JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Impact of Climate Policy on Reducing Environmental Pollution in India: Policy Effectiveness, Co-Benefits and Implementation Challenges

Dr.Udayakumara M
Associate Professor, Department of Economics
Governament Arts,Commerce and P G Collage –Autonomous,Hassan,Karnataka,India.
E-Mail udduruday@gmail.com

Abstract

India faces the dual challenge of sustaining rapid economic development while reducing greenhouse-gas emissions and environmental pollution. Climate policy can contribute to both objectives because interventions directed at decarbonising electricity, improving energy efficiency, promoting renewable energy, electrifying transport, improving waste management and protecting forests can simultaneously reduce carbon dioxide emissions and conventional pollutants. This study examines the effectiveness of India's climate-policy framework in reducing environmental pollution, with particular emphasis on air pollution and the policy interactions between climate mitigation and pollution control. The study adopts a qualitative policy-analysis approach based on a systematic review of peer-reviewed research, official policy documents, India's nationally determined contributions, and evidence on the implementation of the National Clean Air Programme (NCAP). The analysis indicates that India's climate policies have generated important environmental co-benefits, particularly through renewable-energy expansion, energy-efficiency interventions, clean cooking, and electric mobility and pollution-control measures. However, the evidence also demonstrates that climate policy alone has not produced sufficiently rapid or geographically consistent reductions in ambient pollution. Recent assessments of NCAP show substantial variation among cities, while meteorological variability and inadequate regional coordination complicate attribution of observed pollution changes to policy interventions. The study argues that India's climate and environmental policies should be integrated through airshed-level planning, stronger enforcement, sector-specific emission standards, transparent monitoring and greater coordination between national, state and local institutions. India's 2031–2035 NDC, which raises the ambition for emissions-intensity reduction, non-fossil electricity capacity and carbon sinks, provides an opportunity to strengthen these linkages. The paper concludes that climate policy can significantly contribute to pollution reduction, but its effectiveness depends on implementation quality, policy coherence, monitoring capacity and the integration of climate mitigation with local air-quality management.

Keywords: climate policy; environmental pollution; air pollution; India; National Clean Air Programme; renewable energy; climate mitigation; policy effectiveness; sustainable development; emissions.

Introduction

Environmental pollution and climate change represent interconnected but analytically distinct challenges for India. Rapid urbanisation, industrialisation, energy consumption, transport growth and increasing demand for housing and infrastructure have contributed to significant pressures on air, water, land and ecological systems. At the same time, India is pursuing economic development while seeking to reduce the carbon intensity of its economy and contribute to global climate mitigation.The relationship between climate policy and environmental pollution is particularly important because many sources of greenhouse gases are also sources of conventional air pollutants. Fossil-fuel combustion in power generation, industry and transport can simultaneously release carbon dioxide, particulate matter, sulphur dioxide, nitrogen oxides and other pollutants. Consequently, policies that reduce fossil-fuel dependence can produce both climate and public-health benefits. Conversely, poorly designed interventions may generate trade-offs. For example, rapid reductions in sulphur dioxide emissions can produce important health benefits but may also reduce atmospheric cooling associated with sulphate aerosols. Climate policy therefore needs to be evaluated using multiple environmental indicators rather than carbon emissions alone.India's climate-policy architecture has evolved considerably during the last decade. The country's 2022 updated Nationally Determined Contribution (NDC) committed India to reducing the emissions intensity of GDP by 45% from the 2005 level by 2030 and achieving about 50% cumulative installed electric-power capacity from non-fossil-fuel sources by 2030. Information Bureau+1 More recently, India's 2031–2035 NDC increased the ambition further, including a target to reduce emissions intensity of GDP by 47% from the 2005 level, achieve 60% cumulative installed electric-power capacity from non-fossil sources, and create a carbon sink of 3.5–4.0 billion tonnes of CO_2 equivalent through forest and tree cover by 2035.

Air-pollution policy has developed alongside climate policy. The National Clean Air Programme (NCAP), launched in January 2019, initially established a target of reducing particulate pollution by 20–30% relative to the 2017 baseline. The target was subsequently strengthened to up to a 40% reduction in PM_{10} concentrations or achievement of the national standard by 2025–26.

The central argument of the paper is that India's climate policies have considerable potential to reduce environmental pollution, but policy effectiveness depends more strongly on implementation, enforcement, monitoring and cross-sectoral coordination than on the existence of policy targets alone.

Review of Literature

Tibrewal and Venkataraman examined climate co-benefits associated with air-quality and clean-energy policies in India and found substantial potential for simultaneous reductions in climate-forcing emissions and conventional pollutants. Their analysis particularly highlighted the importance of residential clean energy, control of brick production and agricultural-residue burning, while also demonstrating that electricity and transport policies can alter emissions of short-lived climate forcers.

This literature suggests that policy evaluation should move beyond a narrow focus on CO_2. Black carbon, methane, nitrogen oxides, sulphur dioxide and particulate matter can influence both climate and human health.

However, renewable-energy expansion does not automatically guarantee equivalent reductions in ambient pollution. The environmental outcome depends on whether renewable capacity displaces fossil generation, whether coal plants continue operating as baseload or backup capacity, the location of generating units, transmission constraints and the effectiveness of pollution-control standards.

National Clean Air Programme

NCAP represents one of India's most important national-level efforts to address ambient air pollution. Its original framework focused on non-attainment cities and required city-specific action plans. Reviews of these plans identified important weaknesses, including inadequate source-apportionment information, limited financial planning and insufficient institutional mechanisms for regional coordination. The divergence between these findings is important. It does not necessarily mean that one set of studies is incorrect. Rather, it demonstrates the difficulty of identifying a causal policy effect using simple before-and-after comparisons.

Climate co-benefits and policy integration

A major theme in the literature is the need for integrated environmental policy. Climate policies focused exclusively on carbon dioxide can overlook pollutants that have immediate effects on human health. Conversely, air-quality policies that ignore greenhouse gases can lock economies into carbon-intensive technologies. The concept of co-benefits provides a framework for integrating these objectives. A policy such as clean cooking can reduce household exposure to particulate matter while lowering emissions of climate-relevant pollutants. Similarly, public transport and electric mobility can reduce fossil-fuel consumption and urban pollution if electricity generation becomes progressively cleaner.

Research design

This study uses a qualitative policy-analysis and structured literature-review methodology. The purpose is to synthesise evidence on the relationship between climate policy and pollution reduction in India rather than to estimate a new econometric causal effect. The policy-analysis period primarily covers 2015–2026, corresponding to the evolution of India's climate commitments, implementation of major mitigation policies and development of NCAP.

Sources of evidence

Peer-reviewed evidence was identified from academic literature concerning India's climate policy, air pollution, NCAP, energy transition and climate co-benefits. Official sources included India's NDC submissions to the United Nations Framework Convention on Climate Change, Government of India policy documents and official NCAP information.

Analytical approach

The study uses thematic synthesis. Evidence was grouped into the following policy sectors: electricity and renewable energy; transport; industry; residential energy; agriculture and waste; urban air-quality

management; and forests and carbon sinks. The findings are interpreted cautiously because environmental pollution is affected by factors beyond policy interventions. In particular, observed changes in particulate concentrations cannot automatically be interpreted as the causal effect of climate policy.

Results and Discussion

India's evolving climate-policy framework

India's climate policy has shifted from relatively broad commitments toward increasingly quantified mitigation objectives. The 2022 NDC established a 45% reduction in GDP emissions intensity from the 2005 level by 2030 and approximately 50% non-fossil installed electricity capacity by 2030. The 2031–2035 NDC raises these ambitions. India now targets a 47% reduction in GDP emissions intensity relative to 2005, 60% cumulative installed electric-power capacity from non-fossil sources and a carbon sink of 3.5–4.0 billion tonnes of CO_2 equivalent from forest and tree cover by 2035. These targets can indirectly contribute to pollution reduction. However, emissions intensity is different from absolute emissions. If economic output increases rapidly, emissions intensity can decline while total emissions continue to increase. Consequently, environmental-pollution outcomes need to be monitored independently from climate targets.

Renewable energy and electricity-sector transition

Renewable-energy expansion represents one of the strongest potential links between climate policy and pollution control. Coal-fired electricity generation produces CO_2 as well as particulate matter, sulphur dioxide and nitrogen oxides. A progressive shift toward solar, wind, hydro and other non-fossil electricity can therefore generate substantial co-benefits.

However, three conditions are important;

First, renewable generation must actually displace fossil generation rather than merely supplement increasing electricity demand.

Second, coal-fired plants that remain operational must comply effectively with pollution-control standards.

Third, grid expansion and storage must allow variable renewable generation to substitute for fossil generation reliably.

The evidence therefore supports an important policy conclusion: renewable-energy capacity should not be treated as a sufficient indicator of pollution reduction. Actual fossil-generation displacement and pollutant emissions should also be monitored. Research on India's electricity transition reinforces this point.

Transport policy

Transport represents another important area in which climate and air-quality objectives overlap.Internal-combustion vehicles release CO_2 as well as NO_x, particulate matter and other pollutants. Climate-oriented policies that encourage public transportation, non-motorised mobility, vehicle efficiency and electrification can therefore reduce both carbon emissions and urban air pollution.

However, electric vehicles provide their greatest environmental benefits when electricity generation becomes progressively cleaner. Moreover, electrification does not eliminate non-exhaust particulate emissions from tyres, brakes and road dust.

Residential energy and clean cooking

Residential energy use is particularly important for household exposure to air pollution. Traditional biomass combustion can produce substantial indoor particulate pollution and climate-relevant emissions. The transition toward cleaner cooking fuels and electricity can therefore generate significant health and environmental benefits. Research on climate co-benefits in India identifies residential clean-energy policy as one of the important opportunities for reducing short-lived climate forcers. However, affordability, reliability and household behaviour determine whether clean-energy transitions are sustained. Policy should therefore focus not merely on initial access to clean technologies but also on continued affordability and use.

Industrial policy

Indian industry is an important source of both greenhouse gases and conventional pollutants. Steel, cement, brick production, chemicals and other industrial activities require energy-intensive processes and may emit particulate matter and gaseous pollutants. The greatest challenge is that industrial decarbonisation often requires large capital investments. Small and medium-sized enterprises may face particular financing and technology barriers. Consequently, climate policy should combine regulatory requirements with financial incentives, technology transfer and technical assistance.

Meteorology and attribution problem

One of the most important methodological findings from the literature is that pollution concentrations cannot be interpreted without considering meteorology. Wind speed, rainfall, atmospheric stability, temperature and regional transport can substantially alter observed particulate concentrations. A 2024 study concluded that recent $PM_{2.5}$ improvements in India were partly influenced by meteorological variation. Therefore, a decline in annual pollution does not necessarily mean that a policy caused the entire reduction.

Climate-pollution co-benefits

The evidence strongly supports the existence of climate-pollution co-benefits. Policies involving clean electricity, clean cooking, transport reform and industrial efficiency can reduce greenhouse gases and conventional pollutants simultaneously. India's climate and air-quality policies therefore have the potential to produce benefits across several Sustainable Development Goals.

Policy Implications

Move from city-based to air shed-based pollution management

Air pollution does not respect administrative boundaries. Pollution generated in one city or industrial region can affect neighbouring jurisdictions.

Therefore, India's climate and pollution policies should increasingly use airshed-level governance. Recent research specifically recommends shifting assessment from individual cities toward regional airsheds.

Strengthen monitoring

India has expanded air-quality monitoring substantially, but policy evaluation requires greater consistency and spatial coverage.

A national monitoring framework should combine: ground-based stations; low-cost sensors with quality assurance; satellite observations;

Prioritise high-impact sectors

Limited public resources should be concentrated on sectors with both high emissions and high pollution impacts.

Priority sectors include: coal-based electricity; heavy industry; road transport; construction and road dust; brick production; agricultural residue burning; household energy; and waste management.

Limitations of the Study

This study has several limitations.

First, it is a policy-analysis and literature-synthesis study rather than a new econometric assessment. Consequently, it does not estimate a causal coefficient measuring the exact effect of individual climate policies on pollution concentrations.

Second, existing studies use different geographical units, time periods, pollutants, datasets and methodologies. Direct comparison between estimates should therefore be undertaken cautiously.

Third, observed pollution levels are affected by meteorology, economic activity and regional transport. Consequently, before-and-after comparisons may overestimate or underestimate policy effects.

Fourth, India's climate policy is continuously evolving. The inclusion of the 2031–2035 NDC means that some policy outcomes will not yet be observable.

Finally, the study focuses primarily on air pollution because the evidence base linking climate policy and atmospheric pollution is stronger than the evidence for some other environmental domains. Water pollution, soil degradation, biodiversity and plastic pollution deserve additional research.

Future Research Agenda

Future research should move toward stronger causal identification of climate-policy impacts.

First, researchers should develop city- and district-level panel datasets combining pollution, meteorology, economic activity and policy implementation.

Second, difference-in-differences and synthetic-control methods could be used to evaluate specific policy interventions.

Third, satellite observations should be combined with ground-based measurements to overcome limitations in monitoring coverage.

Fourth, researchers should quantify health and economic co-benefits using consistent exposure-response functions.

Fifth, research should examine distributional effects. Pollution reduction is not necessarily socially equitable; low-income populations may experience higher exposure even when city-level averages improve.

Finally, future studies should assess whether India's 2031–2035 NDC produces measurable reductions in both greenhouse gases and conventional pollutants as implementation progresses.

Conclusion

This study examined the impact of climate policy on environmental-pollution reduction in India. The evidence indicates that climate policy has substantial potential to reduce environmental pollution because

many of India's major greenhouse-gas emission sources are also important sources of conventional air pollutants. Renewable-energy expansion, energy efficiency, clean cooking, electric mobility, public transport, industrial decarbonisation and forest protection can produce climate and environmental co-benefits. Research on India confirms that coordinated air-quality and clean-energy policies can generate substantial reductions in climate-forcing pollutants and improve environmental outcomes. However, the evidence also shows that policy commitments do not automatically translate into pollution reductions. The mixed performance of NCAP demonstrates the importance of implementation, monitoring, enforcement and regional coordination. Some cities have recorded substantial reductions in particulate pollution, whereas others continue to experience high or increasing concentrations.

The principal conclusion is therefore that climate policy can be an important instrument for reducing environmental pollution in India, but its effectiveness depends on policy integration, implementation quality and institutional capacity. India should move from fragmented, sector-specific interventions toward an integrated framework in which climate mitigation, air-quality management, public health and sustainable development are evaluated together.

An effective future strategy should be based on four principles: (1) integrate climate and pollution objectives, (2) manage pollution at the airshed level, (3) strengthen monitoring and enforcement, and (4) ensure a just transition toward cleaner energy and production systems.

If these principles are implemented effectively, India's climate-policy framework can generate benefits extending beyond greenhouse-gas mitigation to cleaner air, improved public health, greater energy security and more sustainable economic development.

References

1. Government of India, Ministry of Environment, Forest and Climate Change. (2022). India's Updated First Nationally Determined Contribution under the Paris Agreement. Government of India/UNFCCC.
2. Government of India. (2026). India Nationally Determined Contribution (2031–2035). United Nations Framework Convention on Climate Change.
3. Government of India. (2026). Cabinet approves India's Nationally Determined Contribution (2031–2035). Prime Minister's Office.
4. Ministry of Environment, Forest and Climate Change. (2019). National Clean Air Programme. Government of India.
5. Press Information Bureau. (2024). Goals set under National Clean Air Programme. Government of India.
6. Ganguly, T., Selvaraj, K. L., & Guttikunda, S. K. (2020). National Clean Air Programme (NCAP) for Indian cities: Review and outlook of clean air action plans. Atmospheric Environment: X, 8, 100096.
7. Tibrewal, K., & Venkataraman, C. (2021). Climate co-benefits of air quality and clean energy policy in India. Nature Sustainability, 4, 305–313.

8. Venkataraman, C., et al. (2020). The critical role of policy enforcement in achieving health, air quality, and climate benefits from India's clean electricity transition. Environmental Science & Technology.

9. Lal, R. M., & Nagpure, A. S. (2026). Evaluation of India's National Clean Air Program Performance and Potential Health Benefits. Environmental Science & Technology Letters. Assessing air quality during India's National Clean Air Programme (NCAP): 2019–2023. (2025). Atmospheric Environment, 343, 120974.

10. Impact of the National Clean Air Programme (NCAP) on particulate matter pollution and associated reduction in human mortalities in Indian cities. (2025). Science of the Total Environment, 968, 178787.

11. Air quality co-benefits of ratcheting up the NDCs. (2020). Climatic Change. What Is Polluting Delhi's Air? A Review from 1990 to 2022. (2023). Sustainability, 15(5), 4209.