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A STUDY OF ENVIRONMENTAL DEGRADATION IN RELATION TO URBAN POPULATION, EXPORTS OF GOODS AND SERVICES AND ELECTRIC POWER CONSUMPTION

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Abstract

GHG emissions continued to increase (4% per year since 2010 on average and rapid increase of 2.6% in 2019 due to forest fires) and reached a record high of 59.1 GtCO2e in 2019. Fossil CO2 emissions accounted for maximum GHG emission. G20 countries account for bulk of emissions: Top four emitters - China, US, EU+UK and India contributed 55% of the total GHG emissions in the last decade. Around two thirds of global emissions are linked to the private household activities. The emissions of the richest 1 per cent of the global population account for more than twice the combined share of the poorest 50 per cent. COVID-19 crisis offers only a short-term reduction in global emissions and will not contribute significantly to emissions reductions by 2030. The study made an attempt to find out the various correlations among urban population, Exports of goods and services and Electric power consumption and total Greenhouse gas emissions in India and to study the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions. To analyse the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions the data from 1991 to 2014 has been taken. It has been analysed through the use of SPSS software. The multiple correlation coefficient is 0.99 which is significant at 0.01 level with degree of freedom (df) = 3/20. It indicates that there is a significant joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions. Thus the null is rejected.

INTRODUCTION

The environmental status of a country depends on many factors which include the size of the economy, the current state of technology, the sectoral economic structure, and demand for environmental-related services. Larger economies are characterized with rapid depletion of natural resource and higher pollution levels. Resource depletion and pollution levels are determined by the sectoral economic structure. While agrarian economies tend to exploit more natural resources, industrialized economies tend to suffer from urban pollution and congestion-related problems. The difference between agrarian and industrial economy is evident in the share of the industrial sector's contribution to a country's GDP. While the share of industrial GDP in middle-income countries is above one-third of GDP, the industry sector contribution to GDP in low-income countries is relatively smaller than the contribution of agriculture to the GDP (Panayotou, 1993).

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Emissions Gap Report 2021 was recently released by United Nations Environment Programme (UNEP). This is a report in an annual series that provides an overview of the Emission gap-difference between where greenhouse emissions are predicted to be in 2030 and where they should be to avert the worst impacts of climate change. Limited impact of New or updated NDCs and announced pledges for 2030: Projected to reduce 2030 emissions by only 7.5 per cent, resulting in warming of 2.7°C (slightly less than the 3°C UNEP forecast in its last report). The emission reductions needed is 30% cut to limit warming to 2°C and a 55% cut to limit to 1.5°C. Current net-zero targets could limit global warming to around 2.2°C by century's end. Moreover, the reduction of methane emissions from the fossil fuel, waste and agriculture sectors could help close the emissions gap and reduce warming in the short term. The COVID-19 pandemic led to an unprecedented 5.4 per cent drop in global fossil carbon dioxide (CO2) emissions in 2020. A strong rebound in emissions is expected in 2021.

According to the IPCC 5th Assessment report, the agricultural sector remains the second major contributor to global greenhouse gas emissions (IPCC, 2015). Due to cheaper production cost, lax environmental regulations and somewhat less-stringent industry standards, there is always an influx of carbon-intensive and energy-intensive industries from developed countries to middle-income countries. However, developing countries like China, Iran, India, Indonesia and South Africa have a comparative advantage in carbon-intensive production of goods and as such, increase the aggregate economic growth. Developing countries using their comparative advantage in exchange for modernized technological transfer, innovations, and partnership on clean energy technologies would reduce stress on natural resource and improve environmental sustainability, thus, reducing environmental pollution.

GHG emissions continued to increase (4% per year since 2010 on average and rapid increase of 2.6% in 2019 due to forest fires) and reached a record high of 59.1 GtCO2e in 2019. Fossil CO2 emissions accounted for maximum GHG emission. G20 countries account for bulk of emissions: Top four emitters - China, US, EU+UK and India contributed 55% of the total GHG emissions in the last decade. Around two thirds of global emissions are linked to the private household activities. The emissions of the richest 1 per cent of the global population account for more than twice the combined share of the poorest 50 per cent. COVID-19 crisis offers only a short-term reduction in global emissions and will not contribute significantly to emissions reductions by 2030.

Rapid population growth in a country like India is threatening the environment through expansion and intensification of agriculture, uncontrolled growth of urbanization and industrialization, and destruction of natural habitats (Ray & Ray, 2011). Environmental pollution not only leads to deteriorating environmental conditions but also have adverse effects on the sustainable development and health of the people. The considerable amount of both surface water and ground water contamination due to chemical fertilizers and insecticides in the country leads to various water borne diseases. The growth of population is a fundamental factor in its relationship to natural resources, environment and technology.

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As a policy implication, there is a need for a global partnership that ensures promotion, transfer, and dissemination of clean and modern technologies in developing countries that will assist in the achievement of a long-term sustainability. Energy consumption has a strong positive effect on CO2 emissions, as evidenced in the study. Deterioration of the environment stems from the overdependence on fossil fuel energy technologies to meet the growing energy demand for residential and commercial purposes. Pollution haven in developing countries also propels the adoption of fossil fuel energy technologies rather than renewables in order to accumulate low production cost of goods and services from energy-intensive and carbon intensive industries. Therefore, a reduction of CO2 emissions and environmental pollution will depend on enhanced energy efficiency, behavioural changes in political institutions that adopts inefficient competitive advantage to lure FDI inflows with polluting technologies, the adoption of clean and modern energy technologies such as renewables, nuclear power plants, the adoption of carbon capture and storage for fossil fuel and biomass energy generation processes.

REVIEW OF LITERATURE

The study carried out for the period between 2014-2020 in Indonesia; to examine the relationship between coal consumptions, electricity consumptions, and oil consumptions on MSMEs along with the contributors of exports of goods and services. It has been found that, in the first structure, both coal consumptions and oil consumptions have a positive impact on MSMEs, while electricity consumptions don't. While; in the second structure, the consistency of coal consumptions and oil consumptions explained it, which also has a positive impact on contributors of exports of goods and services. However, neither of them has a positive effect on contributors of exports of goods nor services through MSMEs, in the third structure. However, it is precisely electricity consumptions that have a positive impact through MSMEs to influence contributors of exports of goods and services (Wijaya, Awaluddin, & Kurniawan, 2022).

The findings show that the selected variables are co-integrated; moreover the energy consumption and economic growth are identified as the main reasons for carbon dioxide emissions in both the short-run and long-run. In contrast, exports reduce carbon dioxide emissions in the long-run. Short-run unidirectional Granger causality is found from economic growth to energy consumption, carbon dioxide emissions and exports and from carbon dioxide emissions to energy consumption and exports. Further, it has been found that the long-run causal links exist between carbon dioxide emissions and exports (Rahman & Vu, 2021).

The study reveals a borderline turning point of US$8910 income level for studies that validate the inversed-U shaped relationship between environmental pollution and income levels. Studies with invalid EKC hypothesis, thus, U-shaped, monotone, N-shaped, have a borderline turning point of US$ 5702. Low income and middle-income countries are below the US$ 8910 and US$ 5702 thresholds while high-income countries are above. Due to differences in a period of study and econometric methods employed, the study confirms the validity of heterogeneity among turning point in studies on EKC hypothesis. The structural change in economic development may be what explains the inversed-U shaped relationship between environmental

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deterioration and economic development (Sarkodie & Strezov, A review on Environmental Kuznets Curve hypothesis using bibliometric and meta-analysis, 2019).

The study revealed a strong positive effect of economic development on CO2 emissions, thus, confirms the validity of the EKC hypothesis. Further, it has been concluded that there is more room for improvement as greenhouse gas emissions appear to decline at a sustained increase in foreign direct investment inflows. The inverse U-shape hypothesis was for China, India, Iran, and South Africa at a turning point of foreign investment inflows of US$ 241 billion, US$ 34.7 billion, US$ 3.25 billion and US$ 6.47 billion. This means that foreign direct investment inflows with clean technological transfer and improvement in labour and environmental management practices will help developing countries in the achievement of the sustainable development goals (Sarkodie & Strezov, Effect of foreign direct investments, economic development and energy consumption on greenhouse gas emissions in developing countries, 2019).

The study concludes that the energy consumption, export variety, foreign direct investment, and income were positively contributed to environmental degradation in India. Results also unveil that the environmental Kuznets curve hypothesis does not exist in India. Causality analyses documents, unidirectional causality from income and foreign direct investment to environmental degradation; on the other hand, bidirectional causality was witnessed between energy consumption and environmental degradation and between export variety and environmental degradation in the long run. The long run and the short run causality highlight that India has to forego the short run economic growth in order to improve its environmental quality and reduce global carbon emissions; however, it will not affect its long term economic development process (Adamu, Haq, & Shafiq, 2019).

The study revealed that energy-related services, such as energy imports and exports, are essential in the determination and abatement of CO2 emissions in Australia. This study revealed that any structural change in economic growth in the lives of the populace plays a critical role in environmental sustainability. Decoupling energy production from economic growth is essential to improve energy efficiency while reducing CO2 emissions and environmental degradation. Increasing the share of renewable energy penetration in Australia's energy portfolio decreases the levels of CO2 emissions, while increasing the share of non-renewable energy sources in the energy mix increases the levels of atmospheric emissions, thus increasing climate change and its impacts. Finally, this study revealed that Australia's energy portfolio contributes to CO2 emissions and environmental degradation (Sarkodie & Strezov, Empirical study of the Environmental Kuznets curve and Environmental Sustainability curve hypothesis for Australia, China, Ghana and USA, 2018).

South Africa is a fossil-fuel-rich country in Africa; however, diversification of the energy portfolio by incorporating renewable energy sources will promote air quality and environmental sustainability while reducing their economy's vulnerability to price volatility. Based on the policy implications of the effect of disaggregate and aggregate energy consumption, economic growth, and political institutional quality on environmental pollution, the study proposes, first, a paradigm shift from energy and carbon-intensive industries to a

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service oriented economy which will cause a structural economic change thus, aiding in the mitigation of climate change and its impacts. Second, there is a need for technological advancement in manufacturing industries and power sectors that employ advanced technologies such as carbon capture and storage, among others in other to promote energy efficiency (Sarkodie, S. A., & Adams, S., 2018).

The study reveals that six sectors, namely food, water, health, ecosystem, human habitat, and infrastructure are vulnerable to climate change. The impact of climate change on food security and food production systems affects cereal yield (maize, rice, and wheat), which contributes to two-thirds of global food consumption (FAO, 2018). The empirical results reveal that although Africa produces less anthropogenic greenhouse gas emissions, the continent is highly exposed and vulnerable to climate variability and climate-related events due to their dependence on climate-sensitive sectors, such as agriculture and hydropower for energy generation (Sarkodie & Strezov, Economic, social and governance adaptation readiness for mitigation of climate change vulnerability: Evidence from 192 countries, 2019).

The results of the study show that urban activities are significant sources of total greenhouse gas emissions (36.8 and 48.6 % of total). The urban energy sector accounts for between 41.5 and 66.3 % of total energy emissions. Significant differences exist in the urban share of greenhouse gas emissions between developed and developing countries as well as among source sectors for geographic regions. The 50 largest urban emitting areas account for 38.8 % of all urban greenhouse gas emissions. Study found that greenhouse gas emissions are significantly associated with population size, density, growth rates, and per capita income (Marcotullio P. , Sarzynski, Schulz, & Garcia, 2013).

Considerable improvements have been made in the GHG emission inventory reported in the Indian initial national communication to the UNFCCC11 with respect to the ones reported earlier. The total amount of GHGs emitted in India, according to this report, was 1228 million tonnes, which accounted for only 3 per cent of the total global emissions, and of which 63 per cent was emitted as CO2, 33 per cent as CH4, and the rest 4 per cent as N2O. A comparison of the Indian emissions with some of the largest global emitters indicates that the absolute value of Indian emissions is 24% of the US emissions, 31% of China and 80% of the USSR in 2000. The Indian per capita emissions are only 7% of the US, 13% of Germany, 14% of UK, 15% of Japan, 45% of China and 38% of global average in 2000 (Sharma, Bhattacharya, & Garg, 2006).

Objectives of the study

- To study the various correlations among urban population, Exports of goods and services and Electric power consumption and total Greenhouse gas emissions in India
- To study the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions

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Hypothesis

SET A (of Null Hypothesis):

- 1.0: The correlation between total green house gas emission and electric power consumption is not significant
- 1.1: The correlation between total green house gas emission and percentage of urban population is not significant
- 1.2: The correlation between total green house gas emission and export of goods and services as percentage of GDP
- 1.3: The correlation between electric power consumption and percentage of urban population is not significant
- 1.4: The correlation between electric power consumption and export of goods and services as percentage of GDP
- 1.5: The correlation between percentage of urban population and export of goods and services as percentage of GDP

SET B (Multiple correlation):

- 2.0: The joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions is not significant

METHODOLOGY

To carry out the following study the secondary sources of data has been used to collect data. The data has been collected from various national and international governmental, inter-governmental and private agencies. Number of previous studies has taken into consideration as well. To analyse the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions the data from 1991 to 2014 has been taken. It has been analysed through the use of SPSS software. Multiple correlations by taking total Greenhouse gas emissions as dependent variable and other as independent variables their contribution has been found in determining the former.

Results, Hypothesis testing and interpretation

The first objective was to study the various correlations among urban population, Exports of goods and services and Electric power consumption and total Greenhouse gas emissions in India. The results of correlation among various combinations of these four variables is given in the table 1

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Table 1: Correlation coefficient of various combinations of urban population, Exports of goods and services and Electric power consumption and total Greenhouse gas emissions

Correlations					
		Total Green House Gas Emission	**Electric Power Consumption**	**Percentage of Urban Population**	**Export as Percentage of GDP**
Total Green House Gas Emission	Pearson Correlation	1	.996**	.989**	.940**
	Sig. (2-tailed)		.000	.000	.000
	N	24	24	24	24
Electric Power Consumption	Pearson Correlation	.996**	1	.979**	.929**
	Sig. (2-tailed)	.000		.000	.000
	N	24	24	24	24
Percentage of Urban Population	Pearson Correlation	.989**	.979**	1	.970**
	Sig. (2-tailed)	.000	.000		.000
	N	24	24	24	24
Export as Percentage of GDP	Pearson Correlation	.940**	.929**	.970**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	24	24	24	24
**. Correlation is significant at the 0.01 level (2-tailed).					

(Source: https://data.worldbank.org)

Details about the variables:

- **Urban population** (% of total population) refers to people living in urban areas as defined by national statistical offices. The data are collected and smoothed by United Nations Population Division.
- **Total greenhouse gas emissions** in kt of CO2 equivalent are composed of CO2 totals excluding short-cycle biomass burning (such as agricultural waste burning and savanna burning) but including other biomass burning (such as forest fires, post-burn decay, peat fires and decay of drained peatlands), all anthropogenic CH4 sources, N2O sources and F-gases (HFCs, PFCs and SF6).
- **Exports of goods and services** (% of GDP) represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.
- **Electric power consumption** (kWh per capita) Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants.

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From table 1, it can be seen that, firstly, the correlation coefficient between total greenhouse gas emission and electric power consumption is .996 which is significant at 0.01 level at df = 22. Thus, the null hypothesis (1.0) is rejected. Secondly, the correlation coefficient between total greenhouse gas emission and percentage of urban population is .989 which is significant at 0.01 level at df = 22. Thus, the null hypothesis (1.1) is rejected. Thirdly, the correlation coefficient between total greenhouse gas emission and export of goods and services as percentage of GDP is .940 which is significant at 0.01 level at df = 22. Thus, the null hypothesis (1.2) is rejected. Fourthly, the correlation coefficient between electric power consumption and percentage of urban population is not significant is .979 which is significant at 0.01 level at df = 22. Thus, the null hypothesis (1.3) is rejected. Fifthly, the correlation coefficient between electric power consumption and export of goods and services as percentage of GDP is .929 which is significant at 0.01 level at df = 22. Thus, the null hypothesis (1.4) is rejected. Sixthly, the correlation coefficient between percentage of urban population and export of goods and services as percentage of GDP is .970 which is significant at 0.01 level at df = 22. Thus, the null hypothesis (1.5) is rejected.

The second objective was to study the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions. The data were analysed with the help of multiple correlation and the results are given in Table 2

Table 2: Multiple correlation coefficient of joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.999[a]	.998	.997	28317.05643	.998	2740.591	3	20	.000
a. Predictors: (Constant), Export As Percentage of GDP, Electric Power Consumption, Percentage of Urban Population									
b. Dependent Variable: Total Green House Gas Emission									

(Source: https://data.worldbank.org)

From Table 2, it can be seen that the multiple correlation coefficient is 0.99 which is significant at 0.01 level with degree of freedom (df) = 3/20. It indicates that there is a significant joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions. Thus the null hypothesis that the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions is not significant is rejected.

Further, the percentage of joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions is 99.8% (= R square multiplied by 100) which is significant and high.

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CONCLUSION

Emissions Gap Report 2021 was released by United Nations Environment Programme (UNEP). Emissions Gap Report is an annual series that provides an overview of the Emission gap- difference between where greenhouse emissions are predicted to be in 2030 and where they should be to avert the worst impacts of climate change. Limited impact of New or updated NDCs and announced pledges for 2030: Projected to reduce 2030 emissions by only 7.5 per cent, resulting in warming of 2.7°C (slightly less than the 3°C UNEP forecast in its last report).

The study made an attempt to find out the various correlations among urban population, Exports of goods and services and Electric power consumption and total Greenhouse gas emissions in India and to study the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions. To analyse the joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions the data from 1991 to 2014 has been taken. It has been analysed through the use of SPSS software.

The multiple correlation coefficient is 0.99 which is significant at 0.01 level with degree of freedom (df) = 3/20. It indicates that there is a significant joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions. Thus the null is rejected. Further, the percentage of joint contribution of urban population, Exports of goods and services and Electric power consumption in predicting total Greenhouse gas emissions is 99.8% (= R square multiplied by 100) which is significant and high.

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