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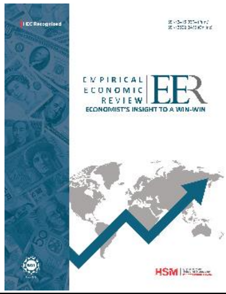

Title: **Impact of Tourism on Carbon Emission: Evidence from SAARC Countries**

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Impact of Tourism on Carbon Dioxide Emissions: Evidence from SAARC Countries

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Abstract

The current study aimed to examine the impact of tourism on carbon dioxide (CO_2) emission using the South Asian Association Regional Corporation (SAARC) countries' panel dataset spanning the time period from (1995-2014). The literature review investigated innumerable studies based on the relationship between tourism and economic growth and reported inconsistent results. However, not many studies have been conducted on SAARC countries so far. Therefore, it was essential to analyse the effect of tourism on CO_2 emission in the selected countries. The current study used an annual balanced panel dataset (1995-2014). The data was taken from the KOF Globalization Index and World Development Indicators (WDI). Pedroni cointegration test was applied to examine the presence of long-term association between candidate variables. Fully Modified Ordinary Least Square (FMOLS) test was employed to estimate the vector of cointegration in long-run. At the end, Panel Granger Causality test was applied to analyse the causality between candidate variables. The results showed the presence of a direct relationship between tourism and CO_2 emission which creates a dilemma for SAARC countries in the context of environmental degradation. Lastly, the findings of Granger Causality test revealed that one directional causality is running from tourism to CO_2 and from economic growth to CO_2 emission. The study proposed some policy recommendations of the empirical findings which may help to reap the economic gains and other benefits accruing from tourism sector and to mitigate its negative effects in the form of environmental pollution. Tourism sector is important for SAARC economies, however, it may have serious inverse environmental effects in the long-run. Therefore, the policy makers must consider this threat rising from the tourism sector.The findings would contribute

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positively to the literature and help policy makers in formulating policies to reduce the negative effects of tourism on CO_2 emission or environmental degradation.

Keywords: CO_2 emission, environment, growth, tourism

Introduction

Over the past few decades, tourism industry has grown into one of the major industries across the globe. It has experienced substantial growth not only in developed countries, but also in developing countries. Despite national and international disharmonies, political instability, natural disasters, terrorism, energy crises and economic turmoil in various regions across the globe, international tourist arrivals worldwide have grown from 166 million in 1970 to 1.4 billion in 2018 (United Nations World Tourism Organization [UNWTO], 2019).

Additionally, the international tourism industry attributed 10.4 % of the world GDP, 319 million jobs and US$ 2.8 trillion revenues in 2018 globally (World Travel and Tourism Council [WTTC], 2019). Along with these direct effects, the tourism sector offers immense positive indirect contributions to economies. However, compared to non-high-tech industries like tourism, endogenous growth theory conditions in any economy to be more favorable to its long-run growth (Tang, 2011). Nevertheless, timely earnings, that is, GDP growth, may be obtained by investing in tourism sector (Capello & Nijkamp, 2011). Modeste (1995) illustrated numerous ways through which tourism promotes the economic growth of a country, such as raising the living standards for residents, accumulating foreign exchange earnings, manufacturing of goods on a large scale, and increasing the government receipts through revenues and taxes. Moreover, by transferring income, the sector steers convergence process from developed to developing economies. Therefore, the development of tourism sector is seen as a driver of economic growth across the globe (Brida & Risso, 2009).

Although, tourism has enormous direct economic effects, it may also have a negative impact on the environment in terms of CO_2 emissions on a global scale. Tourism activities mainly involve the use of energy produced from fossil fuels directly or indirectly through electricity which is usually produced by natural gas and coal. Indeed, in addition to the positive contribution to the economic growth of a country, this sector is also linked to a deleterious natural environment (Tang et al., 2014). The linkages between environment and tourism are obvious. Firstly, tourism activities are based on natural or artificial attractions or environments as well as on the use of natural resources. Secondly, the expansion of tourism activities has environmental impacts linked either to deployment resources, or the pollution created. The United Nations Environment Program (UNEP) proclaims that tourism is a major source of greenhouse gas emissions since it is linked to CO_2 emission (Gossling et al., 2015). Additionally, a report published by UNWTO (2018), reported that tourism sector is liable for 8% of world-wide CO_2 emissions which is speculated to grow faster in future, in particular from accommodation, transportation and other tourism-related activities. Therefore, the growth of tourism sector may have a rather ominous impact on the environment.

Additionally, in accordance with the positive externalities, it becomes vital to emphasize the negative externalities related to the tourism industry. Mainly, due to its dependence on transportation, tourism industry is characterized as one of the main industries in terms of CO_2 emission (Işik et al., 2017). Besides transportation, many other services rendered by host countries to tourists involve higher amounts of energy consumption which is usually produced from non-renewable resources and thus release impressive amounts of greenhouse gases. Resultantly, tourism sector releases only 8% of the total GHG in the world (Lenzen et al., 2018). Additionally, tourism industry has intensified urbanization especially in the most popular tourist destinations, as many new natural environmental sites have been discovered across the globe. Moreover, many new work places have been created giving rise to a demand for residential sectors by locals. The residential sectors also play a substantial role in increasing pollution and CO_2 emissions.

The existing literature shows that several empirical investigations have been conducted to determine the association between economic growth and tourism. It mainly indicates a positive association between the two since tourism promotes economic growth and enhances development (Pavlic et al., 2015). While, as mentioned earlier, the interrelationship between tourism sector and climate change is linked to the consumption of energy and greenhouse gas emissions leading to pollution. However, the findings of empirical studies are mixed based on multiple factors. For instance, In many places or nations, tourism contributes to CO2 emissions through energy use, the design of tourism attractions, the creation of transportation economies, and the reduction of local and administrative service costs (de Vita et al., 2015; Gössling, 2013). On the contrary, an inverse relationship holds for many countries where tourism negatively contributes to CO_2 emission by encouraging plans and state interventions for low levels of gas emissions, adopting the use of cleaner technologies and by investing in renewable energy sources, thereby promoting environmental sustainability (Lee & Brahmasrene, 2013). Specifying the evidence with a mixed impact of tourism on gas emissions, the tourism industry is no longer considered as a "smoke free" industry accompanying the strength of environmental awareness. Therefore, it is interesting to explore whether the tourism has a significant role in explaining CO_2 emissions for SAARC countries. Currently, extensive research is available that examines the relationship between tourism and CO_2 emission for numerous countries with multiple time periods (Becken & Simmons, 2002; Davies & Cahill, 2000; Katircioglu et al., 2014; Robaina-Alves et al., 2016; Scott et al., 2010; Shakouri et al., 2017; Sharif et al., 2017).

Hence, this study proposed some important policy implications for South Asian countries in their tourist sector. These countries must collaborate to learn from one another. To achieve more economic development, these countries may enhance the share of RE to achieve sustainable development. Moreover, these countries also need to focus on every segment of tourism to achieve maximum sustainable economic goals. Tourists are polluting the environment therefore environment-friendly transportation is needed to be focused. Moreover, other segments of tourism also need to be upgraded technologically.

The current study pursued three main objectives. Firstly, it empirically examined the impact of tourism on CO_2 emission for SAARC countries. Secondly, it analyzed the impact of tourism on CO_2 emission through growth channel. Thirdly, it determined the causal linkages between tourism and CO_2 emission.

Section two of the current study briefly discussed literature. Section three described the model, methodologies, and data. Section four was based on discussion and results, whereas section five, summarizes the results and suggests some policy implications.

Literature Review

Tourism and CO_2 Emission

Literature describes the mixed results about the linkages between tourism and CO_2 emission. The current section reviewed the existing literature about tourism and environment in two sub-sections: i) direct association between tourism and CO_2 emission or environmental pollution ii) negative linkages between tourism and CO_2 emission or environmental pollution.

Direct Linkages between Tourism and CO_2 Emission

Davies and Cahill (2000) referred to three different categories to determine for the effects of tourism on environment consisting of (i) The direct impact of travel effects on a location, as well as the tourism activities such as hiking, fishing, and sailing, as well as the operation generation and the provision of amenities catering to tourists. (ii) crucial affects which result from service providers and possess the capacity to encourage the suppliers (iii) downstream effects where service providers can have an impact on the consumption patterns or behavior of custom.

Dubois et al. (2011) asserted that the international mobility trends that are coupled with the tourism and travelling related gas emission harm the natural flora around the globe. Besides, their study stated that there exists a causality between air pollution and transport-related emissions which may cause erratic climate variability, globally. Ghobadi and Verdian (2016) explored the environmental effects on tourism development in Noushahr, Iran and their results showed that there exists a connection among environmental effects and tourism. In the view of local community the level of negative impacts brought about by tourists is far from tolerable level.

Zaman et al. (2016) reported that tourism transport has a profound effect on the economic development, consumption of energy, and CO_2 emissions. They explored the influence of international tourism index, FDI inflows, energy demand, FDI inflows, trade openness, and urban population on CO_2 emission and per capita income for eleven transition economies. Their findings revealed that in the territory, international tourism expenses for travel items and earnings are linked with the intensification of per capita income and CO_2 emission. Sharif et al. (2017) examined the impact of tourism arrivals in conjunction with GDP and FDI on CO_2 emission for Pakistan. Their findings revealed that tourist arrivals and the other two predictors put a substantial positive long-term effect on the emission. Hence, tourism development appears to be the most important contributing factor to boost up emission levels.

Negative Relationship between Tourism and CO_2 Emission

Contrary to what many would anticipate that tourism has detrimental effects on the environment, the studies mentioned below determined that tourism development has not necessarily led to the increased levels of CO_2 emissions. Nepal (2008) indicates that the international tourism is among one of the most significant energy-demanding sectors in South-Africa. Transportation sector activities, mainly the aircrafts, are liable for a larger part of energy consumption and emissions producing elements connected to international tourism. Lee and Brahmasrene (2013) explored the impact of tourism on GDP growth along with CO_2 emissions in European Union (EU) nations and conjectured that tourism induces a substantial inverse effect on high CO_2 emissions. They propounded that the EU countries have been successful in effectively managing the tourism sector which brings about economic growth in conjunction with a reduction in CO_2 emission. Similar results were found by Jebli et al. (2014). They considered the interrelationship among CO_2 emissions, GDP growth, tourism arrivals and renewable energy. Their empirical findings showed that both tourist arrivals and renewable energy have significant and inverse influence on CO_2 emission. Therefore, tourism entrances would lead towards decreased CO_2 emission in the long run. Zhang and Gao (2016) explored the influence of international tourism development on GDP growth, energy consumption, and ecological degradation using China's regional data. The findings suggest that tourism suppresses the inverse effects of CO_2 emissions which is contrary to the notion to some extent that tourism sector would affect the environment adversely through CO_2 emission. The significant inverse impact of tourism on CO_2 emission reveals that an increase in tourism contributes to reducing the environmental damage.

To verify the EKC hypothesis validity in chosen Asia-Pacific countries, Shakouri et al. (2017) conducted a panel study and their results support the presence of tourism-induced EKC hypothesis for Asia-Pacific region. In the long-term, tourist arrivals would exert a significant and inverse impact on CO_2 emission. The findings of Granger causality test show the presence of a uni-directional causality moving from energy consumption to tourism and from CO_2 emission to tourism.

Tourism and Economic Growth

The linkages between tourism and GDP growth involves considerable empirical research that endeavors to pinpoint the relationship. Several scholars exposit a direct association between tourism and GDP growth (Du et al., 2016; Lanza et al., 2003; Lee & Kwon, 1995; Pavlic et al., 2015).

From a theoretical standpoint, there exists four strands of literature to unveil the association between tourism and GDP growth incorporating tourism-led growth (TLG), growth-led tourism (GLT), neutrality and response hypotheses, as well as impartiality hypothesis (Bouzahzah & El Menyari, 2013). The TLG hypothesis infers that tourism-related activities have a direct intervention in GDP growth. In the case of TLG, state must pay more attention to purifying the infrastructure, such as conveyance, accommodation and public security.

On the contrary, economic growth-led tourism (GLT) hypothesis indicates that people tend to spend more money on tourism-related activities when the economy grows. According to this perspective, if the priority of the government is to foster EG, then EG exerts a direct influence on tourism industry. This hypothesis, streaming with the economic growth to tourism activities, is verified for various countries such as: Pakistan (Jalil et al., 2013), China (He & Zheng, 2011) Central and Eastern European countries (Škrinjarić, 2019), and Taiwan (Chi & Lin, 2018).

The feedback or reciprocal hypothesis shows the presence of a response impact between tourism and EG. When this situation persists, concentrating on tourism sector alongside GDP development creates reciprocal benefits for the country. Several researchers have identified a feedback relationship between tourism and EG, for instance for Pakistan (Khalil et al., 2007), chosen small Island States (Roudi et al., 2019), China (Wang & Xia, 2013), and Singapore (Othman et al., 2012). However, in case of neutrality hypothesis not any spillover effects exist between tourism and GDP growth. Therefore, to stimulate economic growth, policy-makers should focus on other strategies (Brida et al., 2016; Lee & Chien, 2008).

According to Tang and Abosedra (2014) tourism sector produces beneficial results in public economics, particularly at a local level. It is subject to augmenting tax revenues of a country, governments increase investment in new infrastructure, such as water, sewage systems, road construction, communication networks, sanitation or health expenditures.

When investment in public sector rises again, positive externalities are generated related to technology and information with growing tourist arrivals in the long-run. However, further infrastructure expenditures from increasing tourist accommodation would necessitate additional financing for touristic facilities.

From the review of literature, it has been concluded that extensive research has been carried out on the topic with disaggregated results worldwide. Many scholars claimed a positive association between tourism and CO_2 emission, while some findings supported negative relationship between the two. The positive association maybe attributed to many factors. One major reason is the dependence of tourism sector on transportation, especially air transport which is responsible for 70 % of CO_2 emission in transportation sector (UNWTO, 2018). On the whole, studies have established a long-term association between tourism and environment, either positive or negative. However, such studies conducted on South-Asian region are clearly missing which needs to be explored. The current study aimed to cover the gap by exploring the specified association. particularly, discovering the association between tourism and CO_2 emission via channel of growth.

Methodology and Data Sources

This section comprises three parts. First section briefly explains the model spécification. The second section consist of data description. Whereas Third, discusses the estimation techniques.

Model Specification

The current study endeavored to analyze the influence of tourism on CO_2 emissions along with some other control variables in selected SAARC economies. To achieve this objective, thestudy followed Kaya identity given by Kaya and Yokobori (1997). This equation of identity concentrates on four main variables involving CO_2 emission level, per capita income, population growth, and utilization of energy per unit. The existing functional form of Kaya identity is presented in the equation below.

$$CO_2 = f(\text{POPUL, AFFLUEN, TECHN}) \quad (1)$$

This equation reflects CO_2 emission level POPUL stands for population growth, AFFLUEN stands for affluence, and TECHN stands for technology. The current study modified and expanded the Kaya identity with the inclusion of some other variables as CO_2 emission level, tourism arrivals, economic growth, and a number of control variables. The modified form of Kaya identity is presented in equation (2) as:

$$CO_2 = f\,(TOUR, Y, X) \tag{2}$$

This augmentation is helpful to observe the consequences of tourism and growth for the determination of CO_2 emission. In equation (2) CO_2 emission is a function of tourism arrivals (TOUR), economic growth (Y), and X is the set of control variables (energy intensity, urbanization, financial development, international trade, and foreign direct investment). For empirical analysis, the specified objectives were achieved by developing the following tourism-induced model using analogous approach to de Vita et al. (2015) and Shakouri et al. (2017) who considered tourism as the major determinant of CO_2 emissions. The econometric model is presented as follows:

$$CO_{2\,it} = \alpha_0 + \alpha_1 TOUR_{it} + \alpha_2 Y_{it} + \sum \alpha_k X_{k,t} + \delta_i + \varphi_t + \mu_{it} \tag{3}$$

In equation (3), the model apprehends the effect of tourism on CO_2 emission. α_0 represents the constant term whereas α_1, α_2 denote the estimated coefficients of the related variables. CO_2 is the gas of carbon dioxide , TOUR is the tourism arrivals, Y is the per capita GDP value in constant 2010 US dollars used for EG and δ_i , φ_t specifies country-specific effect and time-fixed effects, respectively. μ_{it} is the model error term which is supposed to be normally distributed. Many other factors exert a greater influence on gas emission.

To capture the effects of these factors, the Y were added as control variables. Whereas. in equation (3), $X_{k,t}$ is the k^{th} control variables vector, while α_k represents the k variables coefficients. The set of control variables include international trade, FDI, energy intensity, financial development and urbanization. The important contribution of the current study is the estimation of multiplicative interaction model, which would positively help better untangle the association between CO_2 and tourism. Therefore, to capture the impact of tourism via growth channel, the following simple multiplicative interaction model was developed.

$$CO_{2\,it} = \alpha_0 + \alpha_1 TOUR_{it} + \alpha_2 Y_{it} + \alpha_3 TOUR_{it} * Y_{it} + \sum \alpha_k X_{k,t} + \delta_i + \varphi_t + \mu_{it} \tag{4}$$

where $TOUR^*$Y is the interaction term. The explanation of parameters to be estimated is altered fundamentally with the presence of the interactive term (Brambor et al., 2006). The reason behind is that in model (3) TOUR and Y are typically taken independent of one another, whereas in model (4) they are not.

Putting differently, in the first specified model, the impact of TOUR on CO_2 is regarded as constant. While, in the latter model of multiplicative interaction, this impact is contingent on the values held by variable Y (growth). α_3 captures the effects of TOUR on CO_2 for different values of the modifying variable Y and permits this effect to vary. More specifically, the marginal effect of TOUR on CO_2 is:

$$\frac{\partial CO_2}{\partial TOUR} = \alpha_1 + \alpha_3 Y \quad (5)$$

Where,

If $\alpha_3 > 0$ then Y strengthens the tourism impact on CO_2

If $\alpha_3 < 0$ then Y weakens the tourism effect on CO_2

In other words, the conditional impact of focused variable needs to be checked pertaining to emission. Many researchers have attempted to explore the relationship between tourism and CO_2 emission (Katircioglu et al., 2014; Lee & Brahmasrene, 2016; Scott et al., 2010), EG and CO_2 emission (Selden & Song, 1995; Shahbaz et al., 2015), and tourism and EG (Jiranyakul, 2019; Lanza et al., 2003; Pavlic et al., 2015; van der Schyff et al., 2019) separately. However, no study has been conducted so far exploring the connection between tourism and CO_2 emission via growth. A few scholars have also strived to find a combined effect of tourism and growth on CO_2 emission (Solarin, 2014; Yazdi et al., 2013). Though, according to the best of researchers' acquaintance, no prior study has explored the relationship between tourism and CO_2 emission through the channel of growth by adding an interaction term.

EG comes with the development of other sectors' economy including tourism, industrialization, and development of infrastructure. Economic growth may lead the effects of tourism sector on environment to go either way, positive or negative. For instance, when tourism sector grows with economic growth, there is an increased demand for energy consumption which may determine the inverse effects on environment by raising CO_2

emissions, hence causing environmental damage (Chen et al., 2019). Following this, a polluted environment has adverse effects on people, society as well as nature. However, if economic growth is led by utilization of environment friendly technologies and resources, it reduces CO_2 emission (Holtz-Eakin & Selden, 1995). Therefore, the association between tourism and environment with EG requires much consideration.

Data Sources

The current study utilized yearly balanced panel data set(1995- 2014). The data was extracted from the globalization KOF index and WDI). This study utilized a vast amount of data, despite the fact that the data on tourism for certain SAARC countries was not available until 1995 and the data on carbon emissions was not available until 2014. Working with the data set spanning relatively longer is better, nonetheless, it maybe expected that the current study would contribute to state of the literature in order to determine the importance of tourism for tour-environment nexus. This research included following SAARC countries, such as (Pakistan, Bhutan, Bangladesh, India, Maldives, Nepal, and Sri Lanka). Afghanistan was missing in the study due to data unavailability for most of the variables under consideration. Definition and construction of variables are given below in table 1.

Table 1

Variables and their Measurements

Variables	Measurements
CO_2	It is measured as CO_2 emission thousands metric tons per capita (Lee & Brahmasrene, 2016; Shakouri et al., 2017; Solarin, 2014; Zhang & Gao, 2016).
Tourism Arrivals (TOUR)	Tourism arrivals have been used (number of tourist arrivals in millions in the sample selected countries (Dogan & Aslan, 2017; Dogan & Seker, 2016; Katircioglu, 2014).
Economic Growth (Y)	GDP per capita is the total goods and services value produced by any state domestically for a specific time period. Divided the total population by GDP per capita (Sy et al., 2016).
Energy Intensity(EI)	Energy intensity level is the calculation of energy efficiency of a country's economy constructed as the ratio between energy supply and GDP measured at purchasing power parity (Solarin et al., 2015).

Variables	Measurements
Financial development(FD)	Financial development of an economy can be measured by the expansion of financial services and operations. It is measured as a domestic credit to private sector as % of GDP (Alam et al., 2015; Mugableh, 2015; Sy et al., 2016).
Urbanization (Urb)	To capture the impact of urbanization, the proxy of urban population growth rate was used (percentage of GDP). Urban population growth is the escalation of the total number of people living in urban areas for a given period of time (Jamel & Derbali, 2016).
International Trade (TR)	It is taken as the exports and imports of goods and services summation calculated as % of GDP (Khan et al., 2014; Xie et al., 2020).
Foreign direct investment (FDI)	To measure the FDI, FDI was used (net inflows) divided by GDP (Koçak & Şarkgüneşi, 2018).

Estimation Techniques

In order to investigate the relationship between tourism and CO_2, the empirical strategy is divided into four main stages. At an initial stage, panel unit root tests are used to determine the stationarity.

At the second phase, panel cointegration test is undertaken. Similarly, at stage three, FMOLS test is accomplished to estimate the vector of cointegration in long-run. At the end, Panel Granger Causality test is carried out to analyze the causal connection among the selected variables.

The cointegration test results confirmed the long-run association among CO_2 emission, tourism, economic growth, and other control variables. However, it is vital to establish the long-run elasticities of dependent variable and independent variables. The current study utilized FMOLS) estimation technique. FMOLS was used because it extends OLS for cointegrated processes. Furthermore, the primary benefit of FMOLS is that it removes the endogeneity and serial correlation from the OLS estimators.

Results and Discussion

To analyze the possible existence of long-term connection among EG, CO_2 emission, tourism, and other control variables, the non- stationarity of variables is required at I(0) (Integrated order zero) and stationarity at I(1) (Integrated order one). For evaluation of this preliminary restriction, Harris and Tzavalis's (1999), Levin's et al. (2002), and Breitung's (2001) panel unit root tests were applied on every variable individually (see Table 2).

Table 2

Panel Unit Root Tests results

Variables	L-L-C test				BREITUNG test				Harris-Tzavalis test			
	I(0)		I(1)		I(0)		I(1)		I(0)		I(1)	
	Int	Int. & Trend	Int.	Int. & Trend	Int.	Int. & Trend	Int.	Int. & Trend	Int.	Int. & Trend	Int.	Int. & Trend
CO_2	1.0982	0.0547	-3.1584***	-3.2878***	3.3835	0.6844	-3.8254***	-2.9708**	0.9470	0.7242	0.9470***	-0.1871***
GDP	2.8918	-2.587	-3.9465***	-3.7047***	2.2336	-0.684	-2.1697**	-3.1196***	1.0062	0.5014	-0.186***	-0.0536***
TOUR	0.5949	-2.746	-5.8471***	-4.6638***	2.1010	-1.461	-2.9483**	-2.6461**	0.9957	0.6626	0.1373***	0.1930***
EI	-0.076	0.2934	-3.0849**	-2.9327**	3.3716	-0.091	-4.6197***	-2.2479**	0.9438	0.8497	-0.495***	0.4074**
FD	-1.333	0.5793	-2.8212**	-2.5603**	1.9509	0.2506	-2.2236**	-2.8151**	0.9510	0.8035	0.1588***	0.2350***
TR	-0.980	-1.027	-4.3468***	-3.4625**	0.3073	-1.230	-6.1269***	-3.7438***	0.8508	0.5788	-0.150***	0.5788***
URB	-2.259	-2.246	-3.1651***	-3.0417**	-0.854	-0.865	-2.7881**	-2.2639***	0.8454	0.7520	0.3530***	0.3657***
FDI	-1.350	-1.265	-3.9626***	-2.7666**	0.1937	-0.232	-3.2628***	-3.9732***	0.8208	0.4999	-0.176***	-0.1541***

Note. L-L-C represents Levin, Lin and chu panel unit root tests. The ***, ** and * denote significance level at one, five and ten percent respectively.

Table 2 shows the panel unit root test results (LLC, Breitung, and Harris). The findings of each test revealed that all of the selected variables were stationary at first difference level I(1) in both intercept and intercept and trend. Hence, it was concluded that all variables of the study were integrated in a similar order and it was also revealed that there exists robust confirmation for the unit root at I(0) and stationary at I(1).

Furthermore, when it becomes explicit that all selected variables of the study are stationary at I(1), then the second stage of empirical strategy follows to verify the confirmation of the long-term association. Hence, we have employed the Pedroni panel cointegration test was employed. This test has H_0 of the non- existence of cointegration in contradiction with the alternate of cointegration existence.

Table 3

Pedroni Panel Cointegration Test

	Test-Statistics	*p*
$\boldsymbol{H1}$: ***common AR coefficients*** (***within − dimension***)		
Modified variance ratio	-2.4372	0.0074
Modified Phillips − Perron *t*	2.7858	0.0027
Phillips − Perron *t*	-4.0704	0.0000
Augmented Dickey − Fuller *t*	-3.7841	0.0001
H_1: individual AR coefficients (between-dimension)		
Modified Phillips − Perron *t*	3.8703	0.0001
Phillips − Perron *t*	-5.5682	0.0000
Augmented Dickey − Fuller *t*	-4.2944	0.0000

Note. Maximum lengths are selected automatically and optimum lag length is chosen by using Akaike Information Criteria. Bartlett method is utilized as the Kernal estimator calculating the long-run error variance and band width is chosen by Newy West method.

Long-run Dynamics

The findings of cointegration test confirms the long-term connection among CO_2 emission, tourism, economic growth, and other control variables. However, it becomes vital to establish the long-term elasticities of dependent variable and independent variables. To this end, the current study used the FMOLS estimation technique which offers unbiased and consistent long-term coefficients in the model. The findings of FMOLS test for model one and model 2 are represented in Table 4.

Table 4
Panel FMOLS Test Results

Variables	Model 1		Model 2	
	Coefficients	*p*	Coefficients	*p*
lnTOUR	0.2673***	0.000	9.1171**	0.013
lnY	0.6656***	0.003	4.6603**	0.020
lnTOUR*lnY			-0.6391**	0.022
lnEI	0.2175	0.263		
lnFD	-0.7385***	0.000		
lnTR	-1.0745***	0.000	-1.3716**	0.001
lnFDI	2.0559***	0.000	2.2669**	0.002
lnURB	-.2932**	0.035	-0.3252	0.118
constant	-8.6527***	0.000	-66.5045**	0.011
Observations	140		140	
Adjusted R^2	0.6787		0.5420	

The model in Table 4 explains the effect of tourism on CO_2 emission along with GDP and a set of other control variables. Whereas, model 2 shows the influence of tourism via growth on CO_2 emission by introducing an interaction term of tourism and GDP along with the control variables of international trade, FDI and urbanization which would help to analyze the robustness of this relationship. All of the estimated coefficients turned out to be significant, except energy intensity in model 1 and urbanization in model 2, and contain the expected signs.

The results show that tourism places have a significant and direct influence on CO_2 emission in both models although the magnitude of effect changes. These results are consistent with (Dogan et al., 2017; Katircioglu et al., 2014). Tourism sector may stimulate CO_2 emissions in the SAARC countries through numerous factors, such as providing facilities for tourism, air pollution, transportation, as well as local and governmental provision of services to boost tourism. Moreover, tourist arrivals lead towards a continuous growth in tourism activities in SAARC countries. Additionally, the energy demand is increasing within diverse functions, since the value of energy is undeniable in the tourism sector (Katircioglu et al., 2014). Consequently, as the tourism sector continues growing, it progressively relies on energy. Therefore, it leads towards a rise in energy consumption. This augmented consumption of energy from tourism development impacts in deteriorating the environmental quality via CO_2 emission. It is also apparent that tourism development causes environmental degradation through hotel construction and other establishments for tourist in the sample countries.

With regard to the influence of GDP growth on CO_2 emission shown by the GDP growth coefficient which is significant and positive in both models, the coefficient indicate that EG grounds a substantial impact on CO_2 in SAARC countries. The findings are consistent with the work of Hussain et al. (2012), and Saidi and Hammami (2015). Therefore, at higher levels of income there is an increase in GDP growth leading to exert a greater impact of CO_2 emissions perhaps due to growing existence of manufacturing industries. SAARC countries are striving to shift their economies from agriculture-based to industrial-based economies, with the consequent increase in production and consumption. However, if this increased production does not accompany environment-friendly techniques, then it would leads towards increased CO_2 emission and environmental pollution (Everett et al., 2010). Moreover, when individuals and firms have high income, it may increase energy consumption from transportation, electrical devices and appliances among others which may increases the pollution level. Overall, the coefficient of GDP growth coefficient proposes that the association between EG and CO_2 emission is robust when the EG is higher.

In model 2, the interaction term of tourism and growth is inverse and significant which reveals that tourism decreases the environmental pollution when economic growth takes place in SAARC countries. It shows that when the economy grows, it paves the way for other sectors' economic development including tourism. Tourism industry flourishes with the renovation of transportation, investing in waste management and energy efficiency and plays a beneficial role with respect to the environment which, in turn, brings about the environmental preservation and conservation. This result further suggests that tourism has two effects on CO_2 emission: a positive direct effect increasing theemission and negative effect decreasing the emission through the channel of growth. Therefore, tourism sector when developed in conjunction with economic development, works to safeguard the environment and invokes environmental improvement in SAARC countries. Additionally, the marginal effects of TOUR were calculated on CO_2 emissions by the following equation.

$$\frac{\partial CO_2}{\partial TOUR} = 9.1171 - 0.6391Y \qquad (6)$$

where both parameters $\alpha_1 > 0$ and $\alpha_3 < 0$ have different signs. It indicates that the GDP growth role weakens the tourism connection with CO_2 emission. In other words, the role of GDP and tourism are substitutes in explaining the relationship with CO_2 emission.

A set of control variables was added to determine the robustness check of results. Incorporating control variables in model 2 does not erode the direct association among tourism, economic growth, and CO_2 emission. In both models tourism and growth exert a positive impact on CO_2 emission, however, the magnitude of effect changes. In model 2 both tourism and growth have a higher impact on CO_2 emission.

The coefficient for financial development turns out to be significant and negative at 1%. It shows that with the 1% increase in financial development CO_2 emission decreases by 0.74%. A possible explanation for negative coefficient of financial development is that financial sector is playing its role to perk up environment by means of financing investment ventures which are environment friendly. It not only increases the competence of all sectors, however, also saves the environment from deterioration and, hence develops the quality of life (Al-Mulali et al., 2015).

This result may further be elucidated through the government policies, preferring to support the expansion of green finance and hence, the enterprises also have a propensity to devote funds for technological innovation and projects for environmental protection. These findings are in line with Jalil and Feridun (2011), according to which SAARC countries have utilized financial development not only for capitalization, however, to improve technology as well. The coefficient of trade was found to be significant and negative with 1% level of significance. It describes that when trade increases by 1%, CO_2 emission reduces by 1.07%. This result is consistent with the work of Dogan and Turkekul (2016).

Trade may lower pollution level in SAARC countries through two separate mechanisms. Firstly, trade leads towards the expansion of economic activity, and if this expansion is led by a change in the production technique which is environment friendly, then trade would result in decreased pollution in the economy. This effect reflects the scale effect of trade on pollution. Similarly, another effect of trade is the composition effect which postulates that economies specialize in those fields where they find a comparative advantage. Liberalization of trade improves the intensive utilization of any country's plentiful factors. Subsequently, the total impact of trade on pollution in the environment relies on whether trade increases or decreases pollution-intensive activities (Grossman & Krueger, 1991). From the estimates of trade, it can be seen that SAARC countries are exploiting both of these effects to reap the positive impacts of trade on environment. Moreover, the countries are likely to take advantages of technology spillover through trade.

The association between FDI and CO_2 emissions is positive and statistically significant at 1% level of significance. A 1% increase in FDI adds on CO_2 emissions by 2.06%, keeping other factors constant. Transnational Corporation's presence in SAARC countries seems to aggravate pollution. This finding supports pollution-haven hypothesis, which asserts that multinationals, are obligated to invest in host countries via FDI from their home countries (especially to developing economies) with lax environmental regulations (Cole et al., 2005). In other words, developed countries prefer to locate their energy-intensive and dirty industries in developing or less developed countries and deteriorate the quality of environment. Lenient environmental standards and laws are the important determinants of FDI inflows for the selected South Asian countries (Sarkodie & Strezov, 2019).

The estimated coefficient for energy intensity variable turns out to be statistically insignificant, although its sign is positive as expected. The positive relationship shows that energy consumption related activities are not well-managed in South-Asian countries which lead towards an increase in CO_2 emission.

The result concerning urbanization in SAARC countries is quite intriguing, as the coefficient of urbanization is significant having a negative sign. When urbanization increases by 1%, emission reduces by 0.29%. This finding is in consonance with Sharma (2011), who established a negative link between urbanization and CO_2 emissions in case of developing countries. This outcome depicts that urbanization in SAARC countries is not liable for the increasing CO_2 emissions. Thus, environmental deterioration is not aggravated by urbanization rather the growing urbanization contributes to mitigation of CO_2.

This outcome further supports the inferences provided by Capello and Camagni (2000) and Tupy (2015), who pointed out that urbanization reduces the environmental losses in countries, as it advances the public provision. Additionally, some of the SAARC countries have tropical climate conditions, such as Sri Lanka and Maldives, where urbanization may not escalate the consumption of energy, as it does not induce the aggregation of CO_2 emissions in the small island's atmosphere (Gasimli et al., 2019).

Causality Analysis

To investigate the causal relationship between candidate variables, Dumitrescu-Hurlin causality test was employed. Inferences drawn based on this test are given in Table 5.

Table 5

Dumitrescu–Hurlin Panel Causality Test Results

Hypothesis	W-Statistics	*p* -Values	Results
GDP→ CO_2	3.4444	0.0008	Growth led emission
CO_2→GDP	0.9702	0.8004	No causality
TOUR→ CO_2	5.7365	0.0000	Tourism led emission
CO_2→TOUR	1.5504	0.5507	No causality
EI→ CO_2	5.1211	0.0000	Energy led emission
CO_2→EI	3.5853	0.0003	Emission led energy
FD→ CO_2	2.9651	0.0075	FD led emission
CO_2→FD	1.9435	0.2411	No causality
TR→ CO_2	1.7996	0.3363	No causality
CO_2→TR	2.3571	0.0754	Emission-led trade
FDI→ CO_2	1.0953	0.9445	No causality
CO_2→FDI	2.0608	0.1789	No causality
URB→ CO_2	1.9831	0.2186	No causality
CO_2→URB	2.7853	0.0162	Emission led urbanization

Table 5. depicts the findings of panel causality test and explains that GDP homogeneously cause CO_2 emission. However, no causal association exists between CO_2 emission and GDP. The results support growth-led emission hypothesis in SAARC countries which indicates uni-directional

causality running from GDP to CO_2. Similarly, tourism homogenously causes gas emission which supports tourism-led emission hypothesis, however, gas emission does not cause tourism. There exists one-way causality running from tourism to CO_2. Whereas, energy intensity and CO_2 both are causing each other indicating a bidirectional causality. This result favors feedback hypothesis between energy intensity and emission. On the other hand, financial development causes CO_2 emission, however, emission does not cause financial development representing unidirectional causality between them. Furthermore, there is no causality running from trade to emission, however, emission is causing trade indicating unidirectional causality between emission and trade in the selected sample countries. When it comes to FDI, the results explain no causality between FDI and emission confirming no feedback relationship between FDI and gas emission. Lastly, urbanization and emission results show that urbanization does not cause emission, however, causality runs from CO_2 emission to urbanization providing evidence of unidirectional causality between them for selected SAARC countries.

Conclusion

The current study empirically examined the direct and indirect impact of tourism via growth on the environmental pollution using panel-data set of selected SAARC economies for the time span (1995-2014). The results of co-integration test explained that the long run association exists among economic growth, tourism, and CO_2 emission. Furthermore, the findings of FMOLS showed that tourist arrivals have opposite effects on the environmental quality, directly and indirectly via growth. Direct influence of tourism on CO_2 emission is direct and significant causing deterioration in environment. Several factors may be responsible for this stimulating effect on CO_2 emissions in the SAARC countries including the creation of facilities for tourism, air pollution, transportation, as well as local and government provision of services for tourism expansion. Moreover, the continuous growth in tourism activities in SAARC countries would result in more demand for energy. This is because the value of energy for tourism sector is undeniable. Consequently, as the tourism sector grows, it would be increasingly dependent on energy. This boosted consumption of energy from tourism development has a deteriorating impact on the environmental quality via CO_2 emission. Whereas, the indirect impact of tourism has a negative association with the environmental degradation. Indirect effect indicates that tourism enhances the environmental quality through growth. It shows that when the economy grows, other sectors of the economy also develop including tourism. Tourism industry flourishes with the renovation of transportation, investing in waste management and energy efficiency and plays a beneficial role with respect to the environment bringing the environmental preservation and conservation. Lastly, the results of Granger causality analysis revealed that unidirectional causality runs from tourism to CO_2 and from economic growth to CO_2 emission**.**

Overall, the existing literature on the relationship between tourism and CO_2 emissions for SAARC countries is limited. However, it is need of the hour that policy makers understand the actual impact arising from national tourism policies for economic expansion through increasing tourist arrivals. It is substantial for destination countries in the region to develop a sustainable tourism strategy to reduce the inverse impacts of tourism. The results showed that tourism sector is a double-edged sword, therefore; solid steps should be taken at national level. Tourism-induced energy consumption poses a great threat in the region. However**,** energy efficiency could be a right way to mitigate CO_2 emission level. Environment-friendly technologies and use of renewable energy sources that do not depend on burning of fossil fuels in tourism sector should be introduced which would be helpful in mitigating the CO_2 emission and improving the environmental quality. To measure the impact of renewable energy on emission is a limitation here due to the nonavailability of data for some south Asian countries.

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

Data associated with this study will be provided by corresponding author upon reasonable request.

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