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ROLE OF GREENHOUSE GAS AND HUMAN DEVELOPMENT INDICES IN THE ECONOMIC GROWTH OF PAKISTAN

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ABSTRACT

The purpose of this study was to evaluate the role of Greenhouse Gas and Human Development Indices in the economic growth of Pakistan during 2000-2020. To do so, a greenhouse gas Index has been generated by combining the production and consumption side pollution indices. The collected data of this study on human development index and greenhouse gases has been obtained from the World Bank and UNDP websites. Johanson Cointegration and Vector Error Correction Model was applied. The study concluded a relationship between the economic growth and Human Development Index (HDI) and the Greenhouse Gas Index (GHGI). The results of the VECM suggest that in case of Pakistan, there is a long run causal relationship among the variables i.e. in the long run the economic growth is accompanied by the greenhouse gases. The rising amount of GHGs affects the HDI negatively as suggested by the Johanson cointegration test. But the results does not mean that countries should stop development rather they should promote sustainable economic growth. Therefore, to make the economic growth more sustainable policy makers must promote and devise policies which may reduce the environmental pollution while achieving higher economic growth.

Keywords: Greenhouse Gas Index, Human Development Index, Economic Growth, Causal relationship

1. INTRODUCTION

In recent times environmental is posing threats to both developed and developing economies. The problem, however, is considered to be the most serious in developing economies because in developing economies, the environmental laws either does not exist or less followed. Another reason is the rapid industrialization without environmental considerations. (Nazeer, Tabassum, & Alam, 2016). In China, the world second largest economy, the air quality in 17% of the cities is below WHO's standard level means the particulate matters (PM) are far more above the standard (Zheng, Huai, & Huang, 2015). The satnadard for $PM_{2.5}$ is 35 microgram per cubic meter ($\mu g/m^3$), while for PM_{10} is 20 $\mu g/m^3$. The East Asian economies have been growing fast in recent years and environmental stresses are building up due to rapid industrialization. Transboudry air pollution, deforestation, water scarcity and contimination including air polllution are psoing sme serious threats to the well being of the lives of people. The region is not following sustainable development path and going with current trends, the environment will not sustain such a development (Kim, 2006). As industrialization increases it implies greater demand for energy resources which detoriates environment. Major cities includng Bankok, Beijing, Chennai, Manila and Hanoi are found to have greater amount of PMs that the required standard level (Colbek, Nasir, & Ali, 2009). Twenty three percent of the diseases are caused by he air pollution. Similalry, in other Asian countries like Sri Lanka, Nepal and Maldives majority of the population face problems like respiratory diseaes, asthma, dhiarhea etc due to envieonmental pollution (Khwaja et aal., 2012). The FDI inflows, on one hand, significantly affect the economic growth of various countries including Algeria, Jordan, and Libya, on the hand, FDI also have a significant impact on the co_2 emission. The increaesed level of co_2 have negative impact on the economic growth in Algeria, Iran, Kuwait, Morocco, Oman, Saudi Arabia, Tunisia, Turkey, Yemen, and UAE (Abdouli & Hammami, 2015). Air quality in Pakistan's major urban centers has considerably deteriorated over the past five years. Lahore, the capital of Punjab province and the country's second most populated city with over 10 million residents,

regularly features in the list of the most polluted cities globally. From May 2019 to April 2020 Lahore's air contain on average 300 to 400 micrograms per cubic meter $PM_{2,5}$ which significantly exceeded the WHO's standard 35 ($\mu g/m^3$). These statistics implies that diseaes like cancer and cardiovascular and respiratory diseases such as ischemia, myocardial infraction, asthma, and bronchitis have increased significantly ruducing the life expectancy and human development index (HDI) of Pakistan (Habib, Nasim, & Amna, 2021). The climate change due to Greenhouse Gases (GHGs) including CO, CO_2, Chloroflorocorbans (CFCs) etc, has changed the rain patteren in Pakistan which has resulted in frequent floods. Pakistan's economy lost some 5.8% of its GDP due to flood in 2010, similarly between 2010-2015 paksitan has lost 334 billion PKR per year (Rehman et al., 2015). Hence it is concluded that the environmnetal pollution has posed some serious threats to the economic development of Pakistan and many other Asian countries including China, India, Sri Lanka etc. The more economic development the more the air pollution increases in the atmosphere which may lead to severe human chealth crisis and economic growth. The study is aims to explore the relationship among the air pollution (GHGs), HDI and the economic growth.

2. Literature review

Li & Xui, (2021), explored the relationship between china's environment and human development showed that increase in investment in the human development signifaicantly affects the environment hence, there is a correlation between the human development and environment and the economic development is delayed by the deterioration of the environment. An asymetric realtionship between the enewable and non renewable energy and economic growth of pakistan by (Kashif, et al., 2020), has shown that renewable energy positively affects the economic growth while the use of nonrenewable energy plays a negative role in the economic development of Pakistan. Exposure to $PM_{2.5}$ has caused 4.2 million deaths and 103.1 million disabilities in 2015. Hence long exposure to PM affects the human development (Cohen, et al., 2017). (Saidi & Hammami, 2015), examined the relationship between the economic growth and energy, found that energy consumption and economic growth goes side by side. It implies that economic growth is accompanied by higher emission of Co_2 which deteriorates the environmental quality. He, Liu, & Salvo, (2018), examined a relationship between air pollution and labor productivity, concluded a negative relationship between the environmental pollution and labor productivity in china. The study calculated a 6% drop in daily worker productivity per +10 ($\mu g/m^3$) increase in the concentration of $PM_{2.5}$.FDI affects the emission of CO_2 both in long and short run. In long run the increase in the Co_2 emission results in the environmental degradation. Health is directly linked with the per worker output in an economy. Air pollution affects the health which consequently positively affects the government expenditures on human health (Usman, et al., 2019). Difference in environmental regulations have different impact on HDI of China in different regions. The regions having above average HDI have different economic development quality than those regions having low HDI levels. Environmental problems arises with rapid development (Chen, et al., 2020). Various disease including cancer, respiratory diseases and cardiovascular diseases are positively inked with the economic growth, energy consumption and Co_2 emission in the Central Asian countries. Co_2 emission has a positive relationship with child mortality and health of overall population (Rasoulinezhad & Hesary, 2020). A study by (Wanga , Alamri, Mawad, Zhangd, & Khan , 2022), has explored the relationship between environmental quality and economic growth in addition to human capita and renewable resources of energy, concluded the existence of a direct linkage between the economic growth and the corban emissions, however, the foreign trade shown some mixed results due to changing patterns of foreign trade. (Acheampong & Opoku, 2023), has concluded that environmental degradation reverses the process of economic growth. The study estimates that a 1% increase in greenhouse gases results in 0.041% reduction in the growth of GDP. Hence environmental degradation leads to reduced economic growth. A study by (Zeiri, Bouzir, Mbarek , & Benammou, 2023), has determined the effects of economic growth and environment on the health expenditure in G7 countries where CO_2 has been used an indicator of the environment and GDP as an indicator of the economic growth. The study concluded a negative impact of the economic growth has positive impacts on the health expenditures in case of G7 countries, whereas all other countries

including UK, US France, Italy etc. faces negative impacts. In case of Canada the stud concluded some unusual result showing no effect of the growth and degradation on the health expenditure.

A study by (Abid , et al., 2020), has examined the long run and short run causality among energy consumption, CO_2 emissions and GDP growth. The results suggests the existence of both long and short run causality among the stated three variables. It means that each variable causes another and have a significant impact on the other variables. Another finding of the study is that in the short run HDI doesn't have any causal relationship with any of the variable however in the long run there exist the causal relationship. The panel vector autoregressive model (PVAR) by (Azam, Rafiq, Shafique, Yuan, & Salem, 2021), has concluded that economic growth and expansion has a positive impact on the human development index (HDI) of a country. It is possible in a sense that having an economic expansion and growth a country is able to divert more economic and financial resources towards better education, health and other social facilities which directly contribute enhance the HDI positively. (Li & Xu, 2021), has studied the relationship between HDI and environmental pollution. The results suggest that there is an inverted U-shaped relationship between the HDI and EPI. The study further found that the Chinese economic development has promoted the environmental degradation and the regional environment is improving in the long run. A study by (Banday & Kocoglu, 2023), revealed that there is a negative bilateral relationship between HDI and the corban emission meaning thereby economic growth can have a key role in enhancing the HDI in the long run. The study however fund a negative impact upon the HDI by the environmental degradation in the short run.

3.Research Methdology

3.1 Data sources and Methodolgy

Secondary data from 2000-2020 is used. The main sources of the data include World Bank, UNDP, and Pakistan Environmenal Protection Agency. Stationary of the data is checked through Augmentad-Dicky Fuller test. In order to check the long run cointegration of the variables Johenson Cointegration test is applied. Lastly, Vector Error Correction Model will be applied in case of presence of cointegration among the variables.

3.2 Construction of Greenhouse gas Index (GHGI)

Production of goods require various inputs like coal, gas oil and raw materials which are provided by the land, besides capital including building, tool and machinery is also required. However, environment is another non-market, non-priced good used in the production process. For example, manufacturing steel requires input and capital, however the waste products discharged during the prodcution process id emmited into the environment. From caol, gas and oil large amount of GHGs i.e. Co,Co_2,So_2,No_2 and CFCs are emitted in to the environment which deteriorate the ennvironmental quality and may a have a negative impact on the economic growth of a country. This can be summarize as under;

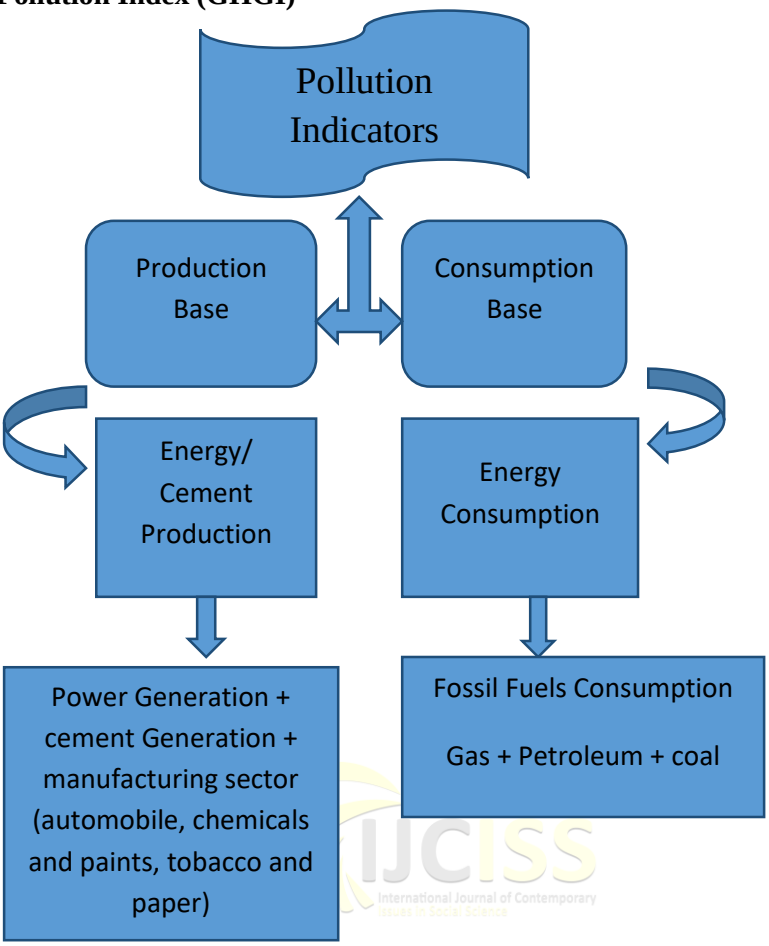
$$\boldsymbol{Y = f(L, K, E)}$$

In the above function E is enterd as an input as environment is used for dumping waste material produced during the production process. E is represented by a special index Greenhouse Gas Index (GHGI).

There exist a relationship between the environment and economic growth, as unhealthy environment leads to deterioriate the labor productivity conluded by (He, Liu, & Salvo, 2018), & (Horii & Ikefuji, 2014).

Production and consumption sectors are the two major causes of air pollution in the form of GHGs, hence, a special GHGI is genearted by combinig the GHG emission from both the sectors. Fig.1 represents the sectors form the consumption and production side and these sectors are selected on basis of availability of data.

Fig.1 Variables of Pollution Index (GHGI)



The production based index include industries such as power, cmenet industry, manufacturing sector including automobile,chemicals, paints and tobacco, similalry, the consumption side index include fossil fuels gas, petroleum and coal in transport industry, residential and agricultural sector etc. Fistly, the production and consumption side indices are generated and then both are combined to form a pollution index called the GHGI.

3.2.1 Prodcution based Index (PI)

$$wPIp = wEPI + wCi + wMI \quad \text{……(1)}$$

The Pip stands for wieghted production index, EPI = Elecrtricity and power industry, CI= Cement industry, MI = manufacturing industry.

3.2.2 Consumption based Index (CI)

$$wCI = wFCT + wFCI \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

W represents weighted average, CI is Consumption Index, FCI stands for Feul Consumpton by Transport Inductry, FCI represents Fossil Feul Consumption by residents, agricultural and commercial sectors.

3.2.3 Pollution Index (GHGI)

The combined polllution index i.e. the Greenhouse Gas Index (GHGI) is obtained by combining the consumption Index (CI) and the Production Index (PI) as under;

$$GHGI = wPIP^{+} wCI \ldots\ldots\ldots\ldots\ldots (A)$$

Where GHGI stands for Greenhouse Gas Index, PIP stands for Production pollution index and CI represents consumption index. The GHGI is calcultaed in Mllion Metric Tons.

3.3 Human Development Index (HDI)

Another variable the study has included is the HDI use by the United Nations. The Index is given as under;

$$HDI = LEI + EI + PCI$$

HDI represnets Human Development Index, LEI represents the Life Expectancy Index and PCI stands for Per Capita Income Index.

Analysis

Following the methodology, first the stationarity of the data is checked. The results confirmed that all the variabales are stationary at 1st difference, all the values are less than 5%.. The outcome is shown in the table 1.

Table 1

GDP	Intercept	Trend & Intercept
At Level	0.5460	0.9885
At 1st Difference	0.2416	0.0303
GHGI		
At Level	0.1887	0.5976
At 1st difference	0.5834	0.0056
HDI		
At Level	0.2228	0.9888
At 1st difference	0.0370	0.0000

The cointegration test is applied under the null hypothesis that there is no cointegration among the variables. The null hypothesis is rejected as one of the probability value is less than 5%. The negative value of GHGI indicates a negative relationship between the economic growth and the GHGI, while HDI has a positive cointegration with the Economic growth.

Table 2

Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical value	probability
None	33.8090	29.7970	0.0004
At most 1	17.1133	14.2646	0.1820
At most 2	0.3964	3.8414	0.5289

Normalized cointegration coeffecients

GDP	GHGI	HDI
1.0000	-4.9567	0.1069
	(1.0066)	(2.6246)

In order to check the long and short run causality among the variable vector error correction model is applied. The results are given in table 4.3.

Vector Error Correction Model

Table 3

Dependent Variable: D(GDP)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2001 2020
Included observations: 20 after adjustments

D(GDP) = C(1)*(GDP(-1) + 3.56158583087*GHGI(-1) - 13.050113231*HDI(-1) - 3.32584949271) + C(2)*D(GDP(-1)) + C(3)*D(GDP(-2)) + C(4)*D(GHGI(-1)) + C(5)*D(GHGI(-2)) + C(6)*D(HDI(-1)) + C(7)*D(HDI(-2)) + C(8)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.204153	0.169427	-1.204959	0.0095
C(2)	-0.060084	0.382088	-0.157252	0.8785
C(3)	0.015303	0.199962	0.076527	0.9407
C(4)	0.362908	0.585089	0.620260	0.0505
C(5)	-0.270319	0.760493	-0.355452	0.7304
C(6)	-1.285710	5.771993	-0.222750	0.8287
C(7)	2.345340	5.495837	0.426748	0.0496
C(8)	0.024036	0.054854	0.438177	0.6716
R-squared	0.682075	Prob (F-statistic)		0.204262

The value is negative along with significant probability value hence there exist a long run

causality from GHGI and HDI to GDP. Similarly, the F-statistics and R-square value is more than 60% so the model is fitted well.

The results given in the tables 4.4 and 4.5 suggest no short run causality among the variables. Hence in the long run there causal relationship among the variables meaning thereby with the economic growth air pollution increases in the long run which affects the HDI and may negatively affect the economic growth.

Table No. 4 Wald test (HDI)

Test-Statistic	Value	df	Probability
F-Statistic	0.383734	(2, 9)	0.6919
Chi-Square	0.767468	2	0.6813

Test statistic	Value	df	Probablity
F-Statistic	0.465172	(2, 9)	0.6423
Chi-Square	0.930344	2	0.6380

Table No. 5 Wald test (GHGI)

Assumptions of OLS

Similarly the table below presents the outcome of the assumptions of OLS.

Table 6

	GHGI	HDI	
GHGI	1		GHGI
HDI	0.92	1	HDI

The results confirms a positive correlation between the dependent variables i.e. GHGI and HDI however, no multicollinearity exists among the variables. Generally, the value of correlation coefficient greater than 0.7 suggests multicollinearity which in this case is less than 0.7.

The residuals are not scattered at much higher distance in fig.1 & 2 so there is no heteroscedasticity. All the assumptions of OLS are satisfied hence, there results of the study are consistent, unbiased and reliable.

Fig. 1

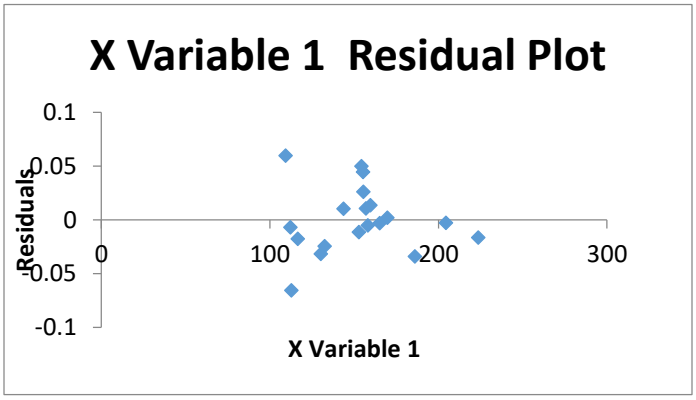
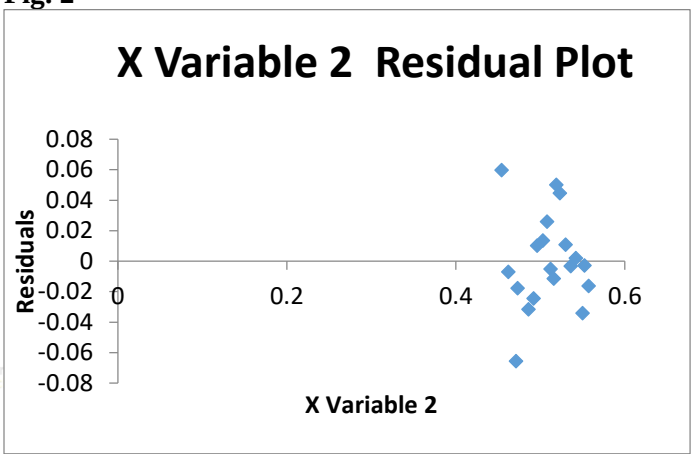


Fig. 2



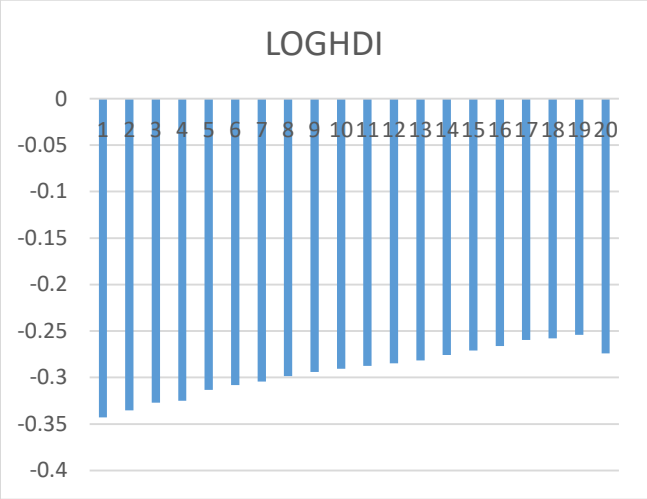
Discussion and Policy Recommendation

The study investigated the effect of GHGI and HDI on the economic growth which has been confirmed by the vector error correction model. According to the results huge industrialization, use of pesticides and agriculture, fossil fuels enhance the environmental problem in the long run in Pakistan. There is a positive relationship between the economic growth and HDI which is consisted with the Li & Xui, (2021), however, in the long run the air pollution negatively affects the economic growth as concluded by with (Habib, Nasim, & Amna, 2021), (Cohen, et al., 2017) (Horii & Ikefuji, 2014) & (He, Liu, & Salvo, 2018). According to the results of the study economic growth is accompanied by environmental pollution. But the findings does not mean that country should quit their economic development but govt. needs to promote sustainable development. The policy makers should devise

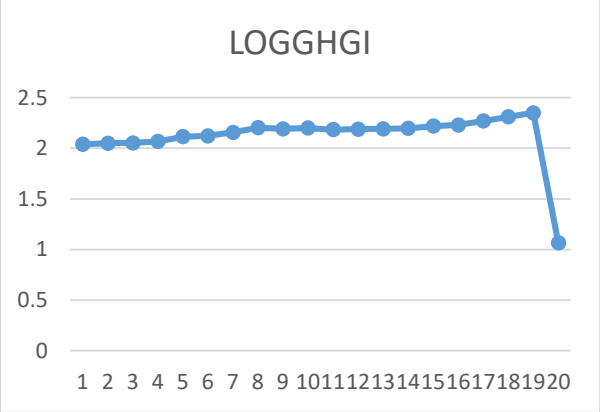
policies which are environmental friendly. These policies include implementation of strict environmental regulations like imposing taxes, fines and investing in environmental friendly technologies. Similarly, voluntary measure can also be adopted including awareness regarding the consequences of air pollution, ensuring effective waste management system on the part of firms.

Appendix

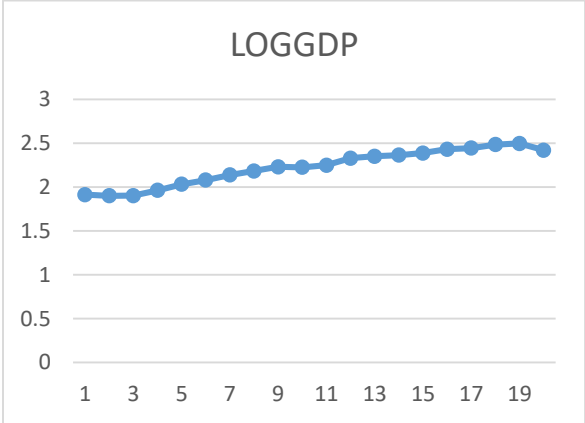
Graph for Human Development Index of Pakistan



Graph for LOG of Greenhouse Gas Index (GHGI)



Graph for Log of Gross Domestic Products (GDP) of Pakistan



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