The role of tourism and renewable energy towards EKC in South Asian countries: fresh insights from the ARDL approach

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Abstract: Over the last few decades, it has become a hot topic that countries are getting economic growth by reducing air quality. This study is an attempt to find out the impact of economic growth (GDP), tourism (TO), and renewable energy (RE) in Pakistan, India, Nepal, and Sri Lanka in the context of EKC (Environmental Kuznets curve). This study utilized the Autoregressive Distributed Lag (ARDL) approach to present empirical results. The stationarity of all the variables was confirmed by the unit root test at first difference. The positive coefficient value of GDP and negative coefficient value of GDP square show the EKC existence in Pakistan and India. But in India, this association is not significant. The empirical results also endorsed the findings of past studies that RE is improving air quality by mitigating CO₂ emissions in Pakistan, India, Sri Lanka, and Nepal. The findings show mixed results regarding the tourism impacts on CO₂ emissions. The positive coefficient of tourism in Pakistan and Nepal implies that tourism is improving the air quality in these countries. Whereas, the negative coefficient of tourism in Sri Lanka and India indicates that tourism is stimulating the CO₂ emissions in these countries. Therefore, these countries need to launch RE resources in the tourist sector to reduce its adverse impacts.

Subjects: Tourism; Tourism Management; Tourism Planning and Policy; Economics of Tourism; Tourism and the Environment; Tourism Development/Impacts

Keywords: Tourism; renewable energy; South Asian countries; EKC; GDP

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This paper analyzes the associations of tourism, economic growth, renewable energy, and carbon emissions in Pakistan, Nepal, India, and Sri Lanka. The findings show that renewable energy and tourism is supporting the cleaner environment in Pakistan and Nepal. The findings are revealing that these countries need to revise their existing tourism and GDP related policies to lower the environmental pollution.
1. Introduction

Governments and policymakers are facing problems of drastic climatic variability (Destek & Sarkodie, 2019; Mariam et al., 2021; Mehmood & Tariq, 2020; Mehmood, Tariq et al., 2021). Over the last 100 years, the average temperature has risen from 0.5 to 0.9 degrees (Aziz et al., 2020). The prime reason behind this rapid increase in temperature is energy consumption by fossil fuels. The fossils burning creates greenhouse gasses (Rafindadi & Usman, 2019; Sarkodie & Adams, 2018). Carbon dioxide (CO₂) constitutes 70% of greenhouse gases. According to the Intergovernmental Panel on Climate change in 2014, the economic growth in developing countries is increasing almost 77% of carbon dioxide emissions (Nataly Echevarria Huaman & Xiu Jun, 2014). Therefore, the main driver of global environmental problems is CO₂ emissions. During the past few years, the nexus of energy-economic growth and environmental problems has been studied vastly. Economic growth achieved through the consumption of fossil fuels adversely affects the climatic quality (Koçak & Şarküneşi, 2018). However, renewable energy (RE) is lowering CO₂ emissions (Bélaïd & Youssef, 2017; Ben Jebli & Ben Youssef, 2017; Mehmood, 2021a; Mehmood, Mansoor et al., 2021; Tariq et al., 2022). RE has the potential to replace nonrenewable energy to reduce CO₂ emissions (Dong et al., 2018; Goh & Ang, 2018; Mehmood, 2021c).

The energy-environment and GDP nexus have been investigated by several studies, but the environment and energy nexus with particular sectors of the economy has been neglected (Kirikkaleli et al., 2020; Kongbuamai et al., 2020; Mehmood, 2021c; Mehmood, Mansoor et al., 2021). This gap needs attention and tourism is an important sector of the economy. Developed and developing countries are trying to develop their tourism sector. Different countries are developing their infrastructure to boost the tourism sector to gain economic objectives. According to UNWTO (2017) tourism has had a share of 10% of the world’s economy during the past few years. Apart from its contribution to national income, tourism is also increasing the share of energy use by consumption of fossil fuels especially in the transport sector (Gössling, 2013; Tsai et al., 2014). RE consumption can be enhanced in the transport sector to achieve a cleaner environment. According to Lin (2010) the modes of transport used by visitors can stimulate environmental problems.

Moreover, the energy usage in hotels for lighting and other purposes can put threats to environmental problems (Ozturk et al., 2016). These kinds of environmental impacts are making countries take appropriate actions to reduce tourism-induced pollution. This important tourism-environment nexus has been studied by very few studies in developing countries (Dogan et al., 2017). Moreover, the South Asian countries have great potential in terms of their tourism sector for economic gains. According to the World Bank in 2020, the number of tourists recorded in Pakistan, India, Nepal, and Sri Lanka is 1.9, 17.9, 1.1, and 2.0 million, respectively. At the same time, these countries are expected to develop their tourism in the coming years. South Asia is the most affected region by environmental problems.

In this regard, the nexus of tourism and environmental problems is crucial to examine in developing countries of South Asia, especially in the context of the Environmental Kuznets curve (EKC). South Asian countries are gaining rapid development in GDP, energy use, and tourism with increased CO₂ emissions. However, the association among these factors has not been investigated briefly. Therefore, considering this research gap, our study is an attempt to find out the association between tourism, RE consumption, and GDP in selected South Asian countries, i.e., Pakistan, Sri Lanka, India, and Nepal in the context of EKC. The contribution of this research to the existing literature is as follows: Firstly, this research will find out the level to which the tourism sector contributes to CO₂ emissions. Moreover, the inclusion of RE and GDP with tourism is the novelty of the current study. Furthermore, this research will present a country-specific analysis to find the impact of RE and tourism on CO₂ emissions. In addition to this, the current study will analyze the EKC significance for examined South Asian countries by incorporating the ARDL (Autoregressive Distributed Log) approach.

Our study is organized as follows: after the introduction in the 1st section, the 2nd section consists of a literature review, and the econometric technique and its significance is in the 3rd section. 4th section is of discussion and results. The last section comprises the conclusion and its policy implications.
2. Literature review

The EKC literature is continuously expanded over the last few decades due to the considerable attention of research scholars (Bekun et al., 2019; Bazoklu et al., 2020; Güngör et al., 2021; SA & V, 2018). Tourism and renewable-related past studies with the EKC hypothesis are described in this section.

Many studies have presented the suitable role of tourism for environmental quality. For example, Kongbuamai et al. (2020) studied the impact of natural resources, GDP, tourism, and energy use, on ecological footprints in ASEAN economies from 1995 to 2020. The results showed an inverted U shape association by showing that natural resources can be utilized properly to improve air quality. Similarly, Danish and Wang (2018) argued that tourism is improving air quality in BRICS and validated EKC over the annual data of 1995–2014. Ben Jebli et al. (2019) explored the causal linkage among CO₂ emissions, trade, tourism, RE, GDP, and foreign direct investment for 22 economies from 1995 to 2010. The scholars found that tourism, RE, and foreign direct investment are lowering CO₂ emissions in Central and South America. Whereas, Saudi et al. (2019) observed a direct association between CO₂ emissions and GDP in Malaysia. Moreover, other research by Ozturk et al. (2016), Raza and Shah (2017), Tariq et al. (2022), and U (2021) also found the same results.

Apart from the positive role of tourism on the environment, there is also available literature, which found the degrading role of tourism on the environment. Tourism as an economic sector can increase energy consumption (Aziz et al., 2020). Energy consumption from fossils will degrade the environment. In this line, Gulistan et al. (2020) investigated that tourism stimulates air pollution in 112 economies and Balsalobre-Lorente et al. (2020) in OECD economies. Mikayilov et al. (2019) also probed this association for Azerbaijan from 1996-to 2014. The scholars utilized the technique of time-varying coefficient and found that tourism is degrading climatic quality. Their study could not validate the EKC hypothesis in Azerbaijan. The linkages between tourism, energy use, and environmental pollution were validated by Shaheen et al. (2019). Dogan and Aslan (2017) also found that GDP increases energy use that increases CO₂ emissions but their results were not similar in terms of tourism-CO₂ linkages. Zhang and Liu (2019) found that tourism reduces environmental quality in Southeast Asia. However, according to the Dogan et al. (2017) tourism positively affects the environment of European countries. Some other studies by Durbarry and Seetanah (2015) in Turkey, Sharif et al. (2017) in Pakistan, and León et al. (2014) in underdeveloped and developed nations, also found that tourism stimulates CO₂ emissions. Recently, Fethi and Senyucel (2020) examined that tourism stimulates CO₂ emissions in 50 economies. At the same time, some research studies presented mixed results like Paramati et al. (2017) probed the association between tourism and CO₂ emissions in Eastern and Western European countries. The scholars found positive nexus between environmental degradation and tourism in Eastern Europe but negative linkages were found in western countries. Moreover, Azom et al. (2018) argued that the tourism nexus is direct in Malaysia but indirect in Singapore and Thailand. Sghaier et al. (2019) also found positive tourism-CO₂ emissions in Tunisia but negative linkages in Egypt. Moreover, Paramati et al. (2017) found mixed evidence of tourism-CO₂ emissions nexus in developing and developed countries. Developed countries are benefiting from tourism as compared to developing nations.

Hypothesis 1 (H-1): The tourism sector impacts environmental degradation by increasing CO₂ emissions.

Our study incorporated RE to find its association with environmental pollution. There exist several studies that included other economic variables in environmental functions. Like Gozgor (2018), M. Hussain et al. (2020), Mehmood, Mansoor et al. (2021), Mehmood, Tariq et al. (2021), and Riti et al. (2017), and Sarkodie and Adams (2018). The EKC purposes that the energy is the main determinant of CO₂ emissions (Pao & Tsai, 2010), which is degrading the environment rapidly (Cetin & Bakirtas, 2020; Koçak & Şarkgüneşi, 2018). In this regard, RE has become an important alternative for industrial production to improve environmental quality Farhani and Shahbaz (2014); Sulaiman (2013). These studies proved that RE contributes to improving the environmental quality continuously. In this regard,
Khattak et al. (2020) in BRICS excluding South Africa and India and S. Nathaniel et al. (2020) in CIVETS countries proved that REIs improving the air quality. The same results were found by the studies of Elshimy and El-Aasar (2020) in Arab countries, S. P. Nathaniel and Htheonu (2019) in Africa, Mehmood (2021c) in G11 countries, Asongu et al. (2019) in the Sub Sahara region, Aziz et al. (2020) in BRICS countries and Waheed et al. (2018) in Pakistan. However, Naz et al. (2019) cannot validate EKC in Pakistan and prove the pollution haven hypothesis. Moreover, some studies found mixed results on the influences of RE on environmental degradation, like Chen et al. (2019) found diverse impacts of RE in different regions of China. Moreover, Charfeddine and Kahia (2019) found marginal impacts of RE on environmental degradation in the MENA countries from 1980 to 2015.

Hypothesis 2 (H-2): RE has significantly improved the environmental quality.

In the US a nexus between GDP and environmental degradation is observed by Menyah and Wolde-Rufael (2010). According to Szymczyk et al. (2021) CO₂ emissions are triggered because of GDP. For developing countries, a positive GDP impact on CO₂ emissions has been observed by Saidi and Ben Mbarek (2016); Saidi and Mbarek (2017). A causal relation between GDP and CO₂ emissions is observed for 16 Asian countries. In the long run, a bidirectional relationship between CO₂ emissions and economic growth was observed by (Lu, 2017). A linkage among REC, CO₂ emissions, oil prices, and GDP has been analyzed for OECD countries by Zaghdoudi (2017). It confirms the EKC hypothesis and a quadratic long-run relationship between GDP and environmental degradation.

Hypothesis 3 (H-3): GDP has a significant positive impact on CO₂ emissions.

From the above-mentioned research studies, it can be observed that most of the studies used panel estimation. This technique can bring unreliable results and it is essential to conduct country-specific analysis to present robust results for accurate policy instruments. Moreover, very few studies have analyzed individual South Asian countries. Therefore, this study will analyze the impacts of tourism and RE on CO₂ emissions in the context of EKC for individual South Asian countries.

3. Data and methodology
After careful examination of past studies, the goal of the current study is to explore the association between tourism, GDP, RE, and environmental degradation in individual South Asian countries. Moreover, this study will also reevaluate the EKC in the study region. Therefore, we included per capita CO₂ emissions (CO₂), Renewable energy (RE) as a share of total energy, numbers of arrivals (TO), GDP (G) per capita, and square of GDP (G²) per capita, and. All data from 1995 to 2020 is acquired from World Development Indicators (WDI). Further, we transformed the annual data into quarterly data because it presents robust results (Mehmood, Tariq et al., 2021; Shahbaz et al., 2013). Following is the estimated equation of our study:

\[
CO₂_t = \beta_0 + \beta_1TO_t + \beta_2G^2_t + \beta_3RE_t + \beta_4G_t + \epsilon
\]  

(1)

We utilized the ARDL method proposed by Pesaran and Pesaran (1997). The ARDL method is accompanied by an error correction term (ECT) and is capable to explore the long as well as short term dynamics (Liu et al., 2019). The ARDL model is superior to other cointegration-based methods. Such as, it provides one of the key rudiments for time series analysis known as variable stationarity. Although no stationarity testing of the selected variables is required by this method. Therefore, in the case of stationarity of all the variables at 1(0), 1(1), or a mixture of 1(0) & 1(1), the ARDL approach may be utilized (Ibrahim & Law, 2016; Mehmood, Tariq et al., 2021; Meo et al., 2018). However, one limitation of this approach is to not consider the stationarity of variables at 1(2). Moreover, the ARDL model does better results in the case of small sample sizes (Meo et al., 2018).

The ARDL model eliminates endogeneity issues, incorporates the lag length of independent as well as dependent variables, and yields consistent outcomes (Uzar, 2020). To find a long-run relationship, we prepare the following equation.
\[
\begin{align*}
\ln \text{CO}_2_t &= \beta_0 + \sum_{n=1}^{p} \delta_n \ln \text{CO}_2_{t-n} + \sum_{o=1}^{q_1} \delta_o \Delta \text{TO}_{t-o} + \sum_{p=1}^{q_2} \phi_p \Delta \text{G}_{t-p} + \sum_{r=1}^{q_3} \mu_r \Delta \text{REN}_{t-r} \\
&+ \sum_{s=1}^{q_4} \beta_s \text{G}_{t-s} + \epsilon_t 
\end{align*}
\]

For short-run analysis we follow the equation as follows:

\[
\begin{align*}
\Delta (\ln \text{CO}_2)_t &= \beta_0 + \sum_{n=1}^{p} \delta_n \Delta (\ln \text{CO}_2_{t-n}) + \sum_{o=1}^{q_1} \delta_o \Delta (\text{TO}_{t-o}) + \sum_{p=1}^{q_2} \phi_p \Delta (\text{G}_{t-p}) \\
&+ \sum_{r=1}^{q_3} \mu_r \Delta (\text{REN}_{t-r}) + \sum_{s=1}^{q_4} \beta_s \Delta (\text{G}_{t-s}) + \epsilon_t 
\end{align*}
\]

In this equation, \( \Delta \) represents the ECT and change operator, respectively.

4. Findings and discussion

To check co-integration among time series, it is essential to incorporate a unit root test (URT) to check the data stationarity. The empirical findings of the URT are reported in Table 1 at an I(0) and I(1). We conducted a stationarity test with structural breaks. These structure breaks may be due to some economic and environmental policies. Table 1 shows the stationarity of all the variables at the 1st difference, which shows the long-run association among the variables of interest for the study region. Studies by Adamu et al. (2019), Li et al. (2021), and Salehnia et al. (2020) for India, China, and MENA countries, respectively supported our results.

After the performance of the URT, it is compulsory to test the level of cointegration among variables. The current study utilized the Bounds test and presents the findings in Table 2. According to this, entire variables in Pakistan, India, and Nepal are co-integrated at a 1% level. The value of the F state ensures correlation among variables. If the F-state value is more as compared to the upper bound value so there is a strong association between variables. Moreover, a lesser F-state value as compared to the lower bound value in Sri Lanka shows no existence of co-integrated in Sri Lanka. Exploration by Aziz et al. (2020), Erdoğan et al. (2020), and Musah et al. (2021) for BRICS countries, G20 countries, and North Africa, respectively backed our findings.

The ARDL long-run results are reported in Table 3. It can be seen that RE is lowering CO₂ emissions in India, Pakistan, Nepal, and Sri Lanka. In Pakistan, India, Nepal, and Sri Lanka, a 1% increase in RE are lowering the CO₂ emissions by 0.6889%, 1.4244%, 4.2149%, and 2.358%, respectively. The empirical results of RE are in line with Aziz et al. (2020) for BRICS countries, Dogan and Seker (2016) for European Union, and Musah et al. (2021) for North Africa. The results showed that RE has the potential to lower CO₂ emissions. Our results are not similar to Charfeddine and Kahia (2019), that acquired marginal impacts of RE on CO₂ emissions. Moreover, tourism is also improving air quality in Nepal and Pakistan. But this association is not significant in the case of Pakistan. These countries need to incorporate RE sources to promote their tourism sector. Sufficient suitable outcomes will be achieved by the implementation of better communication and proper information technologies in the tourism sector. This result is similar to Aziz et al. (2020) for BRICS countries and Mehlood, Mansoor et al. (2021) for South Asian countries. Surprisingly, tourism is stimulating CO₂ emissions in India and Sri Lanka. However, the tourism-CO₂ emissions association is not significant in Sri Lanka. India needs to consider its tourist policy to contain its adverse effects on air quality. The number of arrivals in India is contributing to climatic pollution as a result of transportation. India needs to launch RE resources in the tourist sector to reduce its adverse impacts. Moreover, according to Table 3, EKC is validated in Pakistan and India. This result of the tourism-CO₂ emissions association is in line with Sharif et al. (2017), T. Hussain et al. (2018), and Mehlood, Mansoor et al. (2021). In Nepal, GDP is lowering the CO₂ emissions by 38% annually but more economic growth will start to decline air quality in Nepal. In this regard, Nepal needs to consider environmental
policies to sustain its economic growth. Nepal can overlook its environmental quality to get more economic growth in the future. Therefore, Nepal needs to check its environmental regulations while getting economic growth. In Pakistan GDP has not reached its threshold level and economic growth continues to degrade environmental quality. Currently, Pakistan is importing fossil fuels for industrial production, and the burning of fossils is contaminating its environmental quality. Pakistan needs to focus on available natural renewable resources in order to achieve sustainable development.

Table 4 reports short-run associations among our variables. In Pakistan RE use, GDP, and its square are decreasing CO2 emissions. In India, RE use and the square of GDP per capita are also lowering CO2 emissions. Tourism in India is stimulating CO2 emissions in the short run. GDP is also degrading environmental quality. In this regard, India needs to revise its economic policies to achieve sustainable development. In the context of Sri Lanka, in the short run, no significant relationship can be found between the variables. The negative ECT value validates the stability of our model.

5. Sub discussion
This study is an attempt to find out the impacts of tourism on CO2 emissions. Unlike the previous works, this work conducts a country-specific analysis by incorporating the other important variables of RE and economic growth. The results validate that tourism is environmentally friendly in Pakistan, India, and Nepal but not in Sri Lanka. These results are showing that Pakistan, India, and Nepal are improving their tourism sectors. Our results are consistent with Danish and Wang (2018), that argued that tourism is improving air quality in BRICS countries and validated EKC over the annual data of 1995–2014. A study by Ben Jebli et al. (2019) for 22 Central and South American countries also supports our findings. However, our findings are not in line with the findings of Katircioglu et al. (2020) for a small Island, Cyprus, Sheng Yin and Hussain (2021) for Southeast Asian countries. These works conducted panel studies for Cyprus and

Table 1. Stationary test

| Economy | Variable | At level | 1° difference |
|---------|----------|----------|---------------|
|         |          | T-stat   | Break year    | T-stat | Break year |
| Pakistan | lnCO2t | -1.8421 | 2003Q4 | -8.9471*** | 2007Q1 |
|         | lnRE | -3.9645 | 2002Q4 | -9.9245*** | 2007Q1 |
|         | lnG2 | -2.3964 | 2002Q4 | -11.218*** | 1996Q1 |
|         | lnG2 | -2.3276 | 2002Q4 | -9.2088*** | 1996Q1 |
|         | lnTO | -3.6178 | 2003Q4 | -9.4629*** | 2011Q1 |
| India | lnCO2t | -1.3827 | 2007Q1 | -10.6566*** | 2009Q1 |
|         | lnRE | -2.0043 | 2006Q4 | -7.9673*** | 1996Q1 |
|         | lnG2 | -1.5801 | 2002Q4 | -4.2317*** | 2002Q4 |
|         | lnG2 | -1.0937 | 2002Q4 | -4.3123*** | 2002Q4 |
|         | lnTO | -1.2402 | 2013Q4 | -16.5983*** | 2014Q1 |
| Nepal | lnCO2t | -3.2411 | 2007Q4 | -9.8851*** | 19991Q1 |
|         | lnRE | -2.9201 | 2008Q4 | -9.6504*** | 2002Q1 |
|         | lnG2 | -2.2376 | 2002Q4 | -9.7921*** | 1996Q2 |
|         | lnG2 | -2.2208 | 2007Q4 | -9.7383*** | 1996Q2 |
|         | lnTO | -2.9723 | 2006Q4 | -10.0144*** | 2015Q1 |
| Sri Lanka | lnCO2t | -2.7775 | 2008Q4 | -10.6784*** | 2015Q1 |
|         | lnRE | -3.7970 | 2009Q4 | -9.6824*** | 2006Q1 |
|         | lnG2 | -1.8323 | 2001Q4 | -11.6408*** | 1996Q2 |
|         | lnG2 | -1.6123 | 2001Q4 | -11.5828*** | 1996Q2 |
|         | lnTO | -3.4487 | 2009Q4 | -4.4813*** | 2009Q4 |

Note: ** and *** present the significance at 5 and 1% levels, respectively.
several South and East Asian countries and found that tourism is a contributing factor to environmental degradation. The results also validate the EKC’s existence in Pakistan and India.

Our results show that the Pakistani and Indian economy is on the right path because it will improve air quality in the future. These results have also been validated by Mehmood and Tariq (2020) for South Asia, Who found that the square of GDP is environmentally friendly in the presence of globalization. Similarly, Mehmood et al. (2022) support our finding that validates the existence of EKC for G-11 countries. Moreover, our results are in line with Saudi et al. (2019) for Malaysia, Ozturk et al. (2016) for the upper, middle, and high-income countries, Raza and Shah (2017) for top tourist

| Table 2. Bounds test | Economies | Pakistan | India | Nepal | Sri Lanka |
|----------------------|-----------|----------|-------|-------|-----------|
| Length of lag        | 2         | 1        | 2     | 2     |           |
| Break year           | 2003Q4    | 2007Q1   | 2007Q4| 2008Q4|           |
| F-stats              | 7.3370*** | 8.8985***| 9.7509***| 1.3152|           |
| R²                   | 0.8367    | 0.8137   | 0.7780| 0.4299|           |
| Adj- R²              | 0.7885    | 0.7669   | 0.6917| 0.3648|           |
| D.W test             | 1.5381    | 1.7116   | 1.3265| 1.9696|           |

| Diagnostic Tests     | X² NORMAL | 4.0576   | 3.0783| 20.9209| 59.9580   |
| X² SERIAL            | 3.3980    | 0.8081   | 3.2886| 0.0283|           |
| X² ARCH              | 0.4985    | 0.2551   | 0.0149| 1.5607|           |
| X² WHITE             | 2.1599    | 3.0033   | 1.4412| 5.9665|           |
| CUSUM                | Stable    | Stable   | Stable| Stable|           |
| CUSUMsq              | Stable    | Stable   | Stable| Stable|           |

| Table 3. Long run results | Economy | Variable | Coefficient | T-stat | Prob value |
|----------------------------|---------|----------|-------------|--------|------------|
| Pakistan                   | InREt   | -0.6889*** | -5.8509 | 0.0000 |
|                            | InGt    | 0.2153*** | 9.8905  | 0.0000 |
|                            | InG²t   | -1.8725*** | -9.7829 | 0.0000 |
|                            | InTOt   | -0.0144   | -0.7883 | 0.4341 |
| India                      | InREt   | -1.4243*** | -6.8756 | 0.0000 |
|                            | InGt    | 1.1311    | 1.0223  | 0.3107 |
|                            | InG²t   | -0.0740   | -0.8616 | 0.3923 |
|                            | InTOt   | 0.1230*** | 3.6702  | 0.0005 |
| Nepal                      | InREt   | -2.2149*** | -7.6737 | 0.0000 |
|                            | InGt    | -0.5230*** | -3.7970 | 0.0005 |
|                            | InG²t   | 0.5367***  | 4.5328  | 0.0000 |
|                            | InTOt   | -0.1221**  | -2.3549 | 0.0220 |
| Sri Lanka                  | InREt   | -2.3598    | -1.5238 | 0.1321 |
|                            | InGt    | -0.0232    | -0.0016 | 0.9987 |
|                            | InG²t   | 0.0285     | 0.0321  | 0.9744 |
|                            | InTOt   | 0.0460     | 0.2188  | 0.8274 |

Note: ** and *** present the significance at 5 and 1% levels, respectively.
| Economy  | Variable   | Coefficient | T stat  | P-value |
|---------|------------|-------------|---------|---------|
| Pakistan | $\ln RE_t$ | -0.7635***  | -5.7223 | 0.0000  |
|         | $\ln G_t$  | -0.9322***  | -3.7878 | 0.0004  |
|         | $\ln G^2_t$| -5.2409***  | -6.1765 | 0.0000  |
|         | $\ln TO_t$ | -0.0105     | -0.7787 | 0.4397  |
|         | ECM$^{-1}$  | -0.7249***  | -5.6703 | 0.0000  |
| India   | $\ln RE_t$ | -1.3541***  | -7.6607 | 0.0000  |
|         | $\ln G_t$  | 11.0462***  | 4.2613  | 0.0001  |
|         | $\ln G^2_t$| -1.0161***  | -5.1352 | 0.0000  |
|         | $\ln TO_t$ | 0.0932***   | 3.9884  | 0.0002  |
|         | ECM$^{-1}$  | -0.4374***  | -5.6665 | 0.0000  |
| Nepal   | $\ln RE_t$ | -7.1693***  | -8.3647 | 0.0000  |
|         | $\ln G_t$  | -2.1915     | -0.1097 | 0.9130  |
|         | $\ln G^2_t$| -7.4182***  | -3.1387 | 0.0027  |
|         | $\ln TO_t$ | -0.1000**   | -2.3850 | 0.0204  |
|         | ECM$^{-1}$  | -0.8123***  | -6.8912 | 0.0000  |
| Sri Lanka | $\ln RE_t$ | -0.8648***  | -3.2112 | 0.0020  |
|          | $\ln G_t$  | 0.8351      | 0.5134  | 0.6061  |
|          | $\ln G^2_t$| 0.0034      | 0.0324  | 0.9742  |
|          | $\ln TO_t$ | -0.0577     | -1.1362 | 0.2597  |
|          | ECM$^{-1}$  | -0.1197**   | -1.9284 | 0.0597  |

Note: ** and *** show the level of significance at 5 and 1%, respectively.
arrival countries, Menyah and Wolde-Rufael (2010) for the US, and Zaghoudi (2017) for OECD countries.

REis lowering CO₂ emissions in Pakistan, India, Nepal, and Sri Lanka. RE is mostly generated from hydro and solar energies and these sources do not hurt the environment. These findings are similar to the results of Anser et al., (2021) for BRICST countries, Mehmood (2021b) for South Asian countries, Murshed and Doo (2020), and Mehmood (2021c) for G11 countries.

6. Conclusion and policy recommendations
Over the last few decades, it has become a hot topic that countries are getting economic growth by reducing air quality. As a result, developed and developing economies are facing drastic environmental variability. South Asia is among the most vulnerable region to climatic impacts. South Asian countries are developing their tourist sector to gain economic growth. Therefore, the tourism sector can affect environmental quality in this region. Considering the gap in the literature, this study is an attempt to find out the association between tourism, RE use, and GDP in Pakistan, India, Nepal, and Sri Lanka in the context of EKC. This study utilized the ARDL approach to present empirical results. The URT confirmed that all variables are stationary at first difference. The positive value of GDP and negative value of GDP square show the existence of EKC in Pakistan and India. But in India, this association is not significant. After getting a certain level of economic growth, these countries may face improved air quality. The empirical results also endorsed the findings of past studies that RE is improving air quality by reducing CO₂ emissions in Pakistan, India, Nepal, and Sri Lanka. The findings show mixed results regarding the impacts of tourism on CO₂ emissions. Tourism is improving air quality in Pakistan and Nepal but degrading environmental quality in India. 1% increase in tourists will increase CO₂ emissions by 0.1230% in India and a 1% increase in tourists will lower CO₂ emissions by 0.0144% and 0.1231% in Pakistan and Nepal respectively, which implies that the potential effects of tourism on CO₂ emissions are not homogeneous in different countries in the same region. The specific environmental regulations facilitate bringing favorable environmental impacts.

Hence, this study proposes some important policy implications for South Asian countries in their tourist sector. These countries need to collaborate to learn from one another. In the race to get more economic development, these countries can enhance the share of RE to achieve sustainable development.

In the context of Pakistan and Nepal, this study presents that tourism can be an important factor to improve air quality. Moreover, these countries need to focus on every segment of tourism to achieve maximum sustainable economic goals. In the context of India, tourists are contaminating the environment. India needs to focus on environmentally friendly transportation. Moreover, other segments of Indian tourism need to be upgraded technologically.

Apart from the contribution, this study has some limitations. Firstly, we used CO₂ emissions as a proxy for environmental degradation variables and future research studies can utilize ecological footprints to know their association with tourism. Moreover, future research can include other economic variables for these countries, especially for Sri Lanka to present suitable environmental policies.

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