



Carbon Emissions and Their Role in Global Warming: A Comparative Study

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ABSTRACT

Abstract: Carbon emissions, primarily resulting from fossil fuel combustion, are widely recognized as the principal driver of anthropogenic global warming. This study presents a comparative analysis of carbon emission trends in China, the United States, and India using secondary data from global databases such as the Intergovernmental Panel on Climate Change (IPCC), World Bank, and Global Carbon Project. The research evaluates total emissions, per capita emissions, and sectoral contributions while employing statistical tools such as correlation and regression analysis. The findings reveal significant disparities in emission patterns, emphasizing the importance of equitable and sustainable climate policies. The study concludes that global cooperation, technological innovation, and policy interventions are critical for mitigating climate change.

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1. Introduction

Carbon emissions from anthropogenic sources, particularly fossil fuel combustion, have significantly contributed to global warming and climate change. According to the Intergovernmental Panel on Climate Change (IPCC, 2021), human activities have unequivocally increased atmospheric greenhouse gas concentrations, resulting in rising global temperatures. The concentration of atmospheric carbon dioxide has exceeded 420 parts per million, marking an unprecedented level in recorded history (Global Carbon Project, 2023).

Rapid industrialization, urbanization, and population growth have accelerated energy consumption, thereby increasing carbon emissions worldwide (International Energy Agency [IEA], 2024). Understanding emission patterns across major economies is essential for designing effective mitigation strategies.

2. Literature Review

Extensive research has identified carbon emissions as the primary driver of climate change. The IPCC (2021) highlights that greenhouse gas emissions have led to widespread environmental changes, including rising sea levels and extreme weather events. Similarly, the Global Carbon Project (2023) reports a continuous increase in global emissions due to fossil fuel use and land-use changes.

Pimm et al. (2014) emphasize the ecological consequences of climate change, linking emissions to biodiversity loss and ecosystem degradation. The World Bank (2023) further correlates economic growth with increased energy consumption and emissions, particularly in developing economies.

3. Methodology

This study adopts a mixed-method approach using secondary data from reliable global sources, including the World Bank (2023), IPCC (2021), and Global Carbon Project (2023). A comparative framework is used to analyze emission patterns in China, the United States and India.

3.1 Data Analysis Model

Comparative analysis across countries by using excel sheet.

▪ **Global Emissions Trends**

Global emissions have increased significantly over the past decades.

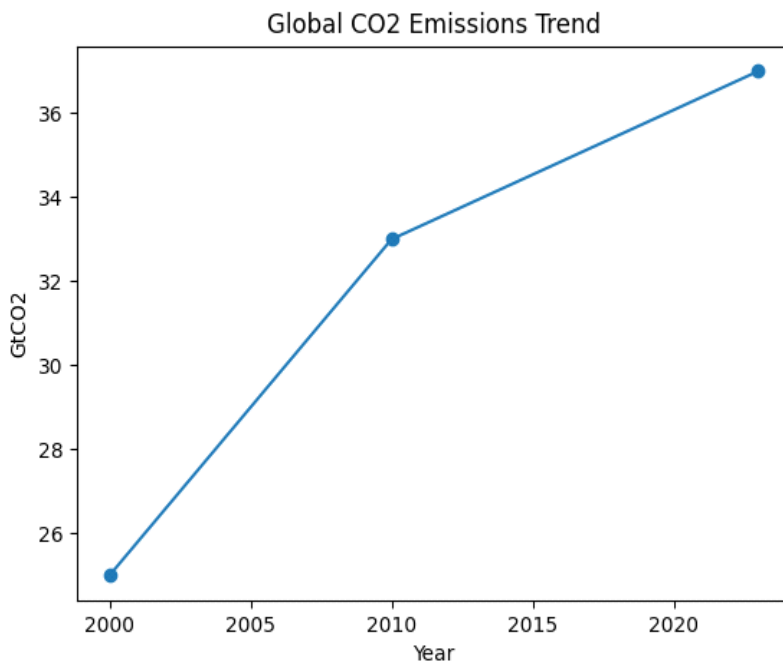


Figure 1. Global carbon dioxide emissions from 2000 to 2023, showing a steady increase with a temporary decline during 2020 (Global Carbon Project, 2023).

▪ **Country-wise Comparison**

Comparison of emissions among major countries.

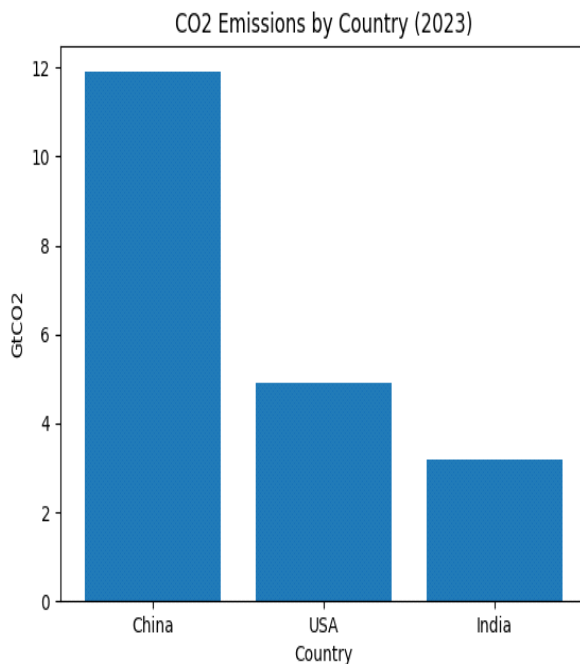


Figure 2. Comparison of carbon dioxide emissions among major economies, highlighting China as the largest emitter (IEA, 2024).

China is the largest emitter due to rapid industrialization and reliance on coal-based energy (IEA, 2024). The United States, although second in total emissions, has the highest per capita emissions, reflecting higher energy consumption levels. India, while experiencing rapid growth, maintains relatively low per capita emissions (World Bank, 2023).

▪ **Per Capita Emissions**

Per capita emissions show inequality between countries.

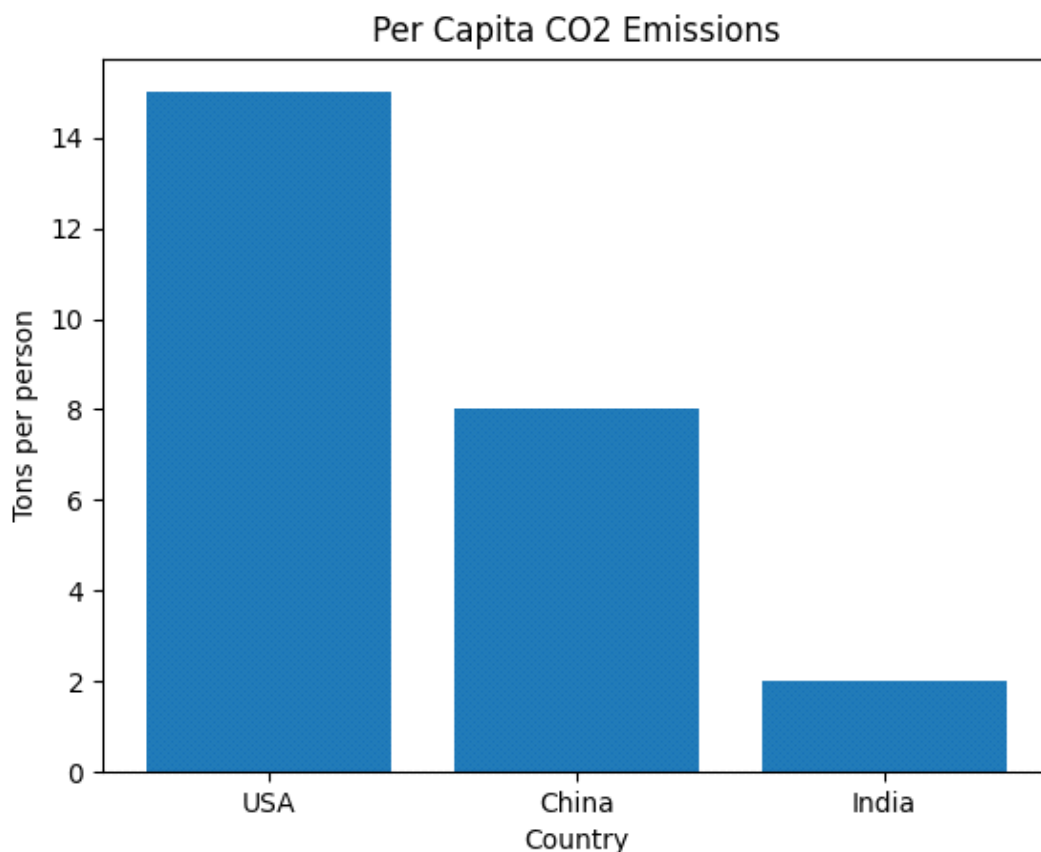


Figure 3. Per capita carbon emissions illustrating inequality between developed and developing nations (World Bank, 2023).

▪ **Policy Implications and Mitigation Strategies**

- Effective mitigation strategies include:
 - Transition to renewable energy sources
 - Implementation of carbon pricing mechanisms
 - Promotion of energy efficiency
 - Strengthening international climate agreements
 - Global cooperation is essential to address climate change effectively (IEA, 2024).

4. Discussion

The comparative analysis highlights disparities between developed and developing nations. While developed countries have historically contributed more emissions, developing nations are experiencing rapid growth. This supports the principle of "common but differentiated responsibilities" in global climate policy.

Conclusion

Carbon emissions remain the primary driver of global warming. Addressing this challenge requires coordinated global efforts, sustainable development practices, and technological innovation. Future research should focus on region-specific mitigation strategies and long-term climate modeling.

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