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Impact of Environmental Degradation, Renewable Energy Consumption and Globalization on Green Growth: An Analysis from Asian Countries

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Abstract

Nations of the world make effort to protect ecologically sustainability to enhance economic growth (GDPg). The improved green technology is obligatory to lessen environmental degradation (CO_2) and nurturing green growth. The existing research examines the factors influencing green growth (GRGDP) by utilising data from 1997 to 2024 in Asian countries. For this purpose, green growth index was used as dependent variable. Though, CO_2 emission, renewable energy use, globalization and gini index were used as independent variables. Data were drawn from nine Asian countries for the analysis. Regression result showed that CO_2 emission has decreased GRGDP in Asian countries. It is also found that energy usage and globalization have increased GRGDP in Asian countries. As a final point, income inequality (GINI) has affected negatively the green growth in Asian countries. On the basis of the outcomes, study suggests that CO_2 should be reduced by shifting to renewable energy use (RNEN), improving energy efficiency, and changing daily transportation and consumption habits. Globalization should also be increased by reducing trade barriers, advancing digital technologies, and improving global transport infrastructure. Finally, there is a need to increase RNEN in Asian economies.

Keywords: Green Growth; CO_2 emission; Renewable Energy Consumption & Asian countries.

Introduction

The most significant greenhouse gas conscientious for evenly environmental greenhouse gasses and atmosphere transform done by individuals is CO_2 (Gaies et al., 2022). Therefore, reducing CO_2 has augmented much of the international policy plan for nations. Furthermore, cost-effectively sustained growth, is measured as a good method for achieving long-lasting development (Zhao et al., 2023; Hao et al., (2021). Worldwide weather change remains very imperative challenge experienced by countries of the world. A most important motivator of this occurrence is the increasing attentiveness of greenhouse gasses in the environment, chiefly CO_2 emissions, methane, and nitrous oxide (Hertwich and Wood, 2018). Industrial actions add to considerably to such kind of emissions, with the developed sector surrounding businesses

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intimately related with equally fossil fuel burning and economic growth (Konečný et al., 2025). Energy serves up as the support of contemporary countries, supporting the manufacturing of commodities and services athwart a variety of sectors. In the sphere of energy-concerned confronts, three serious subjects again and again lead debates (Tarasawatpipat and Mekhum, 2020). Starting from, fossil fuels, with coal, oil, and natural gas, are limited assets. At the same time as considerable assets of these fuels at rest be present, their predetermined life, together with rising requirement, unavoidably indicates that their accessibility will ultimately lessen. As a result, the expedition for another energy sources happens to dominant (Anochiwa et al., 2020).

Ecological worsening is world's major issues nowadays. Such occurrence damages person's physical condition, biodiversity, air quality, natural resources, and the on the whole nation (Rahman, 2020). Public contain long supposed that human action does not be reason for climate change, but to a certain extent that this is an ordinary procedure. Though, advancement in discipline have exposed that the attentiveness of carbon dioxide (CO_2) has augmented due to human actions. Human actions coerce weather change, first and foremost the burning of fossil fuels for energy, which discharges greenhouse gases (GHG) into the air, fascinating warmth and being reason for temperature enhances, changed climate pattern, and additional ecological influences. The sound effects of weather change comprise an increased population dislodgment because of increasing sea levels, droughts, and other weather-related influences, with an improved danger of flooding and injure to communications. The nation's growth is extremely linked with energy usage and is considered as a gauge for the "oxygen" for the entire world's nations. Non-renewable energy (NRNEN) is a requirement for achieving high growth rates. These economies are making efforts to attain GDPg in the course of industrialization (IND), globalization (GLOB), and trade liberalization (TO). Environmental level can be can be reinforced by the effectual utilization of energy and sustainable development strategies. More efficient strategies are needed, particularly in Asian economies where emissions can be observed very higher (Apergis and Ozturk 2015; Hanif and Santos 2016; Wang et al. 2016). Razzaq et al., (2023) shows that comprehensive warming and ecological deterioration have recently been a main confront for countries of globe. Escalating CO_2 and additional GHG have shaped widespread ecological influences. These effects have shaped unanticipated transformations in climate circumstances, augmented earth-temperatures, and showed more important dangers to ecosystems. The answers to several questions come from the EKC model, for example whether a country can attain GDPg without deterioration the environmental structure and whether the ecological excellence is worsening by the quick growth. Considering the significance of environment and green growth, we have looked at the effect of CO_2 emission, RNEN, globalization and income inequality on green growth in Asian economies.

Earlier practical and hypothetical works have showed the energy-growth emission nexus. A lot of research wok highlights the environmental degradation affecting the growth of Asian economies Rehman, 2020 & Razzaq, 2023). CO_2 emissions and energy consumption also seemed to be affecting the GRGDP of economies (Dzvigol et al., 2023). Asian economies also observed experiences regarding impact of GLOB on green growth (Chen et al., 2023). Energy demand is necessary for growth; however, the supply side is limited (Zaleski 2001). Asian economies are confronted with these challenges. However, more work is need in these economies. Considering the significance of energy use and CO_2 emissions, we have highlighted the significance of these factors in

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green growth. Therefore, this study was conducted to analyses the influence of CO_2 emissions, RNEN, globalization, and income inequality on green growth in Asian countries.

Environmental degradation is a tremendously multifaceted problem the nations of the world. The linkage of GDPg, CO_2 and RNEN and finite energies with ecological pollution is the subject matter of rigorous studies from the preceding few decades. High levels of detrimental greenhouse gases affected the economies in the world. Renewable energy seemed to be affecting the economic growth and mitigating CO_2. Recent cross-country indication confirmed that RNEN, when complemented by trade openness and institutional quality, considerably contributed to emissions lessening and GDPg (Khan et al., 2021; Zhang et al., 2023). A lot of work has focused on relationship between economic factors and CO_2 and green growth, in addition to RNEN and CO_2. However, our work considered the role of RNEN with carbon dioxide (CO_2) emissions, globalization, and GINI in green growth of Asian economies.

The study is arranged in the subsequent way. Remaining sections indicates literature review, procedure, data, and model, outcomes and discussion and conclusion and suggestions respectively.

Literature Review

Relevant work mostly confers about relationship between CO_2 emissions and energy consumption (NEN) and green growth but reliable conclusion has not been reached. However, we have considered the impact of CO_2 emissions, RNEN with GLOB and income inequality on green growth in Asian countries. The economy's growth is extremely linked with NEN and is considered as a gauge for the "oxygen" for the entire globe's economies. NRNEN is a precondition for achieving growth. These nations make efforts to obtain growth throughout IND, GLOB, and TO. The ecological quality can be made stronger by the efficient usage of energy and sustainable development strategies. More effectual strategies are needed, mainly in Asian economies where emissions observed far above the ground (Wang et al. 2016; Apergis and Ozturk 2015; Hanif and Gago, 2016); others have experienced too sulfur dioxide (Selden and Song 1994). Role of technology is significant in safe environment and green growth which is indicated by Sun et al., (2008). Result found that technological advancement tended to decrease carbon emissions. Moreover, Alam et al. (2012) investigated the factors affecting GDPg in Bangladesh. ARDL result indicated a unidirectional causal relationship between NEN and GDPg. By using data from 2000 to 2014, Joshi and Rahman (2015) focused on green purchase behavior. It was discovered that consumers' ecological concerns and the practical features of items influenced their environmentally friendly buying behavior.

By using data from 1971 to 2011, Destek (2016) examined an association between RNEN and IND nations. Findings indicated that adverse shocks in RNEN caused for positive shocks in real GDP for South Africa and Mexico. Qi and Li (2017) checked that how did RNEN affected GDPg in China. Result showed that the negative impact of RNEN on GDPg is negative. Furthermore, it has significant threshold effects on development. Xie et al. (2018) analyzed data from seven nations characterized by elevated NEN and revealed a nonlinear correlation between RNEN and economic expansion. Moreover, they indicated that advancements in technology might enhance RNEN, hence favorably influencing economic expansion. Similarly, Wang et al., (2018) used data from 1996 to 2015 and focused on GDPg and CO_2 relationship in BRICS countries. Result showed

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the control of corruption reduced CO_2 emissions. He et al., (2019) checked the impact of RNEN on green growth in China. Result showed the effect of RNEN investment on the GGINDEX was dual threshold effects from green-credit. Moreover, RNEN on the GGINDEX was observed one threshold from green-credit.

Bagheri et al., (2018) worked on energy flows, CO_2 emissions, and green growth in Canada. Findings showed a possible wat to green growth in Canada. All this resulted in more employment and growth in that economy. Moreover, Zafar et al., (2019) used data from 1991 to 2018 and found determinants of green growth. Result highlighted that FDI and TO influenced the GRGDP negatively. Using data from 1990 to 2015, Taskin et al., (2020) examined the relationship between RNEN and GRGDP. The study used trade openness as a control variable. It was found that RNEN and TO tended to increase GRGDP. Long-run (LR) estimates of GRGDP revealed that LR elasticity of GRGDP for TO was much greater as compared to RNEN. Danish and Ulucak (2020) focused on the role of environmental technologies in green growth in BRICS countries. Findings indicated that environmental-related technologies boosted up GRGDP. Results also confirmed that RNEN promoted GRGDP. Fang et al., (2022) inspected the effect of R&D and industrialization on green economic growth in South Asian countries by using data from 2008 to 2020. Result showed that improvement in IND and R&D reduced CO_2 and achieved GRGDP. Study suggested that focus should be made on industrialization. Shang et al., (2023) emphasized on the role of tourism and NEN on GRGDP by using data from 2000 to 2021 in high-income countries. Result showed that tourism affected positively the sustainable GDP. Result showed that tourism progress was a hurdle in LR GRGDP in low-income Asian countries. Finally, NRNEN harmed the sustainable GDPg.

Moreover, Bilal et al., (2021) used data from 1991-2019 and checked the impact of technological innovation and GLOB on growth. Result showed that technological innovation tended to reduce growth in developed countries. By utilizing data from 1985-2019, Anser et al., (2021) examined an association of globalization, energy environment. This study also finds causal consumption, and the result revealed negative and positive GDPg which confirmed the EKC hypothesis. Sun et al., (2022) examined the role of fossil fuels in determining GDPg by using data 1993 to 2018 in Nanjing city. The study showed a CO_2 and growth level controlling for green growth. Zhang et al., (2021) used EKC model and analyzed the bond between urbanization (URB) and CO_2. Result showed that bond between GDPg and URB and CO_2 level showed an EKC, which rose first and then decreased in these countries. Ren et al., (2021) showed that China's overall GRGDP was increased and its growth impetus mostly stopped from the development of green technology; manufacturing, IND, and informal environmental guidelines. It was also found that prescribed environmental guidelines showed GRGDP. Xu (2022) also focused on green growth of economies. The study result showed that that gas and coal seemed substantial for the GRGDP of Chinese economy. Green trade also increased green growth.

Financial globalization may affect green growth indicated by Chen et al., (2023). Result showed that financial GLOB has increased GRGDP in the BRICS. The analysis recommended for more research and developmental expenditures. Dzvigol et al., (2023) used data from 2000 to 2020 to examine the nonlinear effect of environmental regulations, energy use, and growth on GRGDP in European economies. GMM result showed the nonlinear effect of environmental guidelines on a

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nation's GRGDP with more industrialization. Nigeagu (2024) used data from 1996 to 2020 and has checked the factors affecting green development in European economies. The author has found that KOF globalization index and RNEN increased green growth. Wani et al., (2024) used data from 1995 to 2020 to check growth levels. The CS-ARDL result showed the positive relationship between RNEN and FDI and GRGDP in G7 countries. Aziz et al., (2024) investigated that how did RNEN, GLOB, and agriculture affected growth and development by using data from 1980 to 2019. Result showed that capital and globalization affected negatively the CO_2. However, RNEN and trade mitigated environmental externalities. Ashfaq et al., (2024) emphasized on the nexus between RNEN and GRGDP. ARDL result showed that GRGDP and GLOB tended to increase RNEN.

By using data from 1972 to 2022, Alam et al., (2025) emphasized on an association among NEN, CO_2, and GRGDP in Bangladesh. ARDL result highlighted that NEN and gross capital formation (GCF) resulted in increased GDPg. By using data from 2021 to 2030, Alajmi (2025) analyzed GRGDP indicators using three methods to review GRGDP in Saudi Arabia. The author used VECM. Findings indicated that CO_2 were influenced by growth and electricity-generation. Urbanization also affects green growth indicated by Abid (2025) used ARDL and ECM. Result indicated that environmental technologies and urbanization boosted up green growth index. Result showed that urbanization and emissions were enlarged economic growth. Gafsi and Bakari (2025) intricate the dynamics among RNEN, CO_2, and the trajectory of GDPg in G7 countries by using data from 1997-2021. They used VEC model. Result showed a positive impact of RNEN and CO_2 on GDPg fluctuations. By utilizing data from 1990 to 2020, Ding and Keoy (2026) emphasized on green production. Findings showed that geopolitical risk and financial policy vagueness tended to decrease green production practices. It is recommended for achieving certain sustainable development objectives. Ngo et al., (2026) used data from 1996 to 2016 and checked the green growth efficiency from an international viewpoint in 115 nations. Result showed a negative relationship between CO_2 emissions and GRGDP efficiency. Awosusi et al., (2026) examined the factors affecting GRGDP by using wavelet quantile-based approaches. Result showed that solar energy and education affected green growth positively in the medium and LR. Zarrad et al., (2026) investigated the effect of RNEN on GRGDP in 18 G20 countries by using data from 2000-23. ARDL result showed that green growth was increased because of renewable energy use. GMM result showed that artificial intelligence had a marginal contribution towards green growth.

The above-mentioned studies show the significance of macroeconomic variables such as *CO_2*, renewable NEN, URB, industrialization, globalization, and income inequality etc. on GRGDP in developing and developed countries.

Data and Methodology

By using data from 1996 to 2024, we have investigated the factors affecting GRGDP in Asian countries. For this purpose, green growth index was utilized as dependent variables. Though, independent variables were used as CO_2 emission, NEN, globalization and financial development (FD) in this study. Data were taken from nine developing countries including Bangladesh, India, Indonesia, Iran, Jordan, Malaysia, Pakistan, Thailand, and Philippines. Such countries are selected

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on data accessibility from World Development Indicators (WDI) (2026) and the KOF institute (2026).

Model Specifications

This section points out the theories which concludes that RNEN and technology adds to GRGDP. An influential way for enhancing growth as solving environmental concerns is GRGDP. The most important matter for the policy formulators to recognize the variables endorsing GRGDP. Macroeconomic theory postulates that RNEN and associated features are serious for LR GDPg. In line with Alper and Oguz (2016) the decreased dependence on explosive NEN similar to coal, crude oil, and fossil fuels is merely probable when the implementation of RNEN is increased whilst in addition plummeting the negative externalities associated with energy production. GRGDP is additionally a reasonable plan for energy save and CO_2 lessening (Guo et al., 2017) and is an extensively conventional answer to manage the worsening of the environment (Sandberg et al., 2019). GRGDP trusts on technological and market advancement, especially, to get better manufacturing competence. Green technology is an effectual technique for improving GRGDP (Sohag et al., 2019b), and cleaner technical implementation considerably makes reduction in CO_2 (Yin et al., 2015).

However, Chen et al. (2023) explained that technological progression in carbon decline and energy protection get better environmental quality and encourage GRGDP which hinges on renewable communications, trained labor, and global teamwork, which are vital and unified mechanism that jointly improve country's promise to sustainable development. It is also believed that Path-Dependence too exists in NEN, which indicates that just the once public is familiar with a specific method of energy use, they may turn out to be reliant on this NEN. Hence, the dependence of growth on NRNEN is associated with the bond between RNEN and GRGDP (Puffert, 2024).

This study used the following adapted model, which also used by Danish and Ulucak (2020), Fu et al., (2021), Raihan et al., (2023), Fang et al., (2020) and Taskin et al., (2020).

$$\mathbf{GGINDEX_{it} = \beta_0 + \beta_1 CO_{2_{it}} + \beta_2 RNEN_{it} + \beta_3 GLOBZN_{it} + \beta_4 GINI_{it} + \mu_{it} \ldots\ldots\ldots (1)}$$

Where, GGINDEX= Green growth index (Composite index measuring green growth performance across four dimensions (Scale 0 to 100) covering efficient resource use, green opportunities, natural capital protection, and social inclusion

CO_2= Environmental degradation (Co_2 emission kt per capita)

RNEN= Renewable energy Consumption per capita

GLOB= Globalization (KOF index) which measures overall economic, social and political GLOB

GINI= Gini Index indicated by income inequality

μ_{it}= Error term

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Estimation Techniques

In this study, unit root test is used to check data stationarity. On the basis of test, we have used the regression analysis as all the variables are stationary at level. Summary statistics is also shown which indicates the stability of the data. Finally, study has used OLS techniques for this analysis. By using a panel data, Danish and Ulucak (2020) has also used this technique.

Results & Discussion

Stationarity Tests

Table 1 reveals unit root test. Result shows that all the variables are significant showing stationarity of the data at level.

Table 1: Unit Root Results

Variables	Levin, Lin &Chu t* (p-value)	IP & Shin W-stat (p-value)	ADF - Fisher χ^2 (p-value)	PP - Fisher χ^2 (p-value)	Deciscion
GGINDEX$_{it}$	-5.9990* (0.0000)	-7.9257*** (0.0679)	95.7989** (0.0293)	191.52* (0.0000)	Stationary at level
CO$_{2it}$	-5.3488* (0.0003)	-6.6053* (0.0028)	89.1771* (0.0085)	150.425* (0.0084)	-do-
RNEN$_{it}$	-6.1272* (0.0000)	-8.3304* (0.0000)	99.643* (0.0000)	191.263* (0.0000)	-do-
GLOB$_{it}$	-6.2430* (0.0000)	-5.6126* (0.0000)	67.4060* (0.0000)	113.284* (0.0000)	-do-
GINI$_{it}$	-6.2250* (0.0000)	-2.6383* (0.0042)	33.5402** (0.0143)	45.4420* (0.0004)	-do-

Note: ***,** and * shows the significance level at 10%, 5% and 1% respectively.

In table 2, this study presents the descriptive statistics, which shows that green growth index is 0.3313 percent on average. Its standard deviation is 0.3069 which is less than mean value. Showing the stability of data. And it ranges from -0.3920 to 1.0770 percent. CO_2 emission is 3.4364 percent in these Asian countries. On average, globalization is 59.4680 percent in these economies. Finally, mean value of Gini index is 0.6556 percent. Mean values are greater than the standard deviation showing the stability of data.

Table 2: Descriptive statistics

Variables	Observations	Mean	St. deviation	Minimum	Maximum
GGINDEX$_{it}$	261	0.3313	0.3069	-0.3920	1.0770
CO$_{2it}$	261	3.4364	1.6098	0.5980	6.3920
RNEN$_{it}$	261	31.5544	15.6022	4.0600	15.6022
GLOB$_{it}$	261	59.4680	11.0654	33.6239	11.0654
GINI$_{it}$	261	0.6556	0.6780	0.4330	0.8030

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Regression Results

Table 3 reveals the regression results, which shows that CO_2 emissions seem to be affecting green growth in Asian countries. High CO_2 emissions are related to low green growth in developing economies as environmental degradation exhausts community finances, redirects funds in the direction of disaster revival, and locks economies into exclusive fossil fuel systems. Result shows the negative effect of CO_2 emissions on green growth. Result showed one percent increased CO_2 emission results in less green growth by 0.1121 percent. The reason may be more usage of energy driving quick industrialization, escalating global transport, and hopeful the transfer of polluting businesses to economies with feeble ecological systems. Finding is supported by Ngo et al., (2026). Renewable energy consumption is significant as it drives GRGDP by decoupling economic development from CO_2 and encouragement of sustainable development. Renewable energy consumption also affects green growth in Asian economies. Result indicates that one percent increase in renewable energy use has cause for increased GRGDP by 0.0108% in Asian countries. The reason may be the more usage of renewable energy and more industrial production which resultantly increases green growth in Asian countries. Result is favored by Alam et al., (2025). Globalization increases green growth in Asian economies. Globalization enhances green growth by speeding up the sharing of clean technologies, escalating global finance for sustainable projects, and amalgamating environmental principles. Result shows the positive impact of globalization on GRGDP but insignificant. Result is supported by Chen et al., (2023).

Table 3: OLS Results

Variables	Coefficient	Standard Error	t-statistics	p-value
C	0.2860	0.0775	3.6933	0.0003
CO_{2it}	-0.1121*	0.0066	-17.0216	0.0000
$RNEN_{it}$	0.0108 *	0.0007	15.9442	0.0000
$GLOB_{it}$	0.0020	0.0012	1.6115	0.1083
$GINI_{it}$	-0.0412	0.1376	-0.3035	0.7618
R^2	0.70			
Adjusted- R^2	0.69			
F-statistic	149.49			
Probability	0.0000			

Note: ***,** and * shows the significance level at 10%, 5% and 1% respectively.

Conclusion

The existing research examines the variables influencing green growth based on data from 1997 to 2024 in Asian countries. For this purpose, green growth index was used as dependent variable. Instead, CO_2 emission, RNEN, globalization and Gini index were used as independent variables. Data were drawn from nine developing countries for the analysis. Regression result showed that CO2 emissions has decreased green growth in Asian countries. Environmental pollution is increased due to urbanization and more innovation and have negative effects on green growth in

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developing economies. Moreover, renewable energy use and globalization have increased green growth in Asian countries. Gglobalisation is an international occurrence which has affected a lot of features of human life, generally, politically, in addition to economically. Mishkin (2009) and Shahbaz et al., (2015) explained that GLOB unites the globe financial system in the course of FDI and trade. In conclusion, income inequality has affected negatively the green growth in Asian countries. On the basis of the results, study suggests that CO_2 emission should be reduced through by shifting to renewable energy, improving energy efficiency, and changing daily transportation and consumption habits. Globalization should also be increased by reducing trade barriers, advancing digital technologies, and improving global transport infrastructure. Finally, there is a need to upsurge renewable energy consumption in Asian economies.

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