AN EMPIRICAL ANALYSIS ON ECONOMIC DEVELOPMENT AND CO₂ EMISSION IN INDIA BY USING ENVIRONMENTAL KUZNETS CURVE

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---ABSTRACT--

India is the second largest population country in the world, and it has endowed with various natural resources, but in the last few decades, the environmental resources are continuously deteriorated due to economic development and human activities. The air pollution due to CO₂ emissions is one of the biggest challenges for India as well as at the global level. Therefore, this paper analyze the empirical relationship between Economic development as GDP per capita and per capita CO2 emissions as Environmental pollution by using Environmental Kuznets Curve. This research paper is based on secondary data and collected from the International Energy Agency (IEA), the World Bank, and various reports. For data analysis, the correlation and linear regression was used. The linear regression result shows that the R² value is 0.958 and indicated that 95 percent of (dependent variable) per capita CO2 emissions was influenced by the GDP per capita of India. The study found that the relationship between the GDP per capita of India and per capita CO2 emissions have an upward sloping curve and India's Environmental Kuznets Curve is not U shape. This paper recommended the need of environmental policies to reduce CO2 emissions and its was helps to reduce the other various environmental issues such as global warming and climate change, etc.

KEYWORDS: *Environmental Kuznets Curve, Economic Development, Pollution, Deteriorated.*

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1. INTRODUCTION

India is a developing economy with a faster rate of gross domestic product growth and simultaneously there is a decline in environmental quality which indicates the deterioration of environmental resources in India. The energy consumption, human activities, and industrial activities are the major reasons for CO2 emissions. Hence, India has outlined policies to cut its projected greenhouse gas emission to around one-third by 2050 to combat climate change. "The shift away from fossil fuels could affect India's GDP and employment; the Government may loss its revenue from taxes on petroleum products, which would constrain Government spending" (Deepthi Swamy and Varun Agarwal 2022). This situation creates a trade-off between economic growth and environmental resources. The Environmental Kuznets curve shows the relationship between environmental quality and economic development. The EKC hypothesis clearly explains in the earlier stage of economic development of the country that environmental quality was worsened and the environmental pollution will reach the maximum level. The maximum level is referred to as the turning point at the time the country gets adequate resources then tackle environmental pollution and improves the environmental condition. In India, air pollution is one of the biggest environmental issues. It creates lots of issues in the environment such as global warming climate change, air pollution, etc.

According to Global carbon project report 2021, India is the third largest contributor to Carbon emissions. Hence, India signed the Paris agreement to reduce Greenhouse gases, and long-term low-emissions development strategies are determined by the countries themselves and submitted the Nationally determined contribution and follow the low carbon development strategy. "The imperatives of eradicating our development deficits and ensuring our energy security while rationally utilizing our natural resource endowment are therefore two themes

that pervade our low-carbon strategy". Even though human activities, transportation, and industrial activities are continuously increasing the Co2 emission in India as well as in the Global level. Therefore, this study analyze the relationship between GDP per capita and per capita of CO_2 emission in India by using Kuznets Curve.

2. REVIEW OF LITERATURE

Alam et al., (2016) study mainly focused to examine the impact of income, energy consumption, and pollution growth on CO2 emissions by employing annual time series data for the period 1970-2012 for India, Indonesia, China, and Brazil. The study used the Autoregressive Distributed Leg bounds test approach considering both the linear and non-linear assumptions for related time series data for the top CO2 emitter emerging countries in both the short run and long run. This study considers four developing countries which are highly populated as well as top CO2 emitters. While considerable relationships among the key variable are apparent in all these countries as explained earlier through ARDL approaches and EKC hypotheses. This study finds that the EKC of China was not significant in the short run but it was significant in the long run.

Sinha and Younus (2016) analysed the relationship between Carbon Emissions CO2 per capita and GDP real net per capita. The study clearly shows that there is the existence of an N-shaped EKC for CO2 emissions. The economy witnesses a further increase in these emission levels and the tunnelling through the inverted U-shaped EKC for a developing country like India is only temporary. This study demands more stringent environmental policies like carbon tax, command, and control measures.

Saboori et al., (2012) study analysed the causal relationship between economic growth and CO2 emissions in Malaysia. The data used for the study from 1980 to 2009, the environmental Kuznets curve hypothesis was tested utilize the Autoregressive Distributed Leg methodology. The study discussed the increasing threat of global warming, climate change, and global environmental issues. The major explanations for the possibility of an inverted U-shaped relationship between economic growth and environmental pollution. The study results that the existence of a robust long-run relationship between per capita CO2 emissions and real per capita GDP.

Liu et al., (2007) investigated the relationship between environment and development in Shenzhen, the first Chinese special economic zone. The study mainly focuses on assertions that the evidence for the inverted U-shaped relationship applied to a subset of environmental measures for instance certain conventional pollutants such as suspended particulates and Sulphur dioxide the study result shows that production-induced pollutants support EKC while consumption-induced pollutants do not support to EKC.

Panayotou (1993) investigated the nexus between economic growth and environmental degradation by using the cross-section data on deforestation and air pollution for some selected developed and developing nations. For this study, Nitrous oxide and sulphur dioxide are used 39 as the indicators of environmental pollution. The study results show a positive relationship between economic growth and environmental pollution.

3. OBJECTIVES

- To analyse the relationship between GDP per capita of India and per capita CO_2 emission by using Environmental Kuznets Curve.

4. METHODOLOGY

The study is test the Environmental Kuznets Curve hypothesis for per capita CO2 emissions and GDP per capita of India from 1971 to 2020 in the frequency of 5 years. This paper is based on secondary data collected from the International Energy Agency (IEA), the World Bank, and various reports. For this study, the percentage change over the previous year, correlation, and linear regression was used for data analysis.

5. DATA ANALYSIS AND DISCUSSION

Table 1: Per capita of GDP and Per capita CO₂ emissions in India

Year	GDP per capita	Percentage change over in previous year	Per capita CO₂ emissions (in tonnes)	Percentage change over
1971	118.20	-	0.32	-
1975	157.93	33.62	0.35	9.37
1980	267.39	69.31	0.38	8.57
1985	298.00	11.45	0.48	26.32
1990	368.75	23.74	0.61	27.08
1995	**373.63**	**1.32**	**0.73**	**19.67**
2000	442.03	18.31	0.84	15.07
2005	710.51	60.74	0.94	11.90
2010	1350.63	90.09	1.27	35.11
2015	1590.17	17.74	1.56	22.83
2020	**1910.42**	**20.14**	**1.75**	**12.18**

Source: IEA and World bank, 2020

The table 1 shows the GDP per capita and per capita of carbon dioxide in India at 5 years of frequency. The percentage change over the previous year for both the variables are continuously increase over the 5 years. The carbon dioxide emission was started to increase in 1980 and it was 69.31 percent increase over the previous year. In 1990, GDP per capita was 23.74 percent and CO2 emission was 27.08 increase over the previous year. In 1991, the LPG (Liberalization, Privatization, and Globalization) was introduced in India, this encourages and increases production. But after LPG, there is a slight change in GDP growth. In 1995, it was 1.32 percent, compared to the previous year less GDP per capita. The CO2 emission 19.67 was fairly increased over the previous year. It creates a trade-off situation between economic development and environmental quality. India is concentrated on economic development so, the GDP per capita and CO2 emissions was continuously increase from 2000 to 2010. This indicates that India is a developing nation, concentrated on economic development and environmental pollutants also increase. Hence in 2015, India is a signatory to the Paris agreement is a legally binding international treaty on climate change was signed. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels and it was enforced in 2016. This was the reason behind the CO2 emission was slightly changed in 2020. In 2020, GDP per capita was 20.14 percent increase and CO2 emission was 12.18 percent was increase. The Ministry of Environment, Forest and climate reported by that 2030, India will reduce the emissions intensity of Gross domestic product by 45 percent and net CO2 emission will be estimated to be zero. It helps to overcome from air pollution and related environmental problems.

Table 2: Correlation between GDP per capita and per capita CO₂ emissions in India

Correlation Result		Per capita CO2 emissions	GDP per capita
Per capita CO₂ emissions	Pearson Correlation	1	.979[**]
	Sig. (2-tailed)		.000
GDP per capita	Pearson Correlation	.979[**]	1
	Sig. (2-tailed)	.000	
**. Correlation is significant at the 0.01 level (2-tailed).			

The table 2 shows the correlation between GDP per capita and per capita CO2 emission in India. There is a positive correlation between both the variables and significant at 1 percent level, which implies that when GDP per capita increases and per capita CO2 emissions also increase. The correlation result was confirmed that EKC for GDP per capita and per capita CO2 emission was upward sloping not inverted U shape.

Linear regression Result

The linear regression was used to test the EKC hypothesis, to know the relationship between GDP per capita and per capita of CO_2 emissions in India.

Table 3: Linear regression of GDP per capita and per capita of Carbon dioxide Emissions in India

	Carbon dioxide Emission as the dependent variable			
	Estimate	**Std error**	**t- value**	**Significance**
(Constant)	.306	.049	6.198	.000 **
GDP per capita	.011	.001	14.290	.000 **
R squared	0.958			
Adjusted R Square	0.953			

Note: ** 1% level of Significance

Quadratic Function: $Y = a \pm b_x + U$

        $Y = .306 + .011_{(GDP)} + U$
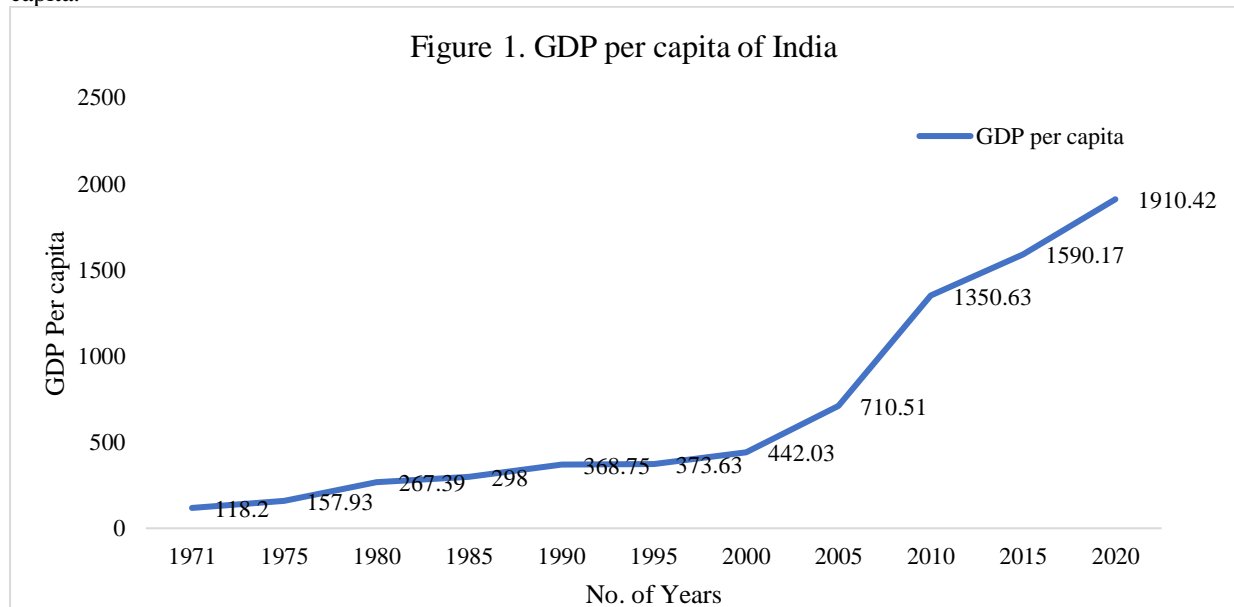
        $Y = CO_2$ emission

        a = Constant

        X_1 = GDP per capita of India

        U = Error Term

Table 3 shows the linear regression analysis of GDP per capita and per capita of CO2 emissions in India. The results reveal that the Carbon dioxide emissions and the GDP per capita are statistically significant at a 1 % level. The R square value is 0.958 and indicates that 95 percent of the dependent variable (CO2 Emissions) was determined by GDP per capita (independent variable). It implies that CO2 emissions increase due to GDP per capita.

Figure 1. GDP per capita of India

Figure 2. Per capita CO2 Emission in India
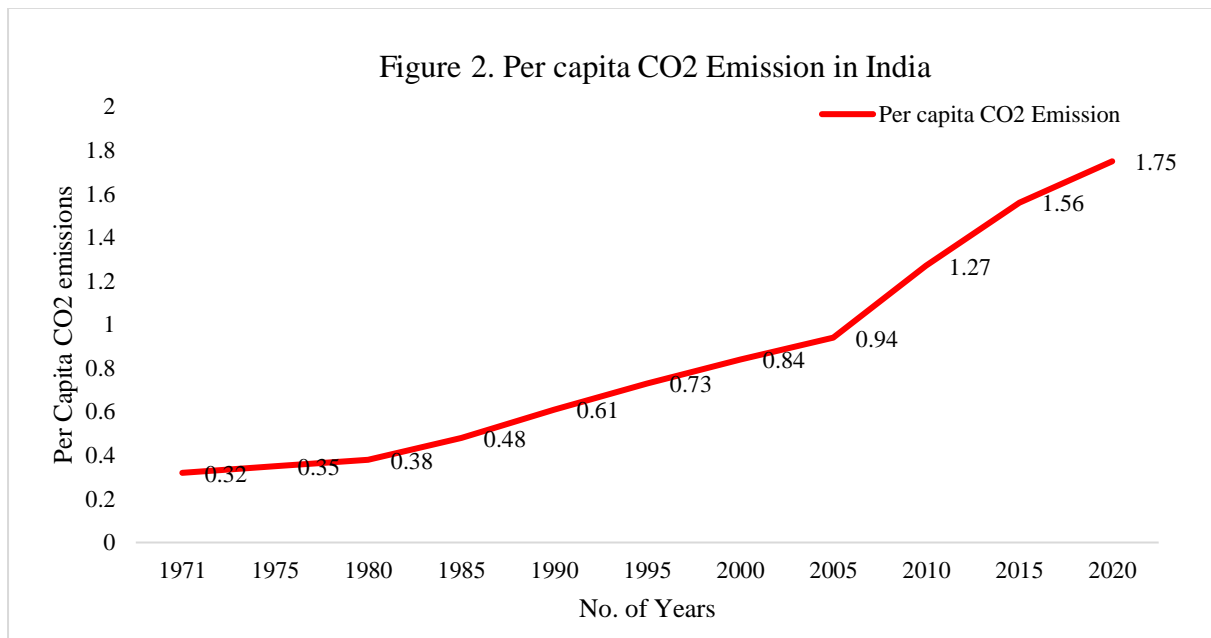
The figure 1. and figure 2. show the relationship between the GDP per capita and CO2 emissions in India. This also proves that India's Environmental Kuznets Curve was not a U-shaped curve, it is an upward-sloping curve. Because India is a developing country, the Economic growth was increases and Environmental quality also started to decline. It indicates that the Government of India should take effective environmental policies for CO2 emissions.

6. CONCLUSION

The study found that India's Environmental Kuznets curve for GDP per capita and per capita CO_2 emission was not a U-shaped curve, it is an upward-sloping curve. Because India is a developing country and mainly focuses on economic growth and production therefore, environmental pollution also increases. The Government of India has taken many steps to reduce the CO_2 emission. India signed the Paris agreement to reduce the CO_2 emissions, development of low carbon strategy, and net zero emissions by 2050. But the air pollution is the biggest issue for major cities in India. The study suggests to the Government and policy makers should make policies for the sustainability of both economic growth and the environment.

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