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On the Nonlinear Impact of Tourism on Environment Quality in South Asia: Evidence from the NARDL Approach

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ABSTRACT

The current study inspects the nonlinear effects of tourism (TOR), energy use, and output growth on carbon emissions in the selected South Asian (SA) countries, namely Pakistan, Nepal, Sri Lanka, and India. The empirical results are obtained by implementing the recently developed nonlinear autoregressive distributive lag (NARDL) technique covering the data spanning from 1990 to 2019. The empirical findings suggest the nonlinear effect of TOR on carbon emissions in the long run. Further, the results revealed that positive shocks in TOR have a positive and significant effect on carbon emissions in the SA region. In contrast, negative shocks in TOR mitigate carbon emissions in all SA economies except Nepal. Moreover, the results demonstrate that energy use and output growth also have a meaningful impact on carbon emissions. Based on the findings, the directions for future research and policy implications are proposed.

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1. Introduction

In the contemporary world, creating and managing a sustainable travel and tourism industry has become a critical challenge for policymakers around the globe. On the one hand, the tourism sector serves as an important element of inclusive growth and economic development by establishing a link between each sector of an economy and supporting economic broadening. Besides, the tourism industry contributes to economic growth by generating employment, enhancing income, improving ways of life, offsetting trade deficit by improving export function, and evolving the overall financial system (Chon et al. 2013; UNWTO 2017; Balsalobre-Lorente et al. 2018; Sinha et al. 2017). Furthermore, the influx of international tourists raises income levels and improves the electricity and transportation industries by expanding social, and economic goods and services (Akadiri et al. 2020).

On the other hand, the expansion of tourist activities has been closely connected to energy use and carbon dioxide emissions, having environmental repercussions (Sharif et al., 2020; Ozturk and Acaravci 2010; Khan et al., 2020). The remarkable rise in global tourist activities has fueled public debate about tourism's meaningful impact on global warming through carbon emissions ($CO_2\,em$). Although tourism is highly vulnerable to environmental alteration, it contributed 5 percent of total greenhouse gas (GHG) emissions in 2008. In contrast, transportation accounts for nearly 75 percent of total GHG emissions (United Nations World Tourism Organization). Furthermore, the tourism hospitality industry consumes a substantial amount of energy and accounts for approximately 20 percent of $CO_2\,em$. The UNWTO symposium proclaimed that carbon dioxide emissions from the hospitality industry can be lowered up to 30–40 percent by introducing innovative technologies and techniques in the tourism industry.

In an earlier study, Bach and Gößling (1996) investigated the empirical relationship between tourism development and environmental quality for the first time. They demonstrated that the tourism industry contributed substantially to environmental deterioration by escalating $CO_2\,em$ growth. Goudie and Viles (2013) also concluded the same outcome. Furthermore, with increasing tourism activities, water is excessively used, natural resources are overexploited, and the volume of wastage material at natural sites is swelling. In this respect, Chan *et al.* (2018) and Latif *et al.* (2018) reported that an increased tourist flow may lead to soil erosion, the polluted area of land pollution, water contamination, air pollution, and eventually demolishing the world's natural beauty. Tourism boosts the ratio of $CO_2\,em$ because of the increase in the consumption of electricity and transportation and building of relatively more houses (Nepal et al. 2019).

Contrary to this, some researchers advocate the proposition that the tourism industry has a positive impact on environmental quality. They argue that the tourism industry provides essential services and encourages innovation and energy proficiency for the sustainable development of a nation. As a result, touristry is considered favorable for environmental protection (Akadiri et al. 2020; Imran et al. 2014; Dogan and Aslan 2017; Gössling and Hall 2006; Paramati et al. 2018). Moreover, if the leaders of the world's economies adopt eco-friendly policies, the tourism industry may positively impact environmental quality (Ahmad et al., 2019). However, the existing empirical literature has not yet thoroughly investigated whether the tourist industry has an asymmetric/non-linear relationship with environmental quality.

Particularly, in the South Asian region, there is still a paucity of literature on the relationship between tourism development and environmental deterioration. As a result, the purpose of this research is to bridge that gap by concentrating on the non-linear/asymmetric and moderating influence of tourism on the ecological system in terms of environmental quality. The particular goals of the study to investigate the non-linear/asymmetric relation between tourism and environmental quality in South Asian (SA) economies.

In the recent decades, South Asian economies have emerged as an attractive tourist place owing to its natural beauty, cultural diversity, rich historical background, and price competitiveness. This region is home to tourism-based countries like Bhutan, Maldives, Nepal, and Sri Lanka that attract tourists from all over the world. According to, the World Economic Forum's Travel and Tourism Competitiveness Index (2019) this region has been ranked as "the most improved region since 2017." The present study explores the nonlinear hidden effects of tourism on carbon emissions in the selected countries over the period 1990-2019 by employing the recently developed nonlinear autoregressive distributive lag (NARDL) technique.

The present study contributes to the existing literature in the following ways: First, it investigates a novel concept namely the non-linear/asymmetric relationship between tourism and environmental quality instead of preceding literature that exclusively investigated linear relationships between these two variables. Second, this study provides an asymmetric analysis of each South Asia economy in a comparative setting. That is, the present research portrays a comparative picture across South Asian economies by providing a comprehensive and updated analysis about individual economies using a fresh data. In this manner, the present study fills the existing research gap on this subject matter in the South Asian region as well as at the individual country level. Third, to unveil the causal associations between the series, this study utilizes the asymmetric causal relationship. This framework helps to explore the nonlinear hidden causal effects of the selected variables. Fourth, the NARDL application is used to get the short-and-long-run empirical results for the relevant policy implications. The empirical outcome suggests that the partial sum of positive shocks in tourism adversely affects the environmental quality. These empirical findings highlight the importance of ecotourism or sustainable tourism in achieving long-term development.

The remaining study is structured as follows: Next section provides the literature review. The discussion on the methodological framework is provided in Section 3 and the description of the data is provided in section 4. Section 5 provides the discussion on empirical findings and finally, section 6 concludes the study and offers some suitable policy implications.

2. Literature Review

Finding environmentally friendly explanations for economic growth is at the heart of sustainable development. In this context, the well-known environmental Kuznets hypothesis states that economic growth hurts ecological quality during an initial stage of economic development. However, once a country reaches a certain level of income, the quality of the environment strengthens (Dasgupta et al., 2002). Several studies investigated the impact of various industries on the ecological system like Plainspoken, Olasehinde-Williams, & Alao (2019) analyzed the role of agriculture in Africa, Raza, Shah, & Sharif (2019) examined the time-frequency relationship of transport-based energy consumption in America, Haiti, (2015) studied Industrial growth in developing world. Sharif, Afshar, & Nisha (2017) inspected the role of tourism on CO2 emission in Pakistan.

Travel for pleasure is considered one of the key aspects of ecological deprivation since it involves massive energy levels for different events such as “food supplying, transportation, housing, and the management of trip-related attractions” (Saenz-de-Miera, & Rosselló,2014). Saenz-de-Miera and Rossello (2014) also identified that a rise in tourist stock added the greenhouse gas emissions in Spain and adversely affected the air concentration level with a 0.45% magnitude in PM_{10} concentration levels through the entrance of each vacationer. Solarin (2014) examined the cointegration and causality of the macroeconomic factors using a multivariate framework that included GDP, energy utilization, financial inclusion, and urbanization. Remarkably, their findings revealed that tourist inflows increased pollution but did not adequately improve the GDP. Moreover, Katircioglu (2014) found that tourist entrances had a substantial negative impact on CO2 emission both in the short term and long-term and also confirmed the Environmental Kuznets Curve hypothesis in Singapore taking the data of energy resources, urbanization, CO2 Emission, and industrialization with the help of Granger Causality test. A similar investigation was carried out by Lee and Brahmasrene (2013) in European Union Countries to analyze long-run equilibrium relationship through panel cointegration techniques and fixed-effects models and found a negatively significant impact of FDI and tourism on CO2 emissions from 1988 to 2009.

Furthermore, Ozturk, Al-Mulali, and Saboori (2016) used panel data of 144 countries over twenty years and employed the system panel generalized method of moments (GMM) and time series GMM to investigate the environmental Kuznets curve (EKC) hypothesis. The researchers took the data on ecological footprint, trade openness, energy consumption, GDP growth from tourism, and urbanization and found an indirect link between tourism growth and the ecological footprint among upper-middle and high-income countries. Another study conducted by Habibullah *et al.* (2016) took the data of international tourist arrivals in 141 countries and investigated their impact on biodiversity using numbers of threatened mammals, fishes, birds, and plants species as the proxy of biodiversity damage and population growth, Per capita Income, crop production, and protected areas as control variables. The results of the robust standard error estimator discovered biodiversity was negatively affected by tourist arrival and positively affect by the GDP per capita with the suggestions to protect the biodiversity to sustain the businesses of tourism. Moreover, France, America, Spain, Italy, the United Kingdom, Mexico, Germany, Thailand, Austria, and China being top tourist nations were selected by Katircioglu, Gokmenoglu, & Eren (2018) taking panel data from 1995–2014 to analyze the tourism-induced environmental Kuznets curve. The panel regression analysis supported that Tourism development exerted an adverse impact on the levels of ecological footprints and improved impact on the levels of environmental quality confirming the inverted U-shape of the environmental Kuznets curve.

Various econometric models of panel and time-series data have been used to investigate the dynamic relationship between trade openness and carbon dioxide emissions. Shahbaz et al. (2018) investigated the variables that contribute to CO_2 emission in Japan from 1970 to 2014 employing the ARDL model and identified that energy consumption, economic growth, and Globalization significantly contributed to carbon emissions. Similarly, a panel data analysis for 36 Sub-Saharan African countries from 1990 to 2013 was conducted by Twerefou et al. (2017) using the system General Method of Moments estimation technique and found that the effects of globalization were outweighed by the positive effects of income on environmental quality and sustainability. However, some studies identified that globalization deteriorated the harmful effects of greenhouse emissions like Lv and Xu (218) did a panel data analysis in 15 developing countries over the period from 1970 to 2012 to examine the influence of economic globalization on CO_2 emissions and found improvements in environmental situations by reducing CO_2 emissions in results of globalization. Similarly, a spatial panel data econometric model for 83 countries was estimated by You and Lv (2018) to investigate the spatial impacts of economic globalization on CO_2 emissions. The results supported an inverted-U shaped Environmental Kuznets Curve for CO_2 emissions and concluded that a relatively high globalized country had a relatively encouraging impact on CO_2 emissions.

Shakouri et al. (2017) examined the long-run relationship between CO_2 emission, energy utilization, economic growth, and tourism by estimating Environmental Kuznets Curve hypothesis in twelve Asia-Pacific countries from 1995 to 2013. The results indicate an increase in the foreign tourist enduring the climate degradation in these countries. Another study (Dogan & Aslan 2017) estimated cross-sectional dependence through a heterogeneous panel model on the data of real income, tourism, energy utilization, and greenhouse gas emissions of European Union nations. The long-run relationship among these variables was confirmed by the LM bootstrap panel cointegration test and although tourism and real income diminished the level of CO_2 emission the energy consumption contributed to climate degradation.

Similarly, the influence of the expenditure on foreign tourist transport, foreign direct investment, urban population, energy consumption, and trade openness on per capita income and CO_2 emission from 1995 to 2013 in eleven emerging economies was investigated by Zaman, Moemen, and

Islam (2017) employing panel econometric techniques and variance decomposition analysis. Their results indicated that CO2 emission had a significant positive relationship with income and tourism. Moreover, a new approach called wavelet transform framework that decomposes data into different time frequencies used by Raza *et al.* (2017) and calculated covariance, correlation, continuous power spectrum, Granger causality, and coherence spectrum to empirically study the impact of tourism development on the degradation of the environment in America taking monthly data between 1996 and 2015. The results revealed that CO2 emissions increased both in the short run and long run due to the development of the tourism industry. Likewise, Sharif, Afshar, & Nisha (2017) employed three cointegration methods to examine the time series data of tourist inflows growth and carbon dioxide (CO2) emission over 40 years and found a statistically significant impact of tourism on CO2 emission through unidirectional causality running from tourist inflows towards climate degradation.

3. Methodology

This study investigates the asymmetric effect of tourism on carbon pollution for the period 1990-2019 in the context of Pakistan, India, Nepal, and Sri Lanka by employing the NARDL estimation technique and incorporating other control variables such as energy and GDP. This technique is the extended version of the ARDL model, which is helpful to inspect the asymmetric and nonlinear linkage between tourism and carbon pollution. The model for this analysis is as follows,

$$CO_{2,t} = \beta_o + \beta_1\, TOR_t + \beta_2\, EN_t + \beta_3\, GDP_t + \epsilon_t \qquad (1)$$

Here, the equation one states that carbon dioxide emissions (CO_2) is dependent on international tourism (TOR), energy use kilowatt-hour (kwh) per capita (EN), gross domestic product growth annual (GDP), and the error term. Thus, the equation (1) shows a long-run model irrespective of using estimation technique, it offers a long-run estimate. To find the short-run and long-run estimates this study restructured the equation (1) into a framework of error correction is as follows below equation (2)

$$\Delta CO_{2,t} = \beta_o + \sum_{k=1}^{p} \theta_k\, \Delta C0_{2,t-k} + \sum_{k=0}^{p} \pi_k\, \Delta TOR_{t-k} + \sum_{k=0}^{p} \delta_k\, \Delta EN_{t-k} + \sum_{k=0}^{p} \lambda_k\, \Delta GDP_{t-k} + \alpha_1 CO_{2,t-1} + \alpha_2 TOR_{t-1} + \alpha_3 EN_{t-1} + \alpha_4 GDP_{t-1} + \epsilon_t \qquad (2)$$

The equation shows the ARDL model developed by Pesaran et al. (2001). Besides, the coefficients with symbols Δ inspects the short-run turns out while the coefficients attached with -, have been normalized on demonstrating the long-run outcomes. This estimation technique has been very suitable because it inspects both long-run and short-run findings only in one equation. Further, this technique is also used whether the order of integration I (1), I (0) or mixed order as this technique may take care of the integration variable properties.

Next, the primary aim of the investigation is to examine the asymmetric effect of TOR on carbon emissions for selected South Asian economies such as Pakistan, India, Nepal, and Sri Lanka. To achieve this objective, Shin et al. (2014) proposed method is used it disaggregates the variables into the positive or negative components. Thus, the study follows the same procedure and disaggregates the variable into a positive (TOR^{+}) part and negative (TOR^{-}) part.

$$TOR_t^{+} = \sum_{n=1}^{t} \Delta TOR_t^{+} = \sum_{n=1}^{t} max\,(\Delta TOR_t^{+},0)= \qquad (3)$$

$$TOR_t^{-} = \sum_{n=1}^{t} \Delta TOR_t^{-} = \sum_{n=1}^{t} min\,(\Delta TOR_t^{-},0)= \qquad (4)$$

After disaggregating the variables into positive or negative dynamics then this shock put in equation (2) is placed with the standard variables and this equation has taken as a nonlinear form of the ARDL model is represented as follows in equation (5)

$$\Delta CO_{2,t} = \beta_o + \sum_{k=1}^{p} \theta_k \Delta C0_{2,t-k} + \sum_{k=0}^{p} \pi_k \Delta TOR^{+}_{t-k} + \sum_{k=0}^{p} f_k \Delta TOR^{-}_{t-k} + \sum_{k=0}^{p} \delta_k \Delta EN_{t-k} + \sum_{k=0}^{p} \lambda_k \Delta GDP_{t-k} + \alpha_1 CO_{2,t-1} + \alpha_2 TOR^{+}_{t-k} + \alpha_3 TOR^{-}_{t-k} + \alpha_4 EN_{t-1} + \alpha_5 GDP_{t-1} + \epsilon_t \quad (5)$$

Here, equation (5) demonstrates the non-linear ARDL model developed by Shin et al. (2014). It is similar to the traditional ARDL. Besides, non-linear ARDL has various advantages over the outdated cointegration estimation models: for instance, firstly, it gives efficient and reliable results even in the case the sample size is small. Secondly, the stationarity test is optional because it is applicable whether the order of integration is I (1), I (0), or both except I (2). Lastly, its finding is effective even in the case of the concerned variable order is I (1), 1(0), or both. After the estimation of equation (5), this study applied various diagnostic tests, for instance, the Wald test to examine the presence of asymmetric impact of variables both in the short-run and long-run. Besides. In the short tun, the Wald test validates the existence of asymmetric impact as $\sum_k \neq \sum \pi_k$ while the long-run asymmetric effect has been confirmed by the Wald test in the case of $\alpha_2^{+}/\alpha_1 \neq \alpha_3^{-}/\alpha_1$.

4. Data

For empirical analysis, this study used annual data set over the period 1990-2019 in the context of concerned South Asian economies, for instance, Pakistan, India, Nepal, and, Sri Lanka. These South Asian economies have been selected based on the reason for a well-organized and experienced tourism sector and revealed a substantial positive effect on carbon dioxide emissions. Moreover, data of the selected variables have been taken from World Development Indicators. In our analysis, carbon dioxide emissions are a dependent variable while tourism is an independent variable. We also incorporate two control variables namely energy use and GDP. Besides, the variables description details and symbols are offered in table 1. The descriptive statistics demonstrate that India has the highest mean value of carbon emissions per capita 1.211 annually on the contrary Nepal has the lowest carbon emissions value is 0.152. However, has the top rank in emitting carbon polluting in the South Asian region. Further, the tourism and energy consumption average values for India are 6.639, and 2.662 while the average values lowest for Nepal are 5.696, and 1.873. The mean value of GDP growth per capita is 1.661 lowest for Pakistan and the highest in the case of India is 4.621.

Table 1. Explanation and Definition of the Selected Variables

Variables	Symbol	Definition	Data Source
International tourism	REM	International tourism, number of arrival person	WDI
Electric power consumption	EN	Electric power consumption (kwh per capita)	WDI
Gross domestic product	GDP	GDP per capita growth (annual %)	WDI
Carbon dioxide emissions	CO_2	CO_2 emissions (metric tons per capita)	WDI

Table 2. Descriptive Statistics				
	CO2	TOR	EN	GDP
Pakistan				
Mean	0.829	5.815	2.601	1.661
Std. dev.	0.128	0.195	0.069	1.799
India				
Mean	1.211	6.639	2.662	4.621
Std. dev.	0.374	0.312	0.152	1.984
Nepal				
Mean	0.152	5.697	1.873	3.083
Std. dev.	0.077	0.161	0.208	1.865
Sri Lanka				
Mean	0.602	5.801	2.506	4.327
Std. dev.	0.241	0.277	0.193	2.115

5. Empirical results

5.1 Outcomes of Unit Root Analysis

The first step toward the empirical analysis is to check the order of integration of the selected variables. Therefore, to examine the stationarity of the variables, the study used the ADF test and Phillip-Perron Test. The results obtained from these tests are presented in Table 3. As described earlier, four variables have been taken for the empirical analysis of four countries. According to the results of both tests, CO_2 emissions and the number of arrivals of international tourists to Pakistan are stationary at first difference while energy consumption and GDP per capita are stationary at level. In the case of India, the variable of CO_2 emissions and energy consumption have integration order one whereas GDP per capita is stationary at order zero. However, the ADF test advocates that the number of international tourists' arrival series is I (0) but the Phillip-Perron test is in favor of I(1). All selected variables of Nepal are stationary at first difference except GDP per capita which has I(0). Similar to Pakistan's data, CO2 emissions and the number of arrivals of international tourists in Sri Lanka are stationary at first difference while energy consumption and GDP per capita are stationary at level.

Table 3. Results of the unit root tests							
	Variables	ADF Test			Phillip-Perron Test		
Country		I (0)	I (1)	Decision	I (0)	I (1)	Decision
Pakistan	CO2	-0.015	-1.178***	I (1)	-0.015	-0.094**	I (1)
	TOT	-0.018	-1.092***	I (1)	-0.018	-1.092***	I (1)
	EN	-0.093**		I (0)	-0.093*		I (0)
	GDP	-0.0.643***		I (0)	-1.256***		I (0)
India	CO2	0.005	-0.959***	I (1)	0.007	-0.959***	I (1)
	TOR	-0.182**		I (0)	-0.009	-1.006***	I (1)
	EN	-0.019	-0.810***	I (1)	-0.019	-0.810***	I (1)
	GDP	-0.739***		I (0)	-0.739***		I (0)
Nepal	CO2	-0.041	-1.578***	I (1)	-0.100	-1.578***	I (1)
	TOR	-0.094	-1007***	I (1)	-0.094	-1.007***	I (1)
	EN	-0.017	-1.074***	I (1)	-0.017	-1.074***	I (1)
	GDP	-0.957***		I (0)	-0.957***		I (0)

Sri Lanka	CO2	0.028	-1.228***	I (1)	-0.028	-1.225***	I (1)
	TOR	-0.046	-0.695***	I (1)	-0.002	-0.695***	I (1)
	EN	-0.090***		I (0)	-0.032**		I (0)
	GDP	-0.759***		I (0)	-0.759***		I (0)
*Note: *, **, and *** show 10%, 5%, and 1% level of significance.*							

4.2 Asymmetric effect of tourism on CO_2 emissions based on NARDL

Outcomes of NARDL for Pakistan

The asymmetric effects of tourism on CO_2 emissions are examined with the help of the non-linear ARDL technique. For Pakistan, the results of NARDL are given in Table 4. The short-run estimates of NARDL depict that an increase in the number of international tourists raises CO_2 emissions. Similarly, energy consumption and GDP per capita also have a direct relationship with CO_2 emissions. Moreover, a positive shock in the number of tourists arrival has statistically insignificant positive effects on carbon emissions whereas a negative shock has a statistically significant positive effect on CO2 emission which reveals that tourism considerably contributes to greenhouse gas emissions in Pakistan.

Panel B of Table 4 shows the long-run estimation of NARDL for Pakistan. A positive shock in tourist arrival has a substantial positive effect on CO_2 emissions and a partial sum of negative change in international travelers in Pakistan declines CO_2 emissions. In other words, a one percent increase (decrease) in international tourists in Pakistan 0.077 percent (-0.130) increase in carbon emission. The diagnostics of NARDL given in panel C show that the overall model is statistically significant as F-stats are highly significant and adjusted R-square about 98 percent. Moreover, the Wald tests for short-run and long-run coefficients of tourism variables are also statistically significant. Furthermore, the value of the error correction term is not only negative but also statistically reliable states that a shock in the short run will annually converge to its long-run equilibrium with the speed of 0.73 percent.

Table 4: NARDL coefficient estimates in Pakistan			
Variables	**Coefficient**	**Std. Error**	**t-Statistic**
Panel A: Short-run estimates			
ΔTOR_t	0.091***	0.020	-4.550
ΔTOR_t^+	0.136	0.088	-1.539
ΔTOR_t^-	0.095***	0.030	-3.166
ΔTOR_{t-1}			
ΔEN_t	0.348***	0.082	4.243
ΔGDP_t	0.006***	0.001	4.800
ΔGDP_t-1	0.002	0.002	0.975
Panel B: Long-run estimates			
TOR_t^+	0.077***	0.026	2.961
TOR_t^-	-0.130***	0.060	-2.167
EN_t	1.826***	0.404	4.518
GDP_t	0.009***	0.003	2.812
C	-3.917***	1.022	-3.830
Panel C: Diagnostic tests			
F-test	10.803***		
ECM	-0.730***	0.143	-5.094
LM test	0.0762		
RESET	1.505		

Adj-R2	0.986		
CUSUM	S		
CUSUM squares	S		
WALD SR-TOR		2.876**	
WALD LR-TOR		3.984***	

*Note: *, **, and *** show 10%, 5%, and 1% level of significant, respectively.*

4.3 Outcomes of NARDL for India

The estimates for the asymmetric impact of the tourism industry on environmental degradation in India based on NARDL are presented in Table 5. Similar to the estimates of Pakistan, CO_2 emissions increase with an increase in international tourists in the country in the short run. As for as the long run results are concerned, a partial sum of positive shocks raises, and a partial sum of negative shocks reduces the CO_2 emission. Moreover, the magnitude of positive shock is greater than negative shock revealing that a one percent increase (decrease) in international travelers in India would cause to surge of 0.458 percent (-0.283) fatal gas. Similarly, a one percent increase in energy consumption and GDP per capita also rise CO_2 emissions by 0.035 and 0.011 percent respectively.

F-stat of the model advocates the significance of the model with a high value of adjusted R-square. Furthermore, the Wald test describes that short-run and long-run estimations for tourism are statistically reliable. Besides, the estimated value of ECM is also statistically negative and significant with 0.232 magnitude of the speed of convergence towards long-run equilibrium.

Table 5: NARDL coefficient estimates in India			
	Coefficient	**Std. Error**	**t-Statistic**
Panel A: Short-run estimates			
$\Delta \mathrm{TOR}_t$	0.106***	0.141	-2.439
$\Delta \mathrm{TOR}_t^{+}$			
$\Delta \mathrm{TOR}_t^{-}$	0.077	0.061	1.256
$\Delta \mathrm{TOR}_t$			
$\Delta \mathrm{TOR}_{t-1}$			
$\Delta \mathrm{EN}_t$	0.002	0.001	1.532
$\Delta \mathrm{GDP}_t$	-0.001	0.001	-1.332
$\Delta \mathrm{GDP}_t$-1	0.002	0.002	0.975
Panel B: Long-run estimates			
TOR_t	0.458***	0.190	2.410
TOR_t^{-}	-0.283***	-0.032	-8.611
EN_t	0.035**	0.019	1.856
GDP_t	0.011*	0.006	1.833
C	-0.196	0.220	-0.891
Panel C: Diagnostic tests			
F-test	6.205***		
ECM	-0.232***	-0.093	-2.475
LM test	1.350		
RESET	0.085		
Adj-R2	0.992		
CUSUM	S		
CUSUM squares	S		

WALD SR-TOR	3.384**	
WALD LR-TOR	7.386***	

*Note: *, **, and *** show 10%, 5%, and 1% level of significant, respectively.*

4.4 Outcomes of NARDL for Nepal

Estimates of the NARDL model for Nepal are given in Table 6. International tourists and degradation of the environment are directly related in the short run with a magnitude of 0.093. Moreover, a negative shock in tourism causes to increase in carbon emissions in the short run. Furthermore, GDP per capita and energy consumption are significant sources of greenhouse gas emissions in the short-run as well as in long run. Similarly, a partial sum of both positive and negative shocks contributes to polluting the environment in long run.

As for as the significance of the model is concerned F-test is highly significant and Wald tests for short-run and long-run tourism coefficients are acknowledged that the estimates coefficients are different from zero. Besides, the value of the adjusted R-square is very high. Moreover, the estimated value of the error correction term is not only negative but also statistically significant depicting the model converges towards its long-run equilibrium with the annual speed of 0.44 percent if any shock occurs during the short run.

Table 6: NARDL coefficient estimates in Nepal

Variables	**Coefficient**	**Std. Error**	**t-Statistic**
Panel A: Short-run estimates			
$\Delta \mathrm{TOR_t}$	0.093***	0.029	3.206
$\Delta \mathrm{TOR}_t{}^{+}$			
$\Delta \mathrm{TOR}_t{}^{-}$	0.357***	0.093	3.09
$\Delta \mathrm{TOR_{t-1}}$	-0.528***	0.176	-2.991
$\Delta \mathrm{EN_t}$	0.036***	0.013	2.769
$\Delta \mathrm{GDP_t}$	0.008***	0.003	2.34
$\Delta \mathrm{GDP_t}$-1	0.008***	0.002	2.849
Panel B: Long-run estimates			
$\Delta \mathrm{TOR}_t{}^{+}$	0.212*	0.110	1.927
$\mathrm{TOR}_t{}^{-}$	0.370*	0.194	1.909
EN_{t}	0.081***	0.017	4.764
GDP_{t}	0.060*	0.033	1.793
C	-0.196	0.220	-0.891
Panel C: Diagnostic tests			
F-test	7.169***		
ECM	-.0.440***	0.183	-2.400
LM test	1.374		
RESET	0.724		
Adj-R2	0.943		
CUSUM	S		
CUSUM squares	S		
WALD SR-URB		10.890**	
WALD LR-URB		15.032***	

*Note: *, **, and *** show 10%, 5%, and 1% level of significant, respectively.*

4.5 Outcomes of NARDL for Sri Lanka

Almost all estimated coefficients are statistically insignificant except for positive and negative shock in short-run results presented in panel A of Table 7. Positive shock and negative shock in tourism demonstrate a direct impact on CO2 emissions with 0.513 and 0.093 magnitudes respectively in the short-run in Sri Lanka. A similar trend of these shocks could be observed from panel B in long run. Nevertheless, energy consumption and GDP per capita are significant elements of environmental degradation in long run.

Similar to the results of previous countries, the F-stats of the model and Wald tests of short-run and long-run coefficients of tourism are statistically meaningful. Besides, adjusted R-square states that around 94 percent of the variation in CO_2 emission is explained by regressors. Moreover, estimated ECM is negative and significant advocates the convergence model.

Table 7: NARDL coefficient estimates in Sri Lanka

Variables	**Coefficient**	**Std. Error**	**t-Statistic**
Panel A: Short-run estimates			
ΔTOR_t	0.020	0.266	0.077
ΔTOR_t^+	0.513*	0.286	1.792
ΔTOR_t^-	-0.093***	0.016	-5.812
ΔTOR_{t-1}			
ΔEN_t	0.358	0.394	0.909
ΔGDP_t	0.005	0.002	2.380
ΔGDP_t-1			
Panel B: Long-run estimates			
TOR_t^+	0.306***	0.121	2.522
TOR_t^-	-0.283**	0.061	-1.934
EN_t	0.455***	0.211	2.156
GDP_t	0.021**	0.009	2.131
C	-0.614	1.044	-0.588
Panel C: Diagnostic tests			
F-test	7.809***		
ECM	-0.787***	0.211	-3.730
LM test	1.358		
RESET	0.857		
Adj-R2	0.942		
CUSUM	S		
CUSUM squares	S		
WALD SR-URB		2.987**	
WALD LR-URB		12.409***	

*Note: *, **, and *** show 10%, 5%, and 1% level of significant, respectively.*

4.6 Asymmetric causality among four selected variables

In Pakistan, unidirectional ono-linear causality exists from tourists' arrival to CO2 emission and from tourism to GDP per capita. Moreover, bidirectional asymmetric causality also exists between energy consumption and tourism. From energy consumption to CO2 emission, from GDP per capita to CO2 emission, and from GDP per capita to energy consumption non-linear causality exist in India as estimated from the test. Furthermore, bidirectional asymmetric causality exists between tourism and CO2 emission, and energy consumption and tourism.

Non-linear causality is observed from energy consumption to tourism and energy consumption to GDP per capita in Nepal. Similarly, tourism and CO2 emission, GDP and CO2 emission, and GDP per capita and tourism have significant bidirectional causality. Results of asymmetric causality among the variables of Sri Lanka demonstrate that unidirectional non-linear causality exists from energy consumption to CO2 emission, GDP per capita to CO2 emission, and GDP per capita to energy consumption. Besides, bidirectional asymmetric exists between tourism and CO2 emission, and energy consumption and tourism in Sri Lanka.

Table 8: Results of Symmetric Causality Test				
Null Hypothesis:	**Pakistan**	**India**	**Nepal**	**Sri Lanka**
$TOR_t^+ \rightarrow CO_2$	Yes	Yes	Yes	Yes
$CO_2 \rightarrow TOR_t^+$	No	Yes	Yes	Yes
$TOE_t^- \rightarrow CO_2$	No	Yes	No	Yes
$CO_2 \rightarrow TOR_t^-$	No	Yes	Yes	Yes
$EN \rightarrow CO_2$	No	Yes	No	Yes
$CO_2 \rightarrow EN$	No	No	No	No
$GDP \rightarrow CO_2$	No	Yes	Yes	Yes
$CO_2 \rightarrow GDP$	No	No	Yes	No
$EN \rightarrow TOR_t^+$	Yes	Yes	Yes	Yes
$TOR^+ \rightarrow EN$	Yes	Yes	No	Yes
$GDP \rightarrow TOR_t^+$	No	No	Yes	No
$TOR_t^+ \rightarrow GDP$	Yes	No	Yes	No
$EN \rightarrow TOR_t^-$	Yes	Yes	Yes	Yes
$TOR_t^- \rightarrow EN$	Yes	Yes	No	Yes
$GDP \rightarrow TOR_t^-$	No	No	Yes	No
$TOR_t^- \rightarrow GDP$	No	No	No	No
$GDP \rightarrow EN$	No	Yes	No	Yes
$EN \rightarrow GDP$	No	No	Yes	No

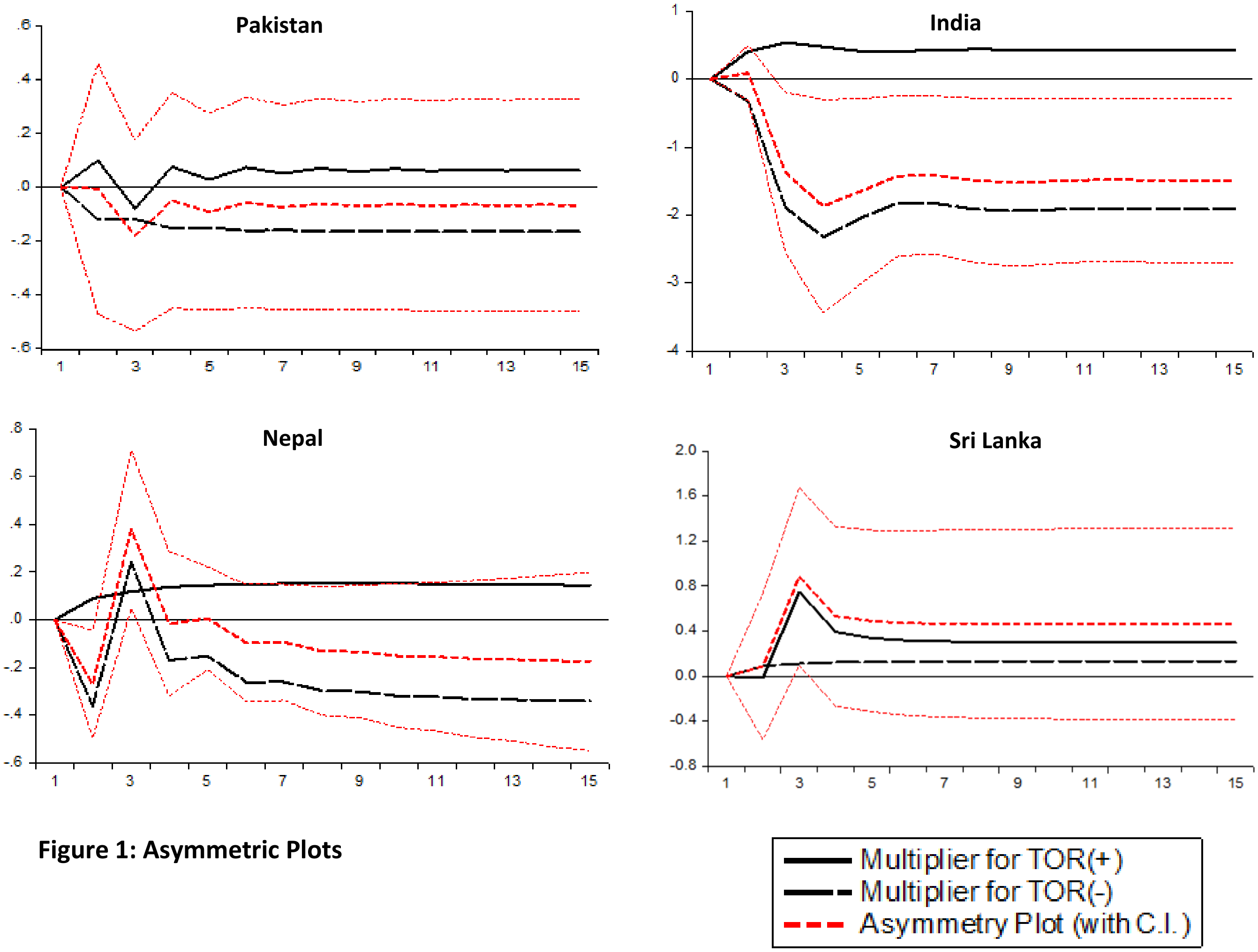

Figure 1: Asymmetric Plots

5. Results' Discussion

The asymmetric effect of tourism on CO_2 emissions in Pakistan, India, Nepal, and Sri Lanka is investigated in the study employing a non-linear ARDL model. The short-run estimated coefficients of the models show that number of international tourist arrival has a direct proportion to CO_2 emissions in Pakistan, India, Nepal, and Sri Lanka with the magnitude of 0.091, 0.106, 0.093, and 0.020 respectively. Moreover, long-run results reveal that partial sum of positive shock in tourist' arrival contributes positively and partial sum of negative shock in tourist' arrival contributes negatively to CO_2 emission in Pakistan, India, and Sri Lanka whereas in Nepal both shocks contribute positively to CO_2 emissions. Apart from that examination of the causality revealed two-way causality between tourism and environmental degradation exists in India, Nepal, and Sri Lanka while unidirectional causality exists from tourism to CO_2 emission in Pakistan. The outcome of the study is supported by Saenz-de-Miera and Rossello (2014) who identified that a rise in tourist stock added the greenhouse gas emissions in Spain and adversely affected the air concentration level and Katircioglu (2014) found that tourist entrances had a substantial negative impact on CO_2 emission both in the short term and long-term in Singapore. Furthermore, a study in European Union Countries identified a negatively significant impact of tourism on CO_2 emissions (Lee & Brahmasrene 2013).

Energy consumption also contributes to polluting the environment. For Pakistan and Nepal, the estimated coefficients of energy consumption are positive in sign and statistically significant both in the short-run and long-run, however, this coefficient is only significant in long run for India and Sri Lanka, revealing that increase in energy consumption considerably reduced environment quality of the selected countries. Moreover, energy consumption has bidirectional causality with tourism in Pakistan and India whereas it has unidirectional causality from energy consumption to CO2 emission in India. In Nepal, energy consumption has a unidirectional relationship from energy consumption to tourism and GDP per capita. Similarly, in Sri Lanka, energy consumption depicts two-way causality with tourism and unidirectional causality with CO2 emission and GDP per capita. These outcomes are consistent with Shahbaz et al. (2018) identified that energy consumption significantly contributed to carbon emissions using the ARDL approach in Japan. Moreover, Dogan and Aslan (2017) employed the LM bootstrap panel cointegration test and confirmed that although tourism and real income diminished the level of CO2 emission, the energy consumption contributed to climate degradation.

As ECK illustrates that being a developing country CO2 emission/environmental degradation increases with the increase in national income. Because Pakistan, India, Nepal, and Sri Lanka are developing nations, most of the estimated coefficients of GDP per are positive and statistically significant advocating the EKC phenomenon.

6. Conclusion and Policy Implications

The primary objective of this study is to inspect the effect of TOR on carbon emissions for the period 1990-2019 by employing nonlinear ARDL for the five SA economies. The empirical finding depicts that TOR infers a nonlinear relationship with carbon emissions. The NARDL results revealed that positive shock in TOR has a statistically significant and considerable impact on carbon emissions in the considered SA nations, i.e., PAK, SL, NEP, and IND.

At the same time, negative shocks in TOR show a substantial and negative influence on carbon emissions in SA economies in the long run. Thus, it highlights a 1% increase (decrease) in TOR could be 0.077% (0.130%) emissions in PAK, approximately 0.458% (0.283%) in IND, 0.212% (0.370%) in NEP, and 0.306% (0.283%) in SL, respectively. Also, the short-run nonlinear turnout shows a significant effect of TOR on carbon emissions. The results demonstrate that positive fluctuations in TOR positively impact carbon emissions in PAK, IND, and NEP except for SL. On the contrary, negative fluctuations in TOR also badly affect environmental pollution in the short run in PAK and NEP.

This paper concludes that SA countries need to use clean production technologies in their economic growth strategy. To mitigate environmental degradation, they should increase the percentage of renewable energy in their fuel mix relative to non-renewable energy. Because tourism harms environmental degradation, SA countries may need to exercise sustainable tourism to reap the benefits without jeopardizing environmental quality. According to our findings, the governments of PAK, IND, NEP, and SL should encourage and persuade foreign investors the investment in green and clean energy schemes to upsurge environmental quality through invention and innovation. Moreover, policymakers of these nations may improve the long-term quality of ecological health by implementing environmental laws.

Moreover, these countries should take advantage of developed countries' transportation and construction incentives. Long-term transportation and infrastructure policies in Nepal and Sri Lanka should be redesigned. In addition, well-defined transportation and construction rules in tourism regions may be adopted to improve environmental quality. There are significant differences between developed and South Asian countries regarding social, economic, institutional, infrastructure, human capital, technological, and ecological awareness (Chan et al., 2018). As a result, the tourism industry in South Asia and other developing countries should formulate a comprehensive plan to develop environment-friendly touristry products based on the innovation produced by the developed economies.

Furthermore, the most effective strategy to prevent pollution in tourist zones is to use green energy. By reducing environmental pollution, SA economies could improve their tourism sectors. The South Asian region has the potential to import and use environment-friendly tourist products currently being practiced in developed countries to contain greenhouse emissions. This study generated a potential conclusion based on various quantiles that could be studied further in the future. Future studies can focus on environmental contamination asymmetries and discrepancies in South Asian countries, which may be assessed using macroeconomic indicators.

Reference

Ahmad, F., Draz, M. U., Su, L., & Rauf, A. (2019). Taking the bad with the good: The nexus between tourism and environmental degradation in the lower middle-income Southeast Asian economies. Journal of Cleaner Production, 233, 1240-1249.

Ahuti, S. (2015). Industrial growth and environmental degradation. International Education and Research Journal, 1(5), 5-7.

Akadiri, S. S., Lasisi, T. T., Uzuner, G., & Akadiri, A. C. (2020). Examining the causal impacts of tourism, globalization, economic growth and carbon emissions in tourism island territories: bootstrap panel Granger causality analysis. Current Issues in Tourism, 23(4), 470-484.

Atzori, R., Fyall, A., & Miller, G. (2018). Tourist responses to climate change: Potential impacts and adaptation in Florida's coastal destinations. Tourism Management, 69, 12-22.

Balsalobre-Lorente, D., Shahbaz, M., Roubaud, D., & Farhani, S. (2018). How economic growth, renewable electricity and natural resources contribute to CO_2 emissions?. Energy policy, 113, 356-367.

Chan, A. P. C., Darko, A., Olanipekun, A. O., & Ameyaw, E. E. (2018). Critical barriers to green building technologies adoption in developing countries: The case of Ghana. Journal of cleaner production, 172, 1067-1079.

Chan, A. P. C., Darko, A., Olanipekun, A. O., & Ameyaw, E. E. (2018). Critical barriers to green building technologies adoption in developing countries: The case of Ghana. Journal of cleaner production, 172, 1067-1079.

Chon, K. S. (2013). Tourism in Southeast Asia: A new direction. Routledge.

Climate change and tourism, UNWTO Report. Available on the link: https://sdt.unwto.org/sites/all/files/docpdf/climate2008.pdf

Dasgupta, S., Laplante, B., Wang, H., & Wheeler, D. (2002). Confronting the environmental Kuznets curve. Journal of economic perspectives, 16(1), 147-168.

Dogan, E., & Aslan, A. (2017). Exploring the relationship among CO_2 emissions, real GDP, energy consumption and tourism in the EU and candidate countries: Evidence from panel models robust to heterogeneity and cross-sectional dependence. Renewable and Sustainable Energy Reviews, 77, 239-245.

Dogan, E., & Aslan, A. (2017). Exploring the relationship among CO_2 emissions, real GDP, energy consumption and tourism in the EU and candidate countries: Evidence from panel models robust to heterogeneity and cross-sectional dependence. Renewable and Sustainable Energy Reviews, 77, 239-245.

Dogru, T., Marchio, E. A., Bulut, U., & Suess, C. (2019). Climate change: Vulnerability and resilience of tourism and the entire economy. Tourism Management, 72, 292-305.

Gössling, S., & Hall, C. M. (2006). An introduction to tourism and global environmental change. In Tourism and global environmental change (pp. 15-48). Routledge.

Gössling, S., & Hall, C. M. (2006). An introduction to tourism and global environmental change.

In Tourism and global environmental change (pp. 15-48). Routledge.

Goudie, A. S., & Viles, H. A. (2013). The earth transformed: an introduction to human impacts on the environment. John Wiley & Sons.

Habibullah, M. S., Din, B. H., Chong, C. W., & Radam, A. (2016). Tourism and biodiversity loss: implications for business sustainability. Procedia Economics and Finance, 35, 166-172.

Imran, S., Alam, K., & Beaumont, N. (2014). Environmental orientations and environmental behaviour: Perceptions of protected area tourism stakeholders. Tourism management, 40, 290-299.

Katircioglu, S. T. (2014). Testing the tourism-induced EKC hypothesis: The case of Singapore. Economic Modelling, 41, 383-391.

Katircioglu, S., Cizreliogullari, M. N., & Katircioglu, S. (2019). Estimating the role of climate changes on international tourist flows: evidence from Mediterranean Island States. Environmental Science and Pollution Research, 26(14), 14393-14399.

Katircioglu, S., Gokmenoglu, K. K., & Eren, B. M. (2018). Testing the role of tourism development in ecological footprint quality: evidence from top 10 tourist destinations. Environmental Science and Pollution Research, 25(33), 33611-33619.

Khan, S. A. R., Yu, Z., Sharif, A., & Golpîra, H. (2020). Determinants of economic growth and environmental sustainability in South Asian Association for Regional Cooperation: evidence from panel ARDL. Environmental Science and Pollution Research, 27(36), 45675-45687.

Latif, M. T., Othman, M., Idris, N., Juneng, L., Abdullah, A. M., Hamzah, W. P., ... & Jaafar, A. B. (2018). Impact of regional haze towards air quality in Malaysia: A review. Atmospheric Environment, 177, 28-44.

Lee, J. W., & Brahmasrene, T. (2013). Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. Tourism Management, 38, 69-76.

Lv, Z., & Xu, T. (2018). Is economic globalization good or bad for environmental quality? New evidence from dynamic heterogeneous panel models. Technological Forecasting and Social Change, 137, 340-343.

Maddison, D. (2001). In search of warmer climates? The impact of climate change on flows of British tourists. Climatic change, 49(1), 193-208.

Nepal R, al Irsyad MI, Nepal SK (2019) Tourist arrivals, energy consumption and pollutant emissions in a developing economy– implications for sustainable tourism. Tour Manag 72:145–154

Olanipekun, I. O., Olasehinde-Williams, G. O., & Alao, R. O. (2019). Agriculture and environmental degradation in Africa: The role of income. Science of the Total Environment, 692, 60-67.

Ozturk, I., & Acaravci, A. (2010). CO2 emissions, energy consumption and economic growth in Turkey. Renewable and Sustainable Energy Reviews, 14(9), 3220-3225.

Ozturk, I., Al-Mulali, U., & Saboori, B. (2016). Investigating the environmental Kuznets curve hypothesis: the role of tourism and ecological footprint. Environmental Science and Pollution Research, 23(2), 1916-1928.

Paramati, S. R., Alam, M. S., & Lau, C. K. M. (2018). The effect of tourism investment on tourism development and CO2 emissions: empirical evidence from the EU nations. Journal of Sustainable Tourism, 26(9), 1587-1607.

Raza, S. A., Shah, N., & Sharif, A. (2019). Time frequency relationship between energy consumption, economic growth and environmental degradation in the United States: Evidence from transportation sector. Energy, 173, 706-720.

Raza, S. A., Sharif, A., Wong, W. K., & Karim, M. Z. A. (2017). Tourism development and environmental degradation in the United States: evidence from wavelet-based analysis. Current Issues in Tourism, 20(16), 1768-1790.

Saenz-de-Miera, O., & Rosselló, J. (2014). Modeling tourism impacts on air pollution: The case study of PM10 in Mallorca. Tourism Management, 40, 273-281.

Shahbaz, M., Shahzad, S. J. H., & Mahalik, M. K. (2018). Is globalization detrimental to CO 2 emissions in Japan? New threshold analysis. Environmental Modeling & Assessment, 23(5), 557-568.

Shakouri, B., Khoshnevis Yazdi, S., & Ghorchebigi, E. (2017). Does tourism development promote CO2 emissions?. Anatolia, 28(3), 444-452.

Sharif, A., Afshan, S., & Nisha, N. (2017). Impact of tourism on CO2 emission: evidence from Pakistan. Asia Pacific Journal of Tourism Research, 22(4), 408-421.

Sharif, A., Baris-Tuzemen, O., Uzuner, G., Ozturk, I., & Sinha, A. (2020). Revisiting the role of renewable and non-renewable energy consumption on Turkey's ecological footprint: Evidence from Quantile ARDL approach. Sustainable Cities and Society, 57, 102138.

Sinha, A., Shahbaz, M., & Balsalobre, D. (2017). Exploring the relationship between energy usage segregation and environmental degradation in N-11 countries. Journal of Cleaner Production, 168, 1217-1229.

Solarin, S. A. (2014). Tourist arrivals and macroeconomic determinants of CO2 emissions in Malaysia. Anatolia, 25(2), 228-241.

Travel and Tourism Competitiveness Report (2019). Travel and tourism at a tipping point, World Economic Forum (WEF), op-cit.

Twerefou, D. K., Danso-Mensah, K., & Bokpin, G. A. (2017). The environmental effects of economic growth and globalization in Sub-Saharan Africa: A panel general method of moments approach. Research in International Business and Finance, 42, 939-949.

UNWTO (2017) World Tourism Organization. UNWTO Tourism Highlights. UNWTO, Madrid

You, W., & Lv, Z. (2018). Spillover effects of economic globalization on CO2 emissions: a spatial panel approach. Energy Economics, 73, 248-257.

Zaman, K., Moemen, M. A. E., & Islam, T. (2017). Dynamic linkages between tourism transportation expenditures, carbon dioxide emission, energy consumption and growth factors: evidence from the transition economies. Current Issues in Tourism, 20(16), 1720-1735.