdoor workers, the elderly, and slum dwellers. The UHI effect

exacerbates air pollution by increasing the rate of ground-level ozone concentrations and decreasing environmental and health conditions.

4. GOVERNMENT POLICY FRAMEWORKS

The increasing climate vulnerability in Delhi, which has been characterized by super-hot days, poor air quality, water shortages, and loss of ecosystems, has required a strategic policy response by the national and state governments. So as to appreciate these intricate and intertwined issues, a set of climate-related frameworks and initiatives have been designed in the last decade to reduce environmental degradation, adjust to variable climate, and improve urban resilience. These policies are based on the larger aims of sustainable development and are informed by the international climate commitments that India has made, as well as by the critical local concern to save the health of the populace, natural resources, and infrastructure.

On the national level, the Government of India in 2008 launched the National Action Plan on Climate Change (NAPCC) which has provided a framework approach to deal with climate concerns at all sectors including energy, water, agriculture, habitat and ecological sustainability. The NAPCC is a broad framework, which identifies eight fundamental missions to help the country develop low-carbon and adapt to climate changes.

To this national vision, the Government of the National Capital Territory of Delhi (GNCTD) has developed its State Action Plan on Climate Change (SAPCC), a locally-specific plan that has prioritized the areas of air quality, water management, urban transportation, green infrastructure, and sustainable urban planning. The SAPCC will mainstream climate resilience into the development agenda of the city, and the specific interventions will be focused on the climate resilience of Delhi in its environmental and socio-economic context.

a) National Action Plan on Climate Change (NAPCC)

National Action Plan on Climate Change, which was launched by the Government of India in 2008, offers the general structure of the response to climate risks throughout the country. It consists of eight national missions that are on solar energy, energy efficiency, sustainable habitat, water conservation, sustainable agriculture, and improvement of knowledge and resilience of the ecosystems. Such missions are to be able to incorporate climate adaptation and mitigation into national development plans. Although the NAPCC has established a solid policy base, there has been an imbalanced translation of national objectives into state-specific implementation, which has frequently been complicated by differences in institutional capacities and state financial resources.

b) Delhi's State Action Plan on Climate Change (SAPCC)

In alignment with the NAPCC, the Delhi government formulated its own State Action Plan on Climate Change to address the city's unique environmental and infrastructural challenges. The SAPCC emphasizes air quality improvement, water conservation, green cover enhancement, and promotion of sustainable transportation. It attempts to mainstream climate concerns into sectoral policies, including urban planning, energy, and public health. However, the plan has faced criticism for its weak implementation due to limited interdepartmental coordination, insufficient funding, and lack of community participation. Furthermore, progress monitoring and impact assessment mechanisms remain underdeveloped.

c) Key Initiatives by the Delhi Government

Besides the SAPCC, the Delhi Government has also introduced specific measures to fight the climate-related issues more directly. The Graded Response Action Plan (GRAP) is one of these initiatives, which specifies a series of emergency measures according to the quality of air. There are steps such as stopping the building process, reducing the number of vehicles, and increasing the number of trains in the case of major pollution.

Another progressive step is the Delhi Electric Vehicle Policy implemented in 2020, which strives to reach 25 percent of new vehicles registered in electric by 2024. The policy offers economic incentives, infrastructural support, and institutional support to decrease the reliance of the city on fossil fuels and control the emission of automobiles.

The rejuvenation of Yamuna River is also in the limelight, as the projects aim at sewage cleaning, industrial effluents and the revitalization of riverbanks and wetlands. There are efforts to create public awareness to encourage responsible behavior and stakeholder participation, but there are still problems in enforcement and inter-agency cooperation.

5. IMPLEMENTATION CHALLENGES

Despite policy intent, implementation challenges persist due to:

a) Institutional Gaps

The institutional architecture of Delhi is fragmented, and the various agencies responsible have overlapping mandates and have little coordination, which limits the ability of the climate governance in Delhi. Functions of the most importance in the context of air quality, water management, transport and land use planning are shared between the Delhi Pollution Control Committee (DPCC), Delhi Jal Board (DJB), Public Works Department (PWD), Delhi Development Authority (DDA) and the three municipal corporations. This results in poor decision-making, lack of coordination and cohesion in the implementation of policies, and poor use of resources since there is no centralized coordination mechanism or action plan. As an example, one agency can work on greening urban areas, and another one can allow construction in ecologically sensitive areas, which will negate the climate resilience efforts as a whole. These institutional silos also hamper monitoring and evaluation of policy outcomes hence adaptive governance in a fast-changing urban environment is a challenge.

b) Resource Limitations

The main limitation in the realisation of climate policies of the city of Delhi is a shortage of sufficient financial and infrastructural resources. Environmental projects that have large scales, such as the expansion of sewage treatment plants, the development of electric vehicle (EV) charging networks, and green belt restoration will need high investment and long-term funding sources. Nevertheless, budgetary allocations are usually inadequate or inconsistent, especially towards long term projects and capital intensive projects. To give an example, even though the Delhi EV Policy offers high adoption rates and incentives, it is inefficient in that the city has yet to obtain a widespread and convenient charging system. Likewise, the Yamuna river restoration is still delayed because of the insufficient funds to provide complete sewage diversion and treatment schemes. The development and maintenance of green space is also

affected by uneven funding at the municipal level resulting in a patchwork of growth and decay of publicly owned environmental resources.

c) Limited Public Participation

Although the world is becoming increasingly aware of climate change and environmental degradation, the extent of climate action among the population in Delhi is low. The government policies are mostly made and carried out top-down and the local communities are hardly consulted in the decision-making or the actual implementation. The behavioural change campaigns like campaigns on waste segregation, rainwater harvesting, or less use of vehicles are usually episodic and there is no follow up to make them permanent. Moreover, most of these programs fail to properly respond to the socio-economic diversity of the Delhi population, and thus are less accessible or applicable to marginalized groups. The ideal policies can be ineffective, unsustainable and lack compliance without proper community involvement. There is therefore a need to promote bottom-up strategies, citizen-based monitoring and environmental education in order to create a culture of collective responsibility and civic ownership in the governance of climate in Delhi.

6. ANALYSIS

The climate governance in Delhi shows the existence of a well-organized and multi-dimensional policy system that meets the national climate objectives. A formal commitment to climate vulnerabilities is reflected in documents like the State Action Plan on Climate Change (SAPCC), the Delhi Electric Vehicle Policy, and area specific interventions like the Graded Response Action Plan (GRAP). However, even with this strategic orientation, the gap between policy making and actual grass root implementation is very high. This gap is also increased by poor mobilisation of the people, inability of the institutions to coordinate, and poor enforcement.

As an example, the GRAP, which is intended to address the air pollution issue by using a tiered emergency response mechanism, depending on the Air Quality Index (AQI) levels, is in essence a reactive one. It only triggers short-term limitations when pollution is in severe or dangerous categories instead of avoiding the worsening by using mitigation measures throughout the year. It therefore does not help in curbing the structural causes of pollution that include vehicle emissions, industrial and construction dust.

Likewise, the Delhi Electric Vehicle (EV) Policy of 2020 is an ambitious and futuristic policy, that seeks to electrify 25 per cent of all new vehicle registrations by 2024. Although the policy offers generous financial incentives and targets are ambitious, its execution is undermined by infrastructural constraints, the most apparent of which is the lack of a charging network in the city and its unequal distribution. The absence of affordable and efficient charging networks not only deters the potential consumers of EVs, but also slows down the overall process of moving towards sustainable urban mobility.

CONCLUSION

The climate crisis in Delhi makes it clear that there is an urgent necessity to transition toward a more integrated, preventative, and community-based model of climate governance than reactive and fragmented policy approaches. Although there are well-defined frameworks like the National Action Plan on Climate Change (NAPCC), Delhi State Action Plan on Climate



Change (SAPCC), and specific plans like the Graded Response Action Plan (GRAP), Delhi Electric Vehicle Policy, and Yamuna River restoration plans, Delhi experiences a growing number of environmental stress factors, with severe air pollution, water shortage, and increased urban heat among them. Although these policies are ambitious in paper, they have poor implementation because of institutional fragmentation, poor funding, and lack of citizen participation. The coordination between agencies is uneven, the infrastructure is not developing according to the policy, and behavioral change programs are not deep or widespread enough to mobilize the citizens properly. To overcome these challenges, Delhi needs to enhance institutional cooperation, maintain a long-term financial commitment, integrate climate resilience in urban planning and promote inclusive engagement of the population. Such holistic and responsible approach is the only way through which Delhi can increase its adaptive capacity and transition towards more sustainable and climate resilient urban future.

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