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Green Foreign Aid for Environmentally Sustainable Growth in South Asian Countries

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Abstract

Among others, environmental degradation has emerged as a serious challenge to be tackled on an urgent basis, worldwide. South Asia, like many other countries, is facing a trade-off between environment and development, therefore environmental degradation has proved to be a threat to the entire South Asian region's sustainable economic growth. Although various factors are responsible for environmental degradation in these countries, the study underwrites the evolving thought of the Environment Kuznets Curve (EKC) by incorporating green aid as a moderating factor and the contribution of economic growth, green aid, population density, and institutional quality are taken as explanatory variables in determining the path and levels of environmental degradation in South Asian region. Panel Quantile Regression Autoregressive Distributed Lag Model (PQARDL) has been employed for the quantitative analysis for the period of 2000-2021. The long run, short run, and convergence coefficients have been estimated. The long-run results bared that economic expansion, green aid, the interaction of economic expansion square with green aid, and quality of institutions have an affirmative and contrarily, the square of economic growth, interaction of economic growth and green aid and population density are found adversely related to degradation of the environment. At the same time, economic growth, the interaction of economic growth with green aid, and population density are negatively concomitant with environmental degradation in the short run. Whereas, an affirmative and significant association has been found between squared economic growth, green aid, the interaction of squared economic growth with green aid, and institutional quality with environmental deterioration in the short run. Likewise, the coefficient of convergence speed is found to be significant but negative. The upshots of the study suggest that attracting green aid by growing international collaboration with international agencies and organizations, strengthening institutional quality, and adopting sustainable urbanization strategies would play the role of environmental safeguard without hurting economic growth in South Asian countries.

Keywords: *Green Aid, Environmental Degradation, Environment and Growth, South Asia, Panel Data Model.*

Introduction

The eight countries i.e. "Afghanistan, India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan, and Maldives" constitute South Asia. The zone caters world's vast majority of the population, mostly dependent upon its environmental and natural resources for livelihood and economic development.

Air pollution is a continuous menace foremost for South countries. According to a recent study, South Asian regions underwrite the wickedest air quality, hence sustainability drifts regions worldwide. The study also found that air pollution is rampant across many South Asian countries, and pollution trends have risen due to unsustainable industrial practices (Abdul Jabbar et al., 2022). The concentration of sulfur dioxide, nitrogen dioxide, and carbon dioxide has been rising for the past few years causing damage to the environmental quality across the South Asian region. Some of the world's most polluted nations are located in South Asia. For instance, Bangladesh, India, Nepal, and Pakistan ranked among the world's top five countries with the highest pollution levels (Lee & Greenstone, 2021). The South Asian air quality is deteriorating in which population growth and rapid industrialization have contributed the most. At the start of the current century, pollution levels soared more than 50% as compared to last century, the population of Bangladesh, India, Nepal, and Pakistan has lost half of their total life years due to pollution[1].

The global pursuit of economic development has been intricately linked with environmental concerns, prompting researchers to sightsee the intricate connotation between environmental deterioration and economic growth. One theoretical framework that has gained prominence in this discourse is the Environmental Kuznets Curve (EKC). This curve posits the transposition of a U-shaped bond between economic growth and deterioration of environmental quality, suggesting that environmental quality initially deteriorates but eventually improves as economies progress over the long period. Contrary to that, the Load Capacity curve advocates that economic activity (GDP) is apt to have a U-shaped effect on environmental quality (Iqbal et al., 2023; Pata & Kartal, 2023; Pata & Tanriover, 2023). The U-shaped affiliation is also named the "Environmental Brundtland Curve" (Olasehinde-Williams, 2023).

Recent studies have advanced the overall understanding of the conventional EKC by incorporating nuanced variables and testing the moderating effects of these external factors. This study, in particular, extends the traditional EKC model by introducing GDP and GDP square as key predictors and incorporating population density, institutional quality, and per capita green aid as independent variables. The novel addition of green aid as a moderator seeks to unravel how international assistance aimed at environmentally sustainable development influences the dynamics of the EKC.

The central hypothesis driving this research is that economic growth alone may not be sufficient to address environmental challenges. Still, rather, the sway of economic actions on the environment can be mitigated by strategic interventions such as green aid. By examining the subduing role of green aid in the EKC framework, this study aims to shed light on whether external financial assistance can potentially flatten the conventional inverted U-shaped trajectory of the EKC, leading to net CO_2 emissions reduction in response to economic growth. Testing the contribution of green aid will help in finding ways to curb air pollution without sacrificing economic growth.

The choice of variables reflects a comprehensive consideration of factors that influence the interplay between economic development and environmental sustainability. As a demographic variable, population density captures not only potential stress on natural resources but also an effective proxy of rapid urbanization in South Asian countries, while institutional quality reflects the governance structures that can

[1] https://www.reuters.com/business/environment/air-pollution-now-major-risk-life-expectancy-south-asia-study-2023-08-29/

exacerbate or alleviate environmental pressures. Per capita green aid is introduced as a measure of external support directed towards environmentally conscious development, recognizing the global interconnectedness of environmental challenges.

In the "South Asian Association for Regional Cooperation" (SAARC) countries, significant efforts have been reported to promote green ingenuities and environmental sustainability. For example, the United States has supported the Recharge Pakistan project to enrich Pakistan's pliability to climate change by enlightening water systems and financing green set-up (US Mission Pakistan, 2023). Similarly, the World Bank has provided funding to support Bangladesh in developing environment management and endorsed private sector involvement in green ventures, aiming to strengthen environmental regulations and curb pollution (World Bank, 2022). These initiatives exhibit a focus on green aid and environmental sustainability in the region.

Building on existing literature that underscores the importance of considering multiple variables in EKC models (Grossman & Krueger, 1991; Stern, 2004), this study underwrites the evolving thought of the EKC by incorporating green aid as a moderating factor. The findings from this research are expected to offer valuable acumens for development practitioners and policymakers pointing to design operative strategies that balance economic growth with environmental sustainability.

In the subsequent sections, firstly, the literature review explores the empirical studies, then this study delves into the methodology employed, presents the empirical findings, and discusses the implications for both theoretical frameworks and practical policy considerations in the realm of sustainable advancement.

Research Question

The study examines the question: Do green aid along with economic growth, population density, and institutional quality influence the state of environmental quality measures by CO_2 emissions in South Asian countries?

Research Objective

The study is planned to unfold the complex relationship of environmental degradation revolving around green aid, institutional quality, population density, and economic growth in the South Asian countries struggling to attain the goal of sustainable economic growth with fragile environmental quality.

Literature Review

The "Environmental Kuznets Curve (EKC) hypothesis" postulates a non-linear liaison between economic growth and the degradation of the environment, particularly in the context of CO_2 emissions. The EKC suggests that as economies develop, environmental degradation primarily worsens, but it begins to improve after the realization of a certain level of affluence. In the case of CO2 emissions, this implies that emissions firstly upsurge with the prosperity level and then plunge as countries nurture richer yonder a firm level (Hannesson, 2022; Murshed et al., 2022).

In the milieu of Asian economies, Wenlong et al. (2023) scrutinized the latent effects of technological novelties, quality of institutions, trade liberalization, and energy efficiency on environment degradation for the period of 1995-2018. Various preliminary tests such as cross-section dependency (CSD), slope heterogeneity, and the long-run relationship between the variables such as Westerlund and Edgerton (2008) have been employed before the application of the cross-sectional "Autoregressive Distributed Lag Model CSARDL" technique. The results of the study reveal the damaging paraphernalia of institutional eminence and trade openness. At the same time, technological innovations and energy efficiency positively impact environmental eminence in the selected Asian economies. All these findings prove the pollution haven

hypothesis and a clue that amplified trade openness brings environmental degradation at the same time, demand for a cleaner environment coupled with higher income.

Moreover, for SAARC economies (India, Pakistan, Bangladesh, Sri Lanka, and Nepal), numerous studies have probed the association between GDP and CO_2 emanations to check the EKC hypothesis. Weak evidence related to EKC for CO_2 emissions has been found, with varying results for different countries and periods. Certain studies have found support for the EKC in certain countries and periods, while others have found little or no evidence for its existence (Adhikary & Hajra, 2021; Hannesson, 2022; Murshed et al., 2022; Nur Mozahid et al., 2022).

Specifically, a study analyzing the EKC for South Asian countries found that GDP impacts CO_2 discharges in the long run, whereas doubled GDP has a destructive impact, approving the structure of the EKC for Pakistan and Sri Lanka. Nevertheless, the results are diverse among the SAARC countries, with some auxiliary the pollution haven notion and others supporting the FDI aura hypothesis (Nur Mozahid et al., 2022).

Another study related to India has found pieces of evidence related to the EKC by De (2022) for the sake of environmental degradation in India. In this study, carbon emissions have been taken as the dependent variable, while economic growth, international trade, and changing manufacturing share serve as independent variables. To explore the quadratic association in the short as well as long run cointegration and ARDL techniques have been used. The outcomes recommended a long-run relationship among CO2 emission, changing share of manufacturing, export as a proportion of GDP, and economic growth. In the short-run, an insignificant relationship is found between carbon emissions and economic evolution in the presence of changing share of manufacturing and export as a proportion of GDP. In addition, long-run EKC also exists in India, however, increasing trends of the share of manufacturing and export as a proportion of GDP are also worth considering and there is a need to devise pollution control and environment improvement policies in India.

It is vital to note that the connotation between GDP and CO_2 emissions is multifaceted and can be predisposed by various factors such as openness of trade, foreign direct investment (FDI), and energy consumption. Additionally, the EKC analysis may not fully account for the impact of the use of imported commodities, the relocation of pollutant industries, and the efficiency of the environmental mutilation caused during the initial phases of economic growth (Leal & Marques, 2022; Nur Mozahid et al., 2022).

In summary, while the EKC hypothesis offers a theoretical framework for understanding the link between GDP and CO_2 emissions, its applicability to specific South Asian countries is subject to various economic, environmental, and policy factors. Further research and analysis are needed to fully understand the dynamics of this relationship from the perspective of South Asian countries.

The role of green aid as a gauge of environmental quality and its curbing role in the EKC hypothesis is examined by (Apergis et al., 2023). They accentuated the protagonist of green aid in the reduction of carbon dioxide emissions for 92 countries throughout 2002-2018. The study classifies the various types of environmental aids used to improve environmental conditions in aid recipient countries. The study employed the General Method of Moments (GMM) on Carbon dioxide emissions served as a predicted variable in response to environmental aid, per capita GDP, squared GDP/per capita, FDI, urban population, energy consumption, and trade liberalization. The study found significant links between targeted green aid to reduce carbon emissions as compared to the non-screened aid. The study also suggests that the range of screened aid should be increased to reduce environmental degradation in developing countries.

Bhattacharyya, Intartaglia, and Mckay (2018) probed the consequences of “energy-related aid” on CO_2 as well as SO2 emissions in 128 countries around the world from 1971-2011. They found a non-systematic impact of “energy led-aid “on the energy sector in almost all 128 countries of the world deduced from the

"Anderson and Hsiao estimator". The study also found that this non-systematic effect is not conditional to income levels and the quality of institutions in these focal countries. However, European and Central Asian countries use "energy related-aid" effectively by reducing CO2 and SO2 emissions as compared to other aid-recipient countries.

Furthermore, the tempering energy innovation and role of consumption of green energy in the EKC has been studied in the framework of the Sub-Saharan African (SSA) region, showing that policies targeting green energy consumption and energy innovation can help mitigate Carbon dioxide (CO_2) emissions (Musibau et al., 2020). While this study focuses on the SSA region, the findings provide acumens into the potential curbing green energy consumption and energy innovation in the EKC for other regions, including the SAARC countries.

Mahalik et al., (2021) investigated the effects of the efficacy of aggregate foreign aid, influxes of foreign remittances, energy aid inflows, real GDP/per capita, energy consumption/per capita, and globalization on CO_2 emissions for India. The autoregressive distributed lag model bounds test has been employed from 1978 through 2014. The results of the model revealed that a statistically substantial association is found between the selected variables. Further, CO_2 emissions are negatively related to energy consumption, foreign aid inflows, and globalization contrarily, foreign direct investment, economic growth, foreign energy aid, and remittances influxes were found to be contributing factors to carbon dioxide emissions.

It is noteworthy that the effectiveness of green aid along with green energy's moderating role and innovation in the EKC can be affected by multiple factors i.e. including institutional quality, energy consumption, and investment in green infrastructure. In SAARC economies, economic growth coupled with institutional quality plays a crucial role in determining carbon dioxide emissions, hence their environmental quality through development strategies of green aid inflows along with viable green energy policies.

In brevity, the green aid inflows can be used to gauge the environmental quality. Whereas, the moderating role of green aid inflows for South Asian countries is subject to the various economic, environmental, and governance factors. Further research and analysis are needed to fully understand the dynamics of this relationship and the impact of green aid and energy initiatives on environmental sustainability in the region.

Population density, a proxy for rapid urbanization and pressure on environmental and natural resources, is one factor contributing to air pollution in SAARC countries. A study found that population density augments ecological discrepancies by hovering traffic crowding, pollution, and unnecessary energy use (Mishra & Dash, 2022). Another study found that population density sways CO2 emission positively and ominously, implying that an upsurge in population raises CO_2 emission for the intact panel (Hasan et al., 2021). To address air pollution in SAARC countries, countries could encourage cleaner fuels, and implement new environment-friendly carriage and energy machinery (Mani & Yamada, 2020).

ul Hasan, Hussain, and Ali (2021) pinpointed the various aspects affecting the environmental quality of SAARC countries for the period of 1991-2016. The study used the fixed effect model technique to find out the possible effects of GDP/ per capita, square of GDP/per capita, income inequality, foreign direct investment, secondary school enrollment, and population density on carbon dioxide emission. A constructive relationship has been found between FDI and carbon dioxide emissions on the other hand, a destructive affiliation was found between secondary school enrollment and carbon emissions. Population density was found to be significantly positive in an increase in carbon emissions in selected countries.

Dimnwobi et al., (2021) examined the factors behind the ecological footprint in the five most populous African countries. The cross-sectional Auto Regressive Distributed Lag model has been used to investigate the latent impact of population density, energy consumption, population growth age structure, trade openness, population growth rate, GDP growth rate/per capita, and urban population growth on ecological

footprint for the period of 1990-2019. The study confirms that population growth, population density, age structure of population growth, per capita GDP growth rate, trade openness, and energy consumption are the responsible for degradation of the environment in selected countries. At the same time, the urban population has no significant effects on ecological footprints.

Studies have shown that the quality of institutions considerably impact reducing CO_2 emissions, thereby improving environmental sustainability (Li et al., 2022; Sheng et al., 2023; Simionescu et al., 2022). Positive changes in institutional quality have been established to have a greater impact on reducing CO2 emissions than negative changes, indicating the significance of improving the quality of institutions for environmental outcomes (Li et al., 2022).

Good governance has been associated with better environmental quality in richer countries, while its impact in middle- and low-income countries has been more complex, with both positive and adverse effects observed (Azimi et al., 2023; Gök & Sodhi, 2021; Simionescu et al., 2022). The governance quality plays a vital role in extenuating the environmental concerns of economic expansion and enhancing environmental protection (Simionescu et al., 2022).

Mahmoodi and Dahmardeh (2022) explained the various contributing factors in the ecological footprints of Asian and European countries. The study employed the Augmented Mean Group (AMG) model to examine the effects of institutional quality, renewable along with non-renewable energies, and economic growth on ecological footprint for the span of 1996 to 2017. The study confirms the EKC relationship in both Asian and European countries. The study originates a venomous liaison between institutional quality and ecological footprint while positive effects of non-renewable energy on selected panels of countries. Contrarily, renewable energy is found to be adversely correlated with the ecological footprint of the European panel of countries.

In the light of above-mentioned ample literature on environmental degradation, it is evident that environmental degradation is a manifest matter of subject in this era. As South Asia is exposed to environmental degradation on the development trajectory, there is an urgent need to focus on this grieve issue. To handle this problem green aid can play an active role in South Asia to reduce CO_2 emissions, hence improving environmental quality. In the researchers' acquaintance, no study has been done to check the link between the distinct and combined effects of green aid and economic growth on the degradation of the environment for South Asian economies.

Methods

Data Description and Measurement of the Variables

Table 1 concisely explains the variables of the study and data sources. Environmental degradation (ED) is measured by CO_2 emissions kilo tons of CO_2 equivalent per capita. Economic Growth (is measured with GDP/per capita which is the ratio between GDP to the population of a country at the constant of 2015. Institutional quality (IQ) is based on the average government effectiveness index, enveloping rule of law index, control on corruption index, regulatory quality index, voice and accountability index, and political stability index. Green aid (GAID) is measured by international financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems (millions of constant 2020 US$) and converted into per capita. Population density (PD) is the population residing per square kilometre in a country. The sample is based on South Asian region countries i.e. "Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka" from 2000 through 2021.

Table 1: Selected Variables, Operational Definition, and Data Source

Symbol	Variables	Operational Definition	Data Source
ED	CO_2 Emissions	Natural log of CO_2 emissions Kilo tons of per capita	World Development Indicators 2023
LGDP	Economic Growth	Natural log of per capita GDP (Constant US$-2015)	World Development Indicators 2023
GAID	Green Aid	Per capita Green aid (constant 2020 US$)	UN Statistics https://unstats.un.org/sdgs/report/2021/extended-report/Goal%20(7)_final.pdf
PD	Population Density	Natural log of the total number of Individuals living in a square kilometer	World Development Indicators 2023
IQ	Institutional Quality	The average of six institutional quality indicators	World Development Indicators 2023

The existing study is designed to explore the liaison between green aid, the quality of certain institutions, and economic growth on environmental deterioration in South Asian economies. The functional form of the anticipated econometric model is as follows:

$$ED = f(GDP, GAID, PD, IQ) \quad \text{(1)}$$

Here, ED represents environmental degradation, GDP denotes economic growth, GAID symbolizes green aid, PD serves as population density and IQ elucidates institutional quality.
The mathematical equation of the model is as follows:

$$ED = a_0 + a_1 GDP_{it} + a_2 GAID_{it} + a_3 PD_{it} + a_4 IQ_{it} + e_{it} \quad \text{(2)}$$

Here,

a_0 is the intercept, a_1, a_2, a_3, and a_4 indicate slope coefficients of ED, GDP, GAID, PD, and IQ, respectively. "i" stands for countries and t represents the period of the study.

Equation 3 has been developed to estimate long-run, short-run, and Error Correction terms by employing the Pooled Mean Group (PMG) Specification which was used by Blackburne & Frank (2007) with the inclusion of the Quantile Regression (QR) method. After that, Cho et al. (2015) cast off the Error Correction Model in quantile regression to modify a Quantile Autoregressive Distributed Lag model. However, a drawback of this model is that it does not postulate any type of specification, therefore, it is imperative to follow certain type of the specifications proposed by Blackburne and Frank (2007) to evaluate ARDL for a panel data set. The present study also employs the Pooled Mean Group (PMG) specification with a homogenous long run, and the short run is cross-sectional heterogeneity to account for unobserved heterogeneity. Previous studies (Arshed et al., 2022; Fahmida et al., 2022; Iqbal et al., 2023; and Zahid et al., 2022) have used the same method.

$$\Delta ED_{it}(\tau_k) = \alpha_0 + \sum_{j=1}^{k} \alpha_{1jt}\,\Delta lGDPL_{it-j}(\tau_k) + \sum_{j=1}^{k} \alpha_{2jt}\,\Delta GAID_{it-j}(\tau_k) + \sum_{j=1}^{k} \alpha_{3jt}\,\Delta lGDP^2{}_{it-j}(\tau_k) + \sum_{j=1}^{k} \alpha_{4jt}\,(lGDP * GAID)_{it-j} + \sum_{j=1}^{k} \alpha_{5jt}\left(lGDP^2 * GAID\right)_{it-j} + \sum_{j=1}^{k} \alpha_{6jt}\,\Delta PD_{it-j}(\tau_k) + \sum_{j=1}^{k} \alpha_{7jt}\,\Delta IQ_{it-j}(\tau_k) + \beta_1 lGDP_{it-1}(\tau_k) + \beta_2 lGDP^2{}_{it-1}(\tau_k) + \beta_3 GAID_{it-1}(\tau_k) + \beta_4 (lGDP * GAID)_{it-1}(\tau_k) + \beta_5 (lGDP^2 * GAID)_{it-1}(\tau_k) + \beta_5 lPD_{it-1}(\tau_k) + \beta_6 IQ_{it-1}(\tau_k) + E_{it}(\tau_k) \dots\dots\dots (3)$$

……(3)

Results and Discussion

Descriptive statistics are mentioned in Table 2 for eight South Asian countries, the averages of environmental degradation (ED), economic growth (LGDP), and square of economic growth ($LGDP^2$) are bigger than their respective standard deviation, which is a clue that the observations of these variables have less tendency to scatter at the time, per capita green aid (GAID), population density (LPD) and institutional quality (IQ) are scattered since standard deviation is greater than their respective averages within selected data. All the selected variables are found positively skewed which reveals that the most of extreme values are lie on the right hand side.

Table 2 – Descriptive Statistics

	ED	LGDP	GAID	PD	IQ
Mean	1.6233	7.2854	5.4026	444.666	-0.622
S.d.	0.762	0.8789	13.369	18.983	0.5701
Skewness	1.6342	0.6964	6.303	1.1338	0.2492
Kurtosis	6.216	2.641	47.921	3.038	4.526

Figure 1 shows the inverted U-shaped environmental Kuznet Cure (EKC) for South Asian countries and depicts a positive bond in economic growth and deterioration of environmental quality at the early stages after a definite level of economic growth, it tends to decrease with the increase of economic growth.

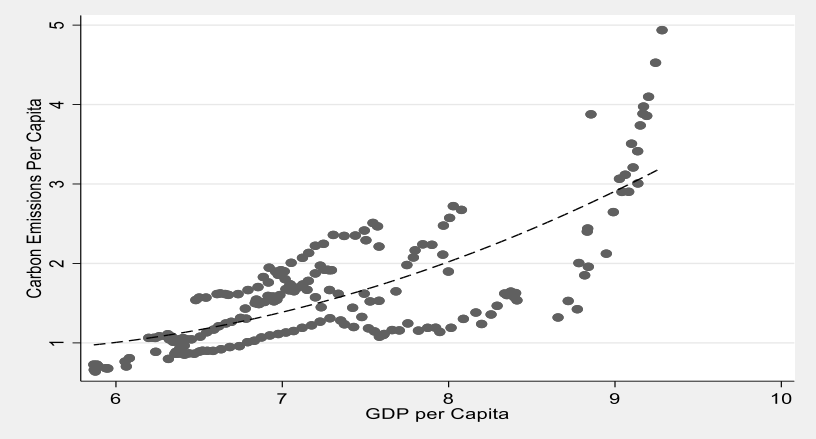

Figure 1: Environmental Degradation and Economic Growth

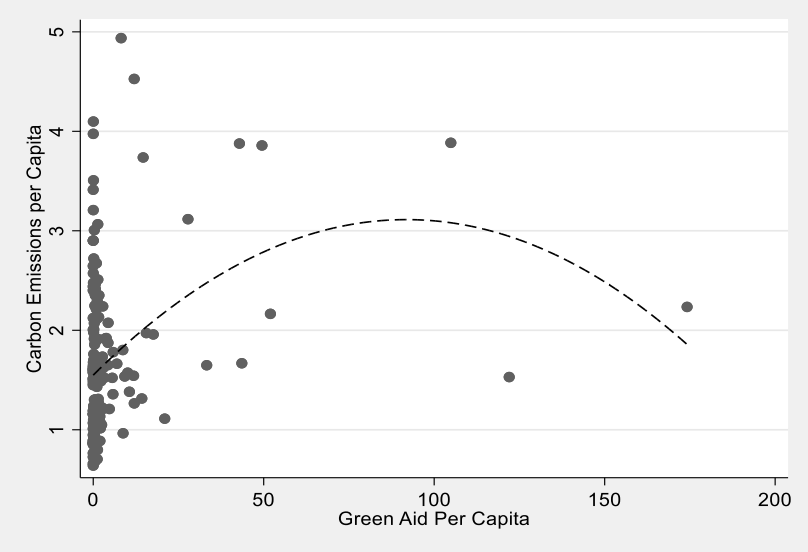

Figure 2: Environmental Degradation and Green Aid

Figure 2 also depicts the link between carbon emissions per capita and green aid per capita with the help of an inverted U-shaped curve. Environmental degradation has a tendency to decline with the larger surge in green aid in the selected countries and this phenomenon happened in extended period of time.

Table 3 shows the upshots of the Pedroni Cointegration test and long run correlation is found between environmental degradation, economic growth, the square of economic growth, green aid, the square of green aid, population density, and institutional quality for South Asian countries since p-values of Modified Phillips-Perron t (less than 0.05), Phillips-Perron t (less than 0.1) and Augmented Dickey-Fuller t (less than 0.05).

Table 3 – Panel Co-integration Test

Pedroni Test for Co-integration	**statistic**	**P value**
Modified Phillips Perron t	2.093*	0.018
Phillips Perron t	-1.312*	0.094
Augmented dickey-Fuller t	-1.769**	0.038

**,* indicates significant at 5% and 1% level of significance

Table 4 – Panel Quantile Regression Long Run Estimates

	Co-ef.	**Prob.**
LGDP	1.111***	0.000
LGDP2	-0.035***	0.000
GAID	0.218***	0.000
LGDP*GAID	-0.059***	0.000
LGDP2*GAID	0.004***	0.000
LPD	-0.103***	0.000
IQ	0.254***	0.000
Obs = 180	Countries = 8	

*** indicates significant at a 1% level of significance

The long-run assessments of the model are accessible in Table 4 and selected variables are statistically significant for this model. The estimates of economic growth (LGDP) and square of economic growth ($LGDP^2$) validate the EKC narration. Accordingly, a 1% upsurge in economic growth escalates 111% environmental degradation (ED) and the square of economic progress hurts the degradation of the environment. Whereas, a 1% increase in the squared economic progress ($LGDP^2$) reduces environmental degradation by 3%, the results are compatible with (Drabo, 2011; Hasan et al., 2021; Nur Mozahid et al., 2022). This is evident from the EKC-related literature that at the initial stages environment is tainted with the increase in economic growth but after a certain level, it tends to decline due to several reasons such as higher economic growth leading to adopt the modern and environment-friendly technologies and sources of renewable energy in the country. Moreover, higher economic growth provides allocation of funds for pollution control steps and a high possibility of reforestation to achieve a sustainable environment in the country.

Next, the coefficient of green aid exhibits an affirmative relationship with environmental degradation, a 1% upsurge in green aid paves the path for 21% environmental degradation (ED) in selected countries. Since green aid encompasses technology transfers or financial assistance, the misuse and/or mismanagement of these resources and continuous aid dependency might increase the risk of crowding out of local communities or local governments to raise the self-sustain strategies in these countries.

Moreover, the interaction term coefficient of economic growth and green aid (LGDP*GAID) was found to be adversely and statistically significantly related to environmental degradation and a 1% intensification in this interaction term drops environmental degradation (ED) by 6% in selected countries. Therefore, results reveal that economic growth and green aid both are essential for a healthy environment and sustainable development. At the same time, the coefficient of $LGDP^2$*GAID was found to be statistically significant and positively related to environmental degradation (ED) and a 1% joint increase also upsurges environmental degradation by 0.04% in South Asian countries. Again the EKC is in action and even green aid is not playing its due role in the improvement of the environmental quality.

Interestingly, the population density (LPD) result shows that a 1% rise in population density diminutions 10% of environmental degradation (ED), and the outcomes are aligned with (Dimnwobi et al., 2021; Hasan et al., 2021). Since population density is closely linked with urbanization, therefore, there might be numerous causes for this positive bond, such as properly managed and planned urbanization, better infrastructure, efficient and cleaner energy use, consumption and transportation systems, implementation of environment-friendly waste management and reduction mechanism and filter water system. In other words, highly dense populated areas can underwrite environmental upkeep by following, proper, sustainable, and effective planning, policies, and practices in selected South Asian countries.

Moreover, institutional quality (IQ) outcomes tell us that a 1% escalation in IQ increases 25% environmental degradation (ED) and the outcomes of the study are compatible with (Mahmoodi & Dahmardeh, 2022). The affirmative relationship between institutional quality and environmental degradation leads to counterintuitive and shows the fragile institutions in South Asian countries. Strong and stable institutions are associated with a better environment. However, the weak institutions facilitate the environmental protection rules and regulations, poorly designed environmental policies, lack of enforcement, and short-run economic gains.

Short-run estimations are presented in following table 5, in which all the variables are found to be statistically significant. Firstly, the coefficient of economic growth is negatively allied with environmental degradation (ED) and a 1% increase in economic growth decreases environmental degradation by 394%. Contrarily, double economic growth impacts environmental quality and a 1% rise in double economic growth increases environmental degradation by 32%. Secondly, green aid in selected countries is also positively and significantly associated with environmental degradation in such a way that a 1% upsurge in green aid also upturns environmental degradation by 11%. Proceeding, the interaction of economic growth

and green aid (LGDP*GAID) was found adversely and statistically significantly related to environmental degradation and a 1% increase in this combination decreases environmental degradation (ED) by 3% in selected countries. The combined effect of the square of economic growth and green aid ($LGDP^2$*GAID) is found positive and statistically significant with environmental degradation (ED) for South Asian sampled countries in the short run. In addition, a 1% upsurge in the combined effect of the square of economic growth and green aid also increases by 0.01% environmental degradation. The coefficient of population density (LPD) was also found negatively and statistically associated with environmental degradation, specifically, a 1% increase in population density decreases environmental degradation (ED) by 87%. Along the same line, institutional quality (IQ) is positively related to environmental degradation (ED), and a 1% increase in institutional quality also increases environmental degradation (ED) by 5% in the short run. In this model, the Error Correction Term (ECT) is negative as well as significant. for this model, and the rate of convergence is 2% it can be interpreted such that this model will congregate towards its long-run equilibrium within 2 years since the data is in annual form.

Table 5 – Panel Quantile Short-Run Estimates

	Coef.	**Prob.**
ΔLGDP	-3.947***	0.000
$\Delta LGDP^2$	0.322***	0.000
ΔGAID	0.111***	0.000
Δ(LGDP*GAID)	-0.029***	0.000
$\Delta(LGDP^2*GAID)$	0.002***	0.000
ΔLPD	-0.869***	0.000
ΔIQ	0.056***	0.000
ECT	-0.002***	0.000
$LGDP_{-1}$	-0.298***	0.000
$LGDP^2_{-1}$	0.021***	0.000
$GAID_{-1}$	-0.037***	0.000
$(LGDP*GAID)_{-1}$	0.009***	0.000
$(LGDP^2*GAID)_{-1}$	-0.0005***	0.000
LPD_{-1}	0.004***	0.000
IQ_{-1}	-0.023***	0.000
Obs = 172	Countries = 8	

*** indicates significant at a 1% level of significance

Conclusion and Policy Implications

Environmental degradation has proved to be a development challenge worldwide and every country of the world is struggling to achieve sustainable economic growth by not compromising on respective environmental quality. South Asian economies are critically injured by environmental degradation; therefore, the present study is based on South Asian countries i.e. "Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka" for the analysis. Although various factors are responsible for environmental degradation in these countries, this study enlightens the contribution of economic growth, green aid, population density, and quality of institutions in environmental degradation. The long run, short run, and convergence coefficient have been estimated and long-run results revealed that economic growth, green aid, the interaction of square of economic growth, green aid, and institutional quality have affirmative and noteworthy effects on environmental degradation. Contrarily, economic growth square, the interaction of economic growth and green aid, and population density are found adversely related to environmental degradation. At the same time, economic growth, the interaction of economic growth and green aid, and population density are negatively associated with environmental degradation. While, a positive and significant association has been found between the square of economic growth, green aid, the interaction of the square of economic growth, and green aid and institutional with the degraded

environment. Likewise, the convergence speed is also found significant and negative, which means the model will congregate in the direction of its long-run equilibrium with this set of selected variables.

Based on empirical results key policy implications are suggested to attain the crucial goal of sustainable economic growth without compromising on environmental quality, an integrated and comprehensive approach based on economic, social, and environmental aspects is needed to uphold the balance in environmental quality and economic growth. There is a dire need to attract green aid by increasing international collaboration with international agencies and organizations, adopting policies to attract green investment to pave the path of sustainable economic development as well as intacting environmental quality. Attracting green investment in the form of transfer of green technology, green energy infrastructure, and innovations in South Asian countries will accelerate sustainable economic growth by strengthening their poor environmental quality. Green investment does not work in the vacuum of effective institutions. Institutional quality plays a deterministic role along with green aid/investment in amending environmental quality on the economic growth trajectory. Therefore, reinforcing the rule of law, improving governance, implementing regulations, and enhancing accountability in South Asian countries would, jointly, ensure a quality environment without hurting their economic development. Lastly, the uncatered population density will increase pressure on the fragile environmental system, hence, deteriorating its quality. Therefore, sustainable urbanization would contribute positively to a sustainable environment for long-term economic growth in South Asian countries.

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