Economic growth and environmental degradation at Indian context : Environmental Kuznets Curve (EKC) approach

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ABSTRACT : Environmental pollution is an important issue in the process of economic growth. The deterioration of environment begins to have direct impact on the quality of human life or even a threat to the survival of human being. This paper investigates the relationship between per capita gross domestic product (GDP) and per capita CO_2 emissions as hypothesized by Environmental Kuznets Curve (EKC) holds in the long-run or not. Co-integration regression methodology is employed for examining the long run relationship between the variables. For this purpose time series data on GDP and CO_2 emission along with foreign direct investment (FDI) and population density (PD) are been taken from year 1991 to 2015. The results revealed that there is no inverted 'U' shaped relationship between per capita GDP and per capita CO_2 emissions *i.e.,* EKC hypothesis has failed at Indian condition to explain the inverted relationship between GDP and CO_2 emission . It indicates that increase in per capita GDP strongly leads to economic growth and welfare of the people while it doesn't cause CO_2 emissions in India.

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Over the last two decades changes in government policies like privatization, liberalization and globalization has given a new boost and opportunity to economy to work freely. As a result, economy starts growing at faster rate. But these reforms had created a tremendous pressure on environment resources like forest, land, water, and air. These changes have made the market too competitive that nobody has time to think about public properties like environment and its resources. Sustainable Development is most common phrase used by the world economics; it means economic development with ecological sustainability. But if we see the reality every economy is concern about its GDP. GDP defines sum total of economic production of goods and services on the basis of transaction in the domestic market in a year. Calculation of GDP ignores the cost of depleting the environment resources. Every economy wants to beats the other economy and wants to be at top. Not only economies but individuals are also running after each other to attain higher ranking in competitive market, ignoring what damages they are causing to environment and its resources, which will indirectly affect their health. Most economic theories of sustainability show that unless there are laws and regulations in place to protect and preserve vital ecosystems, FDI and economic growth in general will intensify the present levels of degradation (Mizan and Halimahton, 2012). This paper is aimed at

investigating the two most important benefits and costs of foreign direct investment in the Indian context that is GDP growth and the environmental degradation.

Environmental Kuznets Curve (EKC) :

In 1955, Nobel laureate Simon Kuznets gave a famous hypothesis an inverse 'U' shaped income- inequality relationship named as Kuznets Curve. In this hypothesis according to Kuznets, at initial level income inequality increases as income rise and reach to peak where average income level is attained and further declines with increase in income level. The EKC hypothesis postulates an inverted 'U' shaped relationship between different pollutants and per capita income, *i.e.*, environmental pressure increases upto a certain level as income goes up; after that, it decreases (Dinda, 2004). Grossman and Krueger (1995) produced the first EKC study as part of the potential environmental impacts of North American Free Trade Agreement. They estimated EKCs for SO_2, dark matter (fine smoke) and suspended particles (SPM) using the GEMS data set. In EKC hypothesis contends that pollution increases initially as a country develops its industry and, thereafter, declines after reaching a certain level of economic progress which is known as threshold level or turning point, it is that point where the environment degradation is at its peak and after that it shows a downfall with further increase in real per capita GDP (Fig. A).

Fig. A: Environmental Kuznets Curve
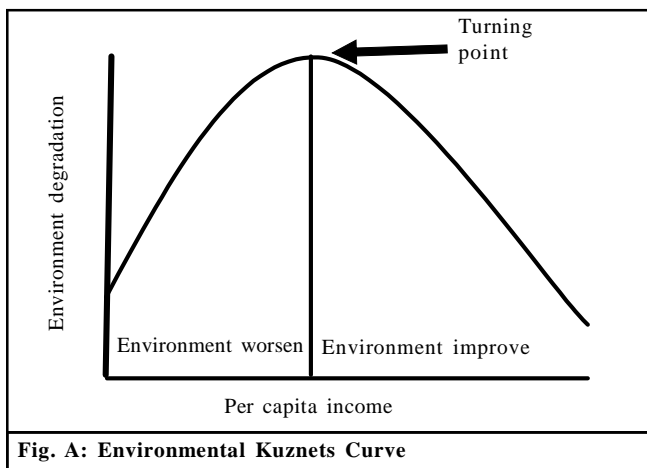
EXPERIMENTAL METHODOLOGY

The study uses the non-linear model to examine the relationship between per capita GDP and environmental degradation in India for the period 1991 to 2015. Besides, the long run growth impact of per capita GDP inflow on CO_2 emissions is due to be important.

The model is:

$$CO_2 = f (Y, Y^2, FDI, PD)$$

$$\log CO_{2t} = г_0 + г_1 \log Y_t + г_2 (\log Y_t)^2 + г_3 \log FDI_t + г_4 \log PD_t + e_t$$

where, CO_{2t} is carbon dioxide in year t; Y_t is per capita GDP in year t; FDI_t is foreign direct investment in year t and PD_t is population density in year t.

In this equation, whenever the co-efficient of the logY is positive and that of $logY^2$ is negative; it indicates the existence of the EKC hypothesis. Data used in this study have been taken from the secondary source *i.e.* World Development Indicators for the period 1991 to 2015. The analysis starts by testing the stationarity of the available data using conventional time series unit root test by using Augmented Dickey Fuller (ADF) test. Then, co-integration test used once the stationarity of all data is detected. The Johansen co-integration test has been used in order to see if there exists a long run relationship between the variables. And also granger causality test was used to test the direction of causality between FDI and GDP, FDI and CO_2 emission, GDP and CO_2 emission and population and CO_2 emission (Stern, 2004).

EXPERIMENTAL FINDINGS AND DISCUSSION

The result indicates that all of the data for India are stationary after the first difference for ADF unit root test. These result confirmed that the model meet the requirement to proceed with panel co-integration test. Once all series are confirmed to be categorizing as stationary, the Johansen co-integration test is used to test whether the dependent variable and all the independent variables in all the equations exhibit fundamental long-

Table 1 : Result of EKC regression	
	India
Constant	-3.20***
GDP	-2.29**
GDP^2	0.41***
FDI	0.02
Population density	2.49***
Adjusted R^2	0.98
F-Value	459.46
DW statistic	1.96

run relationship among each other. The results for Johansen co-integration test shown that the value of trace statistic and Max-Eigen value for India are larger than the 5 per cent critical value. Therefore, we accepting the null hypothesis of four co-integrating vector found in the long run.

To determine the direction of causality between the variables used Granger causality test, it shows that there is PD and CO_2 and GDP and CO_2 having the bi-directional causality. The direction of causality reveals that CO_2 is one of the major pollutants which deteriorates the environment is generated by the economic growth and PD and in same way CO_2 is cause of PD and GDP. While, there is no causality found between GDP and FDI, FDI and CO_2. Table 1 shows the result of the co-efficient of each variable.

From the adjusted R square, F statistic and Durbin-Watson statistic test, it could confirmed that, the model was well fitted. And most of the co-efficients show expected signs and high significance. In case of pollutant CO_2 the anticipated EKCs is not found to exist. The co-efficient of log GDP is -2.29 and log GDP^2 is 0.41. This fallows 'U' shape instated of inverted 'U' shape curve. Persistent growth in material consumption and resource usage will lead to serious long term harm to the environment. This rapid economic growth, however, has come with a huge cost to the environment. The population density is significant determinant of the pollutant *i.e.,* 1 per cent increase in population density will lead to a rise in CO_2 by 2.49 per cent and, respectively. It indicated that, sustained growth of PD was one of the important causes of environmental degradation. This is true as human activities have contributed to the release of pollutants into the atmosphere which are a threat to health and the natural ecosystem and also add to the greenhouse effect (Kennedy, 1999). We should have perfect the population growth policy and environmental protection laws. The co-efficient of FDI on pollution is positive, this revealed that the more FDI the society has the higher pollution.

Conclusion :

The study examines the relationship between economic growth and pollution for India from 1991 to 2015. Per capita GDP was included in the study to explain the EKC. The expected EKC are not found to exist at Indian contest, since India is emerging from developing nation to developed nation, for this it necessary to exploit the environmental resource. This action would cause the environmental degradation. There may be possibility to exist EKC hypothesis in future. This can be manage by strict environmental policies, control of population growth and by diverting the FDI in public private enterprises. At Indian condition precaution is better than cure. For future research elaboration, there is need of identification of the dominant factors that explain the EKC should have a high priority in research and one can design a policy that affects the course of the EKC only when the factors behind EKC have been properly identified.

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Asian J. Environ. Sci., **12**(1) Jun., 2017 : 57-59
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