

## Economic Growth and Environmental Sustainability in India: Challenges and Prospects

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### Abstract

India is one of the fastest-growing economies in the world, growing at the rate of 6 to 7 per cent annually since the 1991 liberalisation. This growth has helped lift millions of Indians out of poverty, but it has serious repercussions for the country's environmental quality due to the excess waste and pollution it creates. This study aims to examine the validity of the Environmental Kuznets Curve (EKC) hypothesis, that is, whether income has the capacity to clean up the environment on its own or whether India needs active government policy intervention. The study uses a narrative review of literature from 1993 to 2025, along with the reports issued by the World Bank, IPCC and India's environment ministry. This study examines disagreement over EKC validity instead of validating it with a new set of data and checks the findings against India's policy framework. The literature does not agree on the validity of EKC, but it agrees well on the development of renewable energy sources, eco-friendly technology, and regulatory enforcement. Despite the presence of a policy framework to protect the environment in India, its lack of implementation still creates many problems for sustainable development. The study recommends faster renewable energy sources, stricter enforcement, increased investment in green technology, and decentralising control for better policy implementation.

**Keywords:** Economic Growth; Environmental Sustainability; India; Environmental Degradation; Climate Change; Sustainable Development; Carbon Emissions; Energy Consumption; Green Growth; Environmental Policy.

### Introduction

Economic growth has long been regarded as the bedrock of development, generating employment and improving infrastructure, thereby raising the standard of living. However, rapid economic growth is often associated with high environmental impact. The experience of many developed nations demonstrates that industrialisation initially deteriorates the environment, which is later restored through effective policies and technological advancements (World Bank, 2023). Today, developing economies like India face an even more complex situation than the developed countries. Unlike earlier industrialised nations, India will have to seek sustained economic growth while simultaneously addressing environmental concerns, as environmental degradation and climate change have become global priorities that need constant and continuous monitoring (Intergovernmental Panel on Climate Change [IPCC], 2023).

Since the 1991 economic liberalisation reforms, India's economy has witnessed strong and sustained economic growth at an average of 6 to 7 per cent a year, making it one of the fastest-

growing major economies of the world (Government of India, 2025; World Bank, 2025). This remarkable progress has helped India lift millions of Indians out of poverty, expand industrial production, accelerate urbanisation, and strengthen the country's global economic position (World Bank, 2025). However, this has negatively affected the country's environmental quality, leading to a rise in air pollution, deteriorating water quality, rapid depletion of groundwater resources, deforestation, loss of biodiversity, and growing greenhouse gas emissions. Fourteen of the world's fifteen most polluted cities, by particulate matter, are in India. The Ganga, Yamuna, and dozens of small rivers carry huge volumes of industrial and municipal waste (IQAir, 2025); even groundwater is pulled out faster than it can refill, especially across the Indo-Gangetic plain. These challenges are well documented in government reports and independent studies, highlighting the urgent need to balance growth and environmental quality (Ministry of Environment, Forest and Climate Change [MoEFCC], 2023).

The relationship between economic growth and environmental quality has been extensively studied in economic literature using the concept of the Environmental Kuznets Curve (EKC). The idea of EKC was developed in the early 1990s and is based on the assumption that the process of economic development initially causes environmental quality to deteriorate, but it begins to improve after a country reaches a certain level of income (Grossman & Krueger, 1991; Grossman & Krueger, 1995). According to this theory, rich societies can afford cleanup, thereby demanding stronger regulatory frameworks, cleaner technologies, and increased investment in sustainable practices. Although the EKC has been tested extensively across countries and various environmental indicators, empirical evidence remains mixed, especially for emerging economies like India (Dinda, 2004; Stern, 2004). While some studies support the inverted U-shaped relationship, others suggest that economic growth alone is sufficient to improve environmental quality without government intervention (Stern, 2017).

The Indian economy is an important case study for examining this relationship because it is pursuing rapid economic growth, large-scale industrialisation, and ambitious climate commitments. As it is one of the world's largest economies by population and among the leading contributors of global greenhouse gas emissions, India's development choices have significant implications not only for its own environmental future but also for global sustainability efforts ([IEA], 2024; United Nations Environment Programme [UNEP], 2024). The key question, therefore, is whether continued economic growth will naturally improve the environment, as suggested in the EKC, or whether proactive government intervention is necessary to ensure sustainable economic development.

Against this background, the present paper examines the relationship between economic growth and environmental quality in India by reviewing existing literature, identifying the major environmental challenges associated with the country's growth process, and evaluating the prospects for achieving sustainable development. The study also explores the policy measures for sustainable economic development, thereby contributing to the ongoing debate on sustainable development in India.

The remainder of the paper is organised as follows. Section 2 works through the existing literature on economic growth and environmental quality in India. Section 3 identifies the research gap addressed by the study. Section 4 sets out the objectives of the study, followed by the methodology in Section 5. Section 6 lays out the findings of the study necessary for

ensuring sustainable development. Section 7 offers policy recommendations, and Section 8 concludes the study.

## **Review of Literature**

The relationship between economic growth and environmental quality has been extensively examined in the development economics literature, with EKC being the dominant theoretical framework. The EKC hypothesis was first proposed by Panayotou (1993), who suggested that environmental quality initially degrades with economic growth but improves as a country's income level increases. Since 1993, the hypothesis has been widely tested across various countries and indicators, although the empirical evidence remains far from conclusive (Dinda, 2004; Stern, 2004).

In the Indian context, studies on the growth-environment nexus have focused primarily on testing the validity of the EKC using advanced econometric techniques. Behra (2021) applied the Autoregressive Distributed Lag (ARDL) approach for the period 1971-2016; the findings supported the conventional inverted U-shaped relationship, and the study further revealed that energy consumption significantly increases emissions, whereas foreign direct investment (FDI) and trade openness have a limited impact. Similarly, Sinha and Shahbaz (2017) also supported the EKC for India using data from 1971-2015, and they argued that India has not yet reached the estimated income turning point of about US\$2,938 per capita, suggesting that economic growth is unlikely to improve environmental quality in the near future. Their study also indicated that renewable energy plays a significant role in lowering CO<sub>2</sub> emissions.

The study by Pata et al. (2022) found a U-shaped relationship for India instead of an inverted U-shaped relationship using the Residual Augmented Least Squares (RALS) Fourier cointegration approach; therefore, their study rejected EKC for India. Similarly, Adeneye and Rasheed (2025) examined a panel of seventeen coal-consuming countries; their study found that EKC was valid for developed economies and not for developing ones, including India. A comparative analysis of India and China by Jiao et al. (2022) found similar results. Their results showed that China had decoupled economic growth from environmental outcomes by 2017, but in India, there still exists a positive relationship between the said variables, and the rising population exerts even more pressure on the environment. Recognising that economic growth alone cannot fully explain the environmental outcomes, recent studies have examined the other determinants of environmental sustainability. In this line, a study by Sharmiladevi (2024) found that factors like agricultural value added, industrial growth, and fossil fuel consumption significantly increase carbon emissions, whereas trade openness and foreign direct investment reduce emissions, challenging the traditional pollution haven hypothesis. This study also incorporated institutional quality and urbanisation into the nexus and highlighted that urbanisation reduces environmental degradation, while institutional quality increases it. This implies that stronger governance initially supports economic growth rather than improving environmental quality. Similarly, Li and Zhang (2025), while studying six SAARC countries, found that institutional quality helps to protect the environment only when it is paired with renewable energy adoption and financial development, while industrialisation and unchecked globalisation continue to increase pressure on the environment.

Various studies have also focused on the role of energy transition and technological innovation in achieving sustainable development. Studies like Raihan et al. (2024) highlighted that increased nuclear energy consumption significantly reduces greenhouse gas emissions in the long run. Bhardwaj and Chauhan (2025) further showed that renewable energy capacity and economic growth Granger-cause each other, indicating that investment in clean technology helps in sustainable economic growth. Similarly, Pachiyappan et al. (2022) found that environmental patents substantially reduce carbon emissions.

Recent studies have also broadened the analytical view by including cross-country and subnational comparisons. A study by Jie and Rabnawaz (2024) used data from 55 countries and argued that technological innovation can help to reduce carbon emissions if it is complemented with institutional governance to effectively use that clean technology. Within India, Kumar et al. (2025) found evidence supporting EKC for the state of Haryana, suggesting that significant regional differences exist in the income-environment network. This finding raises questions regarding the appropriateness of treating India as a homogeneous unit.

Beyond econometric investigations, many studies have examined the policy and governance aspects of sustainable development. Mani et al. (2012) found that the long-term economic costs of environmental damage (such as water contamination and air pollution) are far greater than the short-term costs associated with environmental regulation. Dubash (2012) observed that weak enforcement and institutional limitations continue to weaken policy effectiveness despite the Environmental (Protection) Act, 1986. Similarly, Datt and Ravallion (2002) highlighted the strong relationship between poverty and environmental quality, arguing that poor households rely heavily on natural resources and remain the most vulnerable to environmental shocks. Recently, the study by Singh (2018) assessed India's Nationally Determined Contributions (NDCs) under the Paris Agreement and concluded that, since the country's climate goals are ambitious, stronger policy coordination in the transport, energy, and urban sectors. Supporting these findings, NITI Aayog (2021) identified green energy, eco-infrastructure, sustainable agriculture, energy conservation, and sustainable town planning as important pillars for India's long-term low-carbon development strategy.

Therefore, the existing literature does not converge on a single answer to whether growth enhances environmental quality. Empirical findings vary by environmental indicator, sample period, and econometric method, and factors such as renewable energy consumption, technological innovation, effective governance, and sector-targeted government policies significantly shape the curve. This is the gap that this paper's policy section tries to address.

## **Research Gap**

Despite the extensive literature on the relationship between economic growth and environmental quality in India, many important gaps remain. Results on EKC validity are conflicting; some studies verify it (Behera, 2021; Sinha and Shahbaz, 2017), while others reject it (Pata et al., 2022; Adeneye and Rasheed, 2025). This inconsistency in the results mainly arises from variation in sample periods, econometric techniques applied, and variables used to measure environmental quality. No paper in this literature pulls this apart, and this paper can address this gap.

Secondly, several recent papers study multi-country panels where India is one case among the many countries; therefore, a paper considering India alone is important.

Finally, while many studies concentrate on validating EKC through econometric analysis, very few studies translate their findings into coherent policy recommendations; this study aims to fill these gaps by providing a thorough review of the relationship between variables, and instead of just testing the validity of EKC, the study synthesises evidence from recent research to find the main drivers of sustainable economic growth and also identify the policy measures that can help India to achieve long term economic growth while maintaining the quality of the environment.

## **Objectives**

This study has the following objectives:

1. To critically review current literature and policy framework to understand the relationship between economic growth and environmental quality in India, with a focus on the EKC hypothesis.
2. To evaluate India's current policy framework against the existing literature and to suggest which policy is actually effective.
3. To produce policy recommendations that hold up regardless of the validity of the EKC hypothesis.

## **Research Methodology**

The present study uses the descriptive and analytical research methodology, with a narrative review that brings together what researchers have done to understand the relationship between environmental quality and economic growth in India, specifically studying the Environmental Kuznets Curve. The study relies on peer-reviewed articles from 1993 to 2025, including reports published by reputable organisations such as the World Bank, the Intergovernmental Panel on Climate Change (IPCC), and the Indian Ministry of Environment and Forests (MoEF). The studies relevant to the topic are analysed to assess whether the researchers reach a consensus on the relationship between the said variables. Specific attention is paid to the indicators used in the studies, the research methodology adopted, and the economic policy suggested to resolve the problem.

To check the effectiveness of India's current policy system, the results of the empirical literature were compared with national policies and programs regarding climate change, pollution control, renewable energy, and sustainable development. The interpretative nature of the study helps compare findings to assess the validity of the EKC. Since the study does not use any primary data or new statistical or econometric methods, it gathers evidence from the existing literature to build a clear understanding of the relationship between economic growth and environmental quality in India. The study also makes evidence-based policy recommendations that remain valid despite of the conflicting results on EKC validity.

## **Results and Discourse**

After reviewing the existing literature and policy documents, the complex relationship between economic growth and environmental quality. This relationship cannot be explained by the EKC hypothesis. Various studies confirm the U-shaped relationship (Behera, 2021; Sinha and

Shahbaz, 2017), but many others either reject the EKC or suggest alternative views based on the indicators, study period and econometric technique used (such as Pata et al., 2022; Adeneye & Rasheed, 2025). Therefore, this shows the importance of environmental quality indicators and the econometric technique used to understand the interplay, and it also suggests that economic growth alone does not play a significant role in determining environmental quality. Empirical studies that used carbon dioxide emission as a measure of environmental quality often support the EKC hypothesis, while others using the ecological footprint reject it. Similarly, econometric techniques such as ARDL, FMOLS, DOLS, and RALS-Fourier Cointegration used in the study also play a major role in explaining the variations.

Despite controversy regarding the validity of the EKC hypothesis, the reviewed literature shows agreement on the determinants of sustainable development. Evolution and investment in renewable energy prove to be the most important factors contributing to sustainable development (Raihan et al., 2024; Bhardwaj & Chauhan, 2025). At the same time, developments in green technology and R&D in environmentally friendly products help reduce greenhouse gas emissions in the long run, as suggested by Pachiyappan et al. (2022). Another important determinant of environmental quality is governance and institutional quality of a country, although there are conflicting results concerning this; still, it can be said with confidence that implementation of environmental regulations, good governance and institutional quality have a significantly positive effect on the environment (Dubash, 2012; Li & Zhang, 2025). Moreover, the study suggests that policy effectiveness depends upon its implementation rather than mere creation.

Efforts like the National Action Plan on Climate Change, the National Green Hydrogen Mission, development in renewable energy sources, increasing reliance on electric vehicles, afforestation measures, and contribution to the Paris Agreement clearly show that India's development policy has already incorporated the idea of protecting the quality of the environment while ensuring growth and development. However, implementing these policies faces several challenges, including regulatory and coordination issues, funding allocation, uneven technology adoption, and regional differences in environmental performance. The empirical literature also shows that environmental sustainability can be achieved through proper urban planning, water resource management, improved agriculture, a better transport system and technological innovation. Therefore, an integrated policy measure is required to ensure growth while protecting the environment. Thus, the discussion around EKC is significant in the academic setup, but it does not have a significant effect on decision-making in practice, and an active policy framework is required instead of just validating the EKC hypothesis.

## **Policy Recommendations**

The results of the study recommend the following policy measures:

- i. Accelerate the transition to renewables: More investment should be made in solar, wind power, green hydrogen, and modern electricity infrastructure to reduce dependence on fossil fuels.
- ii. Strengthen environmental governance: Regulatory enforcement needs to be improved through constant monitoring, auditing and increasing industrial accountability.

- iii. Promote eco-friendly innovation: More investments should be made in research and development of eco-friendly and clean technology, and circular economy practices need to be promoted.
- iv. Integrate sustainability in growth planning: The environment should be protected and conserved while framing policies for urbanisation, industrialisation, agriculture and infrastructure development.
- v. Decentralise policy implementation: Since India is a diverse country, state governments should be given the flexibility to formulate sustainable development strategies best suited to their regional needs.
- vi. Increase investment in sustainable development and create public awareness: Public-Private Partnerships in green finance should be promoted, and more awareness must be created among the citizens of the country to protect the environment.

## Conclusion

Presently, India is at a critical phase of the development process, where the challenge is to accelerate the economic growth of the country without compromising the quality of the environment. This study examined the empirical literature and policy documents to understand the relationship between income and the environment, using the case of the Environmental Kuznets Curve.

The existing literature presents inconclusive results regarding the validity of the EKC, as some studies validate the U-shaped relationship while others reject it or present alternative results depending on the environmental indicator and methodology used. Therefore, the EKC should not be seen as a universal theory to explain India's environmental trajectory.

Nevertheless, the empirical literature has rightly presented the policy interventions necessary to improve environmental quality. The major factors that affect the quality of the environment include the development of renewable energy sources, eco-friendly technology, effective regulatory enforcement, infrastructure development and integrated climate policies.

The analysis of India's policy framework suggests that significant efforts have been made in terms of commitment to climate protection, developing renewable energy sources, initiating pollution control programs, and other strategies to ensure sustainable development. Nonetheless, there are still many problems in policy implementation, including the need for sustained investment in environment-friendly sustainable development. Therefore, the study suggests that future studies should not rely on EKC; instead, countries should work to incorporate social, economic and sustainable concepts in the policy framework.

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