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TOURISM GROWTH, ECONOMIC DEVELOPMENT, AND ENVIRONMENTAL SUSTAINABILITY IN SAUDI ARABIA

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Abstract. This study investigates tourism development's economic and environmental impacts focusing on sustainability and long-term growth, among other economic indicators, in Saudi Arabia. It evaluates the Tourism-Induced Environmental Kuznets Curve (T-EKC) hypothesis, which suggests that while initial tourism growth may harm the environment, pollution levels typically decline as economies mature and adopt sustainable practices. Using Fully Modified Ordinary Least Squares (FMOLS) regression, this study analyzes the relationship between the ecological footprint and key variables—GDP per capita, squared GDP per capita, tourism expenditure per capita, energy production per capita, and trade openness—from 2002 to 2020. The results indicate that GDP and energy production per capita increase environmental pressure, while tourism expenditure also adds to the ecological footprint. Conversely, trade openness may reduce environmental impact through cleaner production practices. These findings support the T-EKC hypothesis and highlight tourism's dual economic and environmental challenges. They underscore the necessity for policy-driven strategies that effectively balance economic growth and sustainability, which aligns with Saudi Arabia's Vision 2030.

Keywords: tourism development; economic development; environmental Kuznets Curve; environmental sustainability

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1. Introduction

Tourism has long been recognized as a critical driver of economic growth, contributing significantly to GDP, employment, and foreign exchange earnings. Empirical studies illustrate a strong correlation between tourism indicators, such as expenditure, revenue, international tourist arrivals, and overall economic development (Ageli, 2013; Ali & Salameh, 2021; Emam & Ali-Dinar, 2024; Bayramli & Karimli, 2024; Awanet al., 2025).

In Saudi Arabia, tourism is a key component of Vision 2030, a strategic initiative designed to reduce oil dependence and encourage new economic sector growth (Vision 2030, 2024). However, the rapid expansion of the tourism sector also brings environmental challenges, necessitating policies that harmonize economic advantages with ecological sustainability. Notable concerns include carbon emissions from transportation, excessive water usage in the hospitality industry, and waste management challenges. Furthermore, the substantial influx of visitors to Mecca and Medina for religious tourism exacerbates these pressures, underscoring the urgency of effective sustainable management strategies. Tourism can boost economic growth, but proper management is required to avoid harming the environment (Holden, 2016; Kilinc-Ata & Barut, 2024; Segarra et al., 2024).

Saudi Arabia has introduced ambitious sustainability initiatives to address environmental challenges, including the Saudi Green Initiative (SGI) and Sustainable Tourism Global Center (STGC). These initiatives are aligned with the nation's objective of achieving net zero emissions by 2060, as outlined in Vision 2030 (Vision 2030, 2024). The country is making significant investments in renewable energy, promoting green transportation, and implementing stricter environmental regulations to minimize the ecological footprint of tourism. The private sector is also crucial in developing eco-friendly accommodations and sustainable transportation options. Notable projects, such as the Red Sea Project, which operates solely on renewable energy, and Trojena in NEOM, which integrates cutting-edge clean energy solutions, exemplify Saudi Arabia's commitment to leading the way in sustainable tourism (Vision 2030, 2024).

This study utilizes Fully Modified Ordinary Least Squares (FMOLS) regression to investigate the validity of the Tourism-Induced Environmental Kuznets Curve (T-EKC) hypothesis in Saudi Arabia, spanning 2002 to 2020. This research focuses on the ecological footprint as the dependent variable, with tourism expenditure per capita as the primary independent variable. Additional variables considered included GDP per capita, the square of GDP per capita, energy production per capita, and Trade openness. The T-EKC hypothesis expands on the broader Environmental Kuznets Curve (EKC) hypothesis by emphasizing the influence of tourism on environmental change. While the EKC examines the impact of industrialization and energy usage on environmental quality, the T-EKC suggests that initial increases in tourism may negatively impact the environment. Pollution levels decline as economies mature and adopt sustainable practices (Akadiri et al., 2021). This research adopts ecological footprint as a more holistic indicator of environmental impact rather than focusing exclusively on CO₂ emissions, thereby contributing to the growing body of literature on sustainable tourism economics.

The primary goal of this study is to analyze the relationship between tourism growth and environmental quality in Saudi Arabia, evaluate the validity of the T-EKC hypothesis within the country's economic context, and assess the effectiveness of sustainable tourism policies in mitigating environmental degradation. The study indicates that higher GDP and energy production per capita increase environmental pressure, while tourism expenditure also contributes to ecological footprint expansion. In contrast, greater trade openness can reduce environmental impact through technology transfer and cleaner production methods. The relevance of the GDP squared per capita supports the T-EKC hypothesis, suggesting that economic growth can eventually enhance environmental quality. The findings offer valuable insights for policymakers as they develop tourism strategies that align with Vision 2030. Enhancing sustainable tourism policies through investment in green infrastructure and implementing eco-friendly initiatives is essential. Expanding the adoption of renewable energy is crucial to reduce tourism emissions. Stricter regulations for pilgrimage tourism, such as mandatory carbon offsets, promotion of sustainable transportation methods, and improved waste management, can significantly mitigate its environmental impact. Moreover, encouraging eco-tourism and cultural tourism can help distribute environmental pressure evenly across regions. Investing in and trading green technologies can bolster Saudi Arabia's sustainability efforts. This study comprises four primary sections: theoretical background, research objectives and methodology, results and discussion, and conclusions.

2. Theoretical Background

The relationship between tourism and environmental degradation has been examined thoroughly using various datasets and methodological approaches. Existing literature can be categorized into three primary groups: panel studies, country-level studies, and studies focused explicitly on Saudi Arabia. This organized framework underscores the key findings and emphasizes the distinctive contributions of this research on the T-EKC in Saudi Arabia from 2002 to 2020.

Panel studies provide valuable insights into the T-EKC hypothesis by examining various countries over extended periods. Nosheen et al. (2021) focused on Asian economies using Dynamic Ordinary Least Squares (DOLS) and cointegration tests. Their findings confirm that while economic growth initially deteriorates environmental quality, it ultimately leads to improvement. They noted that tourism and energy consumption contributed significantly to increased CO₂ emissions. Similarly, Rahman et al. (2022) analyzed the top ten tourist destinations worldwide using Cointegration and Structural Autoregressive Distributed Lag (CS-ARDL) and

Average Mean Group (AMG) estimators. Their study revealed that tourism and fossil fuel consumption further exacerbated CO₂ emissions, whereas renewable energy played a crucial role in alleviating environmental degradation. Işık et al. (2020) examined G7 countries and found that the T-EKC hypothesis related to tourism was applied only to France, whereas tourism had a detrimental impact on CO₂ emissions in Italy. Azam et al. (2018) explored the T-EKC hypothesis in Malaysia, Singapore, and Thailand, uncovering contrasting results. Tourism in Malaysia was associated with increased CO₂ emissions, while in Singapore and Thailand, it was correlated with improved environmental quality due to advanced environmental regulations and green policies. Ahmad et al. (2018) analyzed the provinces involved in China's One Belt One Road (OBOR) initiative using FMOLS and cointegration tests. Their findings indicate that tourism reduces CO₂ emissions in most provinces but increases pollution in high-tourism areas.

The second category focuses on individual countries, allowing for a more in-depth examination of the relationship between tourism and the environment within specific economic and policy contexts. De Vita et al. (2015) expanded the traditional EKC model in Turkey, showing that while tourism contributes to higher emissions during the early stages of development, it later supports environmental improvements as the economy grows and cleaner technologies are adopted. Bamidele et al. (2022) examined the relationship among tourism development, energy consumption, and CO₂ emissions in Nigeria from 1995 to 2016. Researchers found that while tourism contributes to economic growth, it does not harm environmental quality. Fossil fuel-based energy consumption increases CO₂ emissions, whereas renewable energy use helps to reduce them. Their findings confirm the T-EKC hypothesis.

The third category includes studies that focus on Saudi Arabia, highlighting the environmental effects of tourism in the context of its rapidly expanding economy. As Saudi Arabia has undergone swift economic expansion and a burgeoning tourism sector, numerous investigations have explored its environmental repercussions. Li et al. (2024) examined the country's carbon emissions from 1990 to 2022 through the lens of the T-EKC framework and utilized Granger causality analysis. They identified a U-shaped correlation between economic growth and ecological decline, suggesting that, although international tourism leads to higher carbon emissions, using renewable energy helps reduce environmental damage. Tabash et al. (2023) analyzed the environmental impacts of religious tourism from 1986 to 2020 by employing the FMOLS and DOLS models. Their findings indicate that pilgrimage-related activities significantly exacerbated environmental degradation, contradicting the EKC hypothesis and supporting the Pollution Halo Hypothesis. By contrast, Emam and Ali-Dinar (2024) conducted Granger causality tests. They discovered that while tourist arrivals fostered GDP growth, they did not directly contribute to CO₂ accumulation, possibly because of practical government sustainability efforts. Ozturk et al. (2022) further reinforced that pilgrimage tourism substantially increases CO₂ emissions, revealing bidirectional causality between GDP and pollution. Finally, Faisal et al. (2024) concentrated on Saudi Arabia's sustainability initiatives from 2002 to 2020. They concluded that, while tourism expenditure did not significantly influence CO₂ emissions, energy consumption remained a critical driver of environmental degradation, with a direct relationship between GDP growth and emissions.

This study examines the connection between tourism development, economic growth, and environmental sustainability in Saudi Arabia from 2002 to 2020. It employs the ecological footprint as the dependent variable, with tourism expenditure, trade openness, GDP, GDP squared, and energy production as independent variables. Unlike earlier studies that primarily focused on CO₂ emissions, this investigation utilized the ecological footprint as a more comprehensive environmental indicator, encompassing land use, resource depletion, and carbon footprint. While previous research specific to Saudi Arabia has primarily centered on pilgrimage tourism, this study considers total tourism expenditure, offering a more comprehensive view of tourism's environmental impact. These findings align with the T-EKC hypothesis, showing that higher tourism expenditure leads to the deterioration of the ecological footprint. This finding contrasts with the results of Faisal et al. (2024), who found no significant correlation between tourism expenditure and CO₂ emissions. Furthermore, this study highlights the role of trade openness in reducing the ecological footprint, drawing attention to a factor that has often been overlooked in prior Saudi-focused EKC research.

3. Research Objectives and Methodology

3.1. Model Specification

This study explores the long-term link between environmental degradation, measured by the ecological footprint (EF), and several key economic and tourism-related factors in Saudi Arabia. These factors included GDP per capita (GDP), squared GDP per capita (GDP²), tourism expenditure per capita (Tourism), energy production per capita (EP), and trade openness (Trade). Additionally, this study examined the validity of the T-EKC hypothesis.

$EF = f(\text{Tourism}, \text{GDP}, \text{GDP}^2, \text{EP}, \text{Trade})$.

The analysis employs the FMOLS estimation technique and utilizes time series data from Saudi Arabia from 2002 to 2020.

The model is specified as follows:

$$EF = \beta_0 + \beta_1 \text{Tourism}_t + \beta_2 \text{GDP}_t + \beta_3 \text{GDP}^2_t + \beta_4 \text{EP}_t + \beta_5 \text{Trade}_t + \epsilon$$

Where ϵ : error term

The framework for this analysis is based on the T-EKC hypothesis. While the traditional EKC hypothesis investigates the relationship between economic growth and environmental quality, the T-EKC hypothesis addresses how tourism development affects environmental degradation. By integrating tourism expenditures with conventional economic indicators, this study seeks to provide deeper insight into the interplay between tourism development, economic growth, and environmental sustainability in Saudi Arabia.

The initial estimation employed Ordinary Least Squares (OLS) to analyze the relationship between the ecological footprint and its key determinants. As shown in Table 1, GDP and Tourism have a significant positive impact on the ecological footprint, while Trade has a significant negative effect. Additionally, GDP² indicated a marginally significant negative effect, and energy production per capita was not statistically significant. The goodness-of-fit test for the OLS model presented in Table 2 demonstrated a high level of explanatory power, with an R-squared value of 0.9089 and an adjusted R-squared of 0.8739, suggesting that the model accounted for a substantial portion of the variation in the ecological footprint. However, the Durbin-Watson statistic of 1.38 pointed indicates potential autocorrelation. Coupled with concerns regarding endogeneity and serial correlation, this indicates that OLS may not be suitable for accurately estimating long-term relationships in time series data.

This study uses the FMOLS technique, initially developed by Phillips and Hansen in 1990 (Ucal & Bilgin, 2009), to estimate cointegrating relationships. FMOLS corrects for serial correlation and endogeneity while adjusting for autocorrelation and heteroscedasticity, which results in unbiased and efficient parameter estimates. The FMOLS method is particularly valued for its ability to provide reliable estimates, even with small sample sizes, making it an important robustness check (Bashier & Siam, 2014). This method is particularly effective for examining the long-term relationship between the ecological footprint and its determinants, as it minimizes the potential distortions found in standard OLS regressions.

Before applying FMOLS, we verify that all variables are integrated of order one (I(1)) and that cointegration is essential. As shown in Table 3, the unit root tests reveal that the variables are non-stationary at their levels but achieve stationarity after the first differencing, thereby satisfying the I(1) condition. Furthermore, the Johansen Cointegration Rank Test presented in Table 4 confirms the presence of long-run equilibrium relationships among the variables. This evidence suggests a shared long-term movement among the variables, justifying the use of FMOLS to estimate the long-term relationship between the ecological footprint, economic growth, and tourism development in Saudi Arabia.

Table1. Ordinary Least Squares (OLS) Regression Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.070036	1.211218	-0.057823	0.9548
EF	1899904.	1254695.	1.514236	0.1539
GDP	0.000297	8.59E-05	3.456403	0.0043
GDP ²	-5.27E-09	2.53E-09	-2.081961	0.0577
Trade	-3.319251	0.772151	-4.298707	0.0009
Tourism	4.842604	1.906012	2.540700	0.0246
R-squared	0.908893	F-statistic	25.93796	
Adjusted R-squared	0.873852	Prob(F-statistic)	0.000002	

Table 2. Goodness-of-fit for the OLS model

Goodness-of-fit tests	
Durbin-Watson test	DW = 1.378150
	p-value = 0.01395
Jarque-Bera normality test	Jarque-Bera statistic=1.891660
	p-value = 0.388357
Homoscedasticity Test:Breusch-Pagan-Godfrey	F-statistic=1.0115
	p = 0.4495
Breusch-Godfrey Serial Correlation LM Test	F-statistic = 0.6903
	p-value = 0.5219

Table 3. Unit Root Test Results Using the Elliott, Rothenberg, and Stock DF-GLS

Variable		At Level	At first Difference	
		Constant	Constant	constant and trend
EF	test statistic	-1.029	-3.538	-4.099
	Test critical values:			
	1% level	2.699	-2.708	-3.770
	5% level	1.961	-1.963	-3.190
	10% level	-1.606	-1.606	-2.890
EP	test statistic	-1.082	-3.867	-4.433
	Test critical values:			
	1% level	-2.699	-2.708	-3.770
	5% level	-1.961	-1.963	-3.190
	10% level	-1.607	-1.606	-2.890
GDP	test statistic	-1.489	-3.488	-4.049
	Test critical values:			
	1% level	-2.699	-2.708	-3.770
	5% level	-1.961	-1.963	-3.190
	10% level	-1.607	-1.606	-2.890
GDP ²	test statistic	-1.446	-3.296	-3.644
	Test critical values:			
	1% level	-2.699	-2.708	-3.770
	5% level	-1.961	-1.963	-3.190
	10% level	-1.607	-1.606	-2.890
Trade	test statistic	-0.855	-2.058	-3.669
	Test critical values:			
	1% level	-2.708	-2.708	-3.770
	5% level	-1.963	-1.963	-3.190
	10% level	-1.606	-1.606	-2.890
Tourism	test statistic	-2.689	-4.527	-3.952
	Test critical values:			
	1% level	-3.770	-2.708	-3.770
	5% level	3.190	-1.963	-3.190
	10% level	-2.890	-1.606	-2.890

Table 4. Johansen Cointegration Rank Test

Null hypothesis (r)	Test Statistic	Critical Value (5%)	Decision
$r \leq 5$	9.7	9.24	Reject $r \leq 5$
$r \leq 4$	26.9	19.96	Reject $r \leq 4$
$r \leq 3$	48.78	34.91	Reject $r \leq 3$
$r \leq 2$	89.87	53.12	Reject $r \leq 2$
$r \leq 1$	641.93	76.07	Reject $r \leq 1$
$r = 0$	NaN	102.14	Not Computed

3.2. Data

Ecological footprint (EF) data were obtained from the Global Footprint Network (Global Footprint Network, n.d.). Data on tourism expenditure per capita (Tourism), GDP per capita (GDP), GDP squared per capita (GDP²), and trade openness (Trade) for 2002–2020 were sourced from the World Bank. The energy production (EP) data were retrieved from the Energy Information Administration (EIA).

EF measures human demand on Earth's ecosystems and is expressed in hectares. EF is preferred over CO₂ emissions as a primary environmental indicator because it provides a more comprehensive environmental impact assessment (Al-Malki et al., 2024). While CO₂ emissions only account for greenhouse gases from fossil fuel use, ecological footprint measures the total biologically productive area required for human activities. This broader indicator captures the cumulative effects of land use, resource extraction, and waste production, making it essential for assessing sustainability and guiding policy decisions. Tourism is the primary independent variable that measures tourism development by calculating international tourism expenditure (in current US dollars) per capita in that year. Nosheen et al. (2021) state that tourism contributes to air, water, and noise pollution. Air pollution primarily results from transportation and energy-intensive development of tourism infrastructure, such as hotels and resorts. Following these studies (Ozturk et al., 2022; Nosheen et al., 2021; Zhang et al., 2020; Adebayo et al., 2022; Saenz-de-Miera & Rosselló, 2014), this study assumes a positive correlation between tourism expenditure and ecological footprint. GDP is the total gross domestic product in current US dollars divided by population for a given year. The relationship between economic growth and environmental impacts varies across studies. Ozturk et al. (2022) suggest that GDP negatively affects CO₂ emissions, whereas other studies (Li et al., 2024; Tabash et al., 2023; Nosheen et al., 2021; Adebayo et al., 2022) indicate that GDP growth is linked to increased CO₂ emissions. This study assumes that economic growth positively affects the ecological footprint.

GDP² reflects a nonlinear and inverted U-shaped association between economic growth and environmental degradation, suggesting that a higher GDP² contributes to reducing the ecological footprint (Nosheen et al., 2021). EP was assumed to drive the ecological footprint. Ghaderi et al. Ozturk et al. (2023), Ozturk et al. (2022), and Adebayo et al. (2022) showed that energy utilization contributes to pollution. Trade measures a country's engagement in international Trade and is calculated as the sum of exports and imports relative to the GDP. This study suggests that Trade negatively affects the ecological footprint. Managi et al. (2008) contend that trade openness enhances environmental quality.

4. Results and Discussion

4.1. Descriptive and Summary Statistics

Table 5 presents the summary statistics for the EF and key independent variables. The EF showed moderate variability (mean = 3.26, std. dev.: 0.63) and a relatively normal distribution (skewness: -0.11, kurtosis: 1.84). Among the independent variables, the EP (mean = 8.83E-07, std. dev.: 8.08E-08) and GDP (mean: 18,329.24, std. dev.: 5,154.89) display slightly positive and negative skews, respectively, while GDP² (mean: 3.61E+08) suggests potential nonlinear relationships. Tourism (mean: 0.127, skew: 0.53) shows a moderately positive skew, and Trade (mean: 0.75, skew: -0.21) indicates a moderate variation in trade openness. Normality tests (Jarque-Bera) revealed no significant deviations from normality across the variables. This dataset offers

valuable opportunities to explore the drivers of ecological footprint, including the roles of energy production, GDP, tourism expenditure, and trade openness.

Table 5. Descriptive statistics of the variables.

	EF	EP	GDP	GDP ²	Tourism	Trade
Mean	3.262105	8.83E-07	18329.24	3.61E+08	0.127289	0.753716
Median	3.320000	8.69E-07	19930.41	3.97E+08	0.117988	0.795617
Maximum	4.280000	1.04E-06	24175.58	5.84E+08	0.212221	0.961026
Minimum	2.330000	7.40E-07	8380.959	70240479	0.055566	0.497135
Std. Dev.	0.632083	8.08E-08	5154.889	1.76E+08	0.046393	0.130943
Skewness	-0.107546	0.353022	-0.563866	-0.225347	0.533138	-0.205168
Kurtosis	1.840191	2.364049	2.114210	1.745295	2.331383	2.045817
Jarque-Bera	1.101543	0.714820	1.627985	1.407117	1.253993	0.854083
Probability	0.576505	0.699486	0.443086	0.494821	0.534194	0.652437
Sum	61.98000	1.68E-05	348255.5	6.86E+09	2.418488	14.32061
Sum Sq. Dev.	7.191516	1.18E-13	4.78E+08	5.57E+17	0.038742	0.308627
Observations	19	19	19	19	19	19

4.2. Model Estimation

The FMOLS estimation results in Table 6 indicate significant long-run relationships between independent variables and EF. EP and GDP positively impact EF, showing that economic growth and increased energy production lead to greater environmental pressure (Li et al., 2024; Tabash et al., 2023; Nosheen et al., 2021; Adebayo et al., 2022; Ghaderi et al., 2023; Ozturk et al., 2022). Tourism also has a strong positive effect, emphasizing its environmental costs (Ozturk et al., 2022; Nosheen et al., 2021; Zhang et al., 2020; Adebayo et al., 2022; Saenz-de-Miera & Rosselló, 2014). By contrast, Trade negatively impacts EF (Managi et al., 2008), suggesting that it may lead to cleaner technologies and efficient resource use. The marginal significance of GDP² supports the T-EKC hypothesis (Nosheen et al., 2021), suggesting that environmental decline may first increase with economic growth but then decrease after surpassing a certain threshold. The model shows strong explanatory power, with R-squared values of 0.8887 and 0.8545, confirming the robustness of long-run relationships.

Table 7 presents the goodness-of-fit tests and diagnostic checks used to assess the reliability of the FMOLS estimation. The Breusch-Godfrey serial correlation LM test confirms no serial correlation in the residuals, as the test fails to reject the null hypothesis of no autocorrelation. Additionally, the Breusch-Pagan-Godfrey Heteroskedasticity test indicates that heteroskedasticity is not present, as the null hypothesis of homoscedasticity is not rejected. These diagnostic results suggest that the FMOLS model was correctly specified and provided reliable estimates. It is a suitable method for analyzing the long-term connections among economic activity, tourism, and ecological footprint in Saudi Arabia.

Table 6. FMOLS estimation.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EP	2064358.	623915.1	3.308717	0.0057
GDP	0.000252	5.98E-05	4.217932	0.0010
GDP ²	-4.02E-09	1.89E-09	-2.124414	0.0534
Trade	-3.271224	0.564711	-5.792744	0.0001
Tourism	5.782995	1.534811	3.767887	0.0023
R-squared	0.888713	Mean dependent var	3.313333	
Adjusted R-squared	0.854471	S.D. dependent var	0.608470	
S.E. of regression	0.232121	Sum squared resid	0.700441	
Long-run variance	0.029416			

Table 7. Goodness-of-fit for the FMOLS model

Goodness-of-fit test	FMOLS model
Breusch- Serial Correlation LM Test:	p-value=0.5219
Heteroskedasticity Test: Breusch-Pagan-Godfrey	p-value=0.4495

Conclusions

This study validates the Tourism-induced Environmental Kuznets Curve (T-EKC) theory in the context of Saudi Arabia, demonstrating that tourism expenditure and economic growth initially increase ecological degradation but later contribute to environmental improvements as sustainable policies and technologies advance. The findings also highlight that energy production significantly impacts the ecological footprint, emphasizing the need for cleaner energy sources during the country's economic transition. Furthermore, trade openness reduced the ecological footprint, suggesting that greater economic integration and sustainable trade policies can support environmental sustainability in Saudi Arabia.

The key benefit of this study lies in its country-specific approach, which provides insights tailored to Saudi Arabia's unique economic and environmental landscape. Given the ambitious Vision 2030 goals, there is an urgent need for more studies that specifically utilize Saudi data, rather than applying generalized findings from other countries. Every nation has distinct economic structures, environmental policies, and tourism dynamics, making it essential to generate localized empirical evidence that aligns with the national strategies for sustainable development. However, this study has certain limitations. Data availability over a relatively short period (2002–2020) restricted the scope of the models that could be applied. Additionally, this period does not fully capture the impact of major economic disruptions, such as the COVID-19 pandemic, which has significantly affected global tourism, transportation, and economic activity. The absence of such economic shocks in the dataset may have influenced the results, warranting further research.

Another significant limitation of this study is its focus on the tourism sector. While this focus enables a comprehensive analysis of tourism's contribution to economic development and its role in Saudi Arabia's sustainable development goals, it is essential to recognize that other non-oil industries may also make substantial contributions to economic growth and environmental outcomes. Consequently, the relationship between tourism development, economic expansion, and environmental sustainability may not be unique to this sector; similar patterns could emerge in other areas of the economy. To gain a deeper understanding of the broader economic and environmental implications, future research should conduct cross-sectoral comparisons to ascertain whether tourism exhibits distinct economic-environmental dynamics or reflects more general trends associated with national development.

Future research should extend the data set to include a longer period and incorporate major economic shifts to enhance the robustness of the analysis. Moreover, advanced econometric models such as the Nonlinear Autoregressive Distributed Lag (NARDL) model can offer a more in-depth analysis of the asymmetric impacts of economic expansion and environmental changes. Additionally, incorporating renewable energy production as a key variable would offer more comprehensive policy insights and help shape sustainable tourism strategies aligned with Saudi Arabia's long-term economic and environmental goals.

By addressing these gaps, future research can provide more precise and actionable recommendations for policymakers to ensure that Saudi Arabia's tourism sector contributes to economic prosperity and environmental sustainability.

References

- Adebayo, T. S., Akadiri, S. S., Asuzu, O. C., Pennap, N. H., & Sadiq-Bamgbopa, Y. (2023). Impact of tourist arrivals on environmental quality: a way towards environmental sustainability targets. *Current Issues in Tourism*, 26(6), 958-976. <https://doi.org/10.1080/13683500.2022.2045914>
- Ageli, M. M. (2013). Tourism economics in Saudi Arabia: PP-VAR approach. *Asian Journal of Business and Management*, 1(1), 21–27. <file:///C:/Users/271/Downloads/admin,+Tourism+Economics+in+Saudi+Arabia+PP-VAR+Approach.pdf>
- Ahmad, F., Draz, M. U., Su, L., Ozturk, I., & Rauf, A. (2018). Tourism and environmental pollution: evidence from the one belt one road provinces of Western China. *Sustainability*, 10(10), 3520. <https://doi.org/10.3390/su10103520>
- Akadiri, S. S., Uzuner, G., Akadiri, A. C., & Lasisi, T. T. (2021). Environmental Kuznets curve hypothesis in the case of tourism island states: The moderating role of globalization. *International Journal of Finance & Economics*, 26(2), 2846-2858. <https://doi.org/10.1002/ijfe.1938>
- Al-Malki, A., Abid, M., Sekrafi, H., & Hamed Ahmed Alnor, N. (2024). Does globalization matter for environmental sustainability? New evidence from the QARDL approach. *Cogent Economics & Finance*, 12(1), 2306767. <https://doi.org/10.1080/23322039.2024.2306767>
- Ali, A., & Salameh, A. A. (2021). Role of travel and tourism sector in the attainment of Vision 2030 in Saudi Arabia: An analytical study. *Problems and Perspectives in Management*. [https://doi.org/10.21511/ppm.19\(2\).2021.23](https://doi.org/10.21511/ppm.19(2).2021.23)
- Awan, A., Hussain, K., Zafar, M., & Bajwa, S.U. (2025). Is tourism conducive to green growth? An investigation of the role of tourism-based economic expansion in the nexus of leisure tourism and business tourism. *Journal of Hospitality and Tourism Insights*, 8(1), 120-137. <https://doi.org/10.1108/JHTI-11-2023-0855>
- Azam, M., Alam, M. M., & Hafeez, M. H. (2018). Effect of tourism on environmental pollution: Further evidence from Malaysia, Singapore and Thailand. *Journal of Cleaner Production*, 190, 330-338. <https://doi.org/10.1016/j.jclepro.2018.04.168>
- Bashier, A. A., & Siam, A. J. (2014). Immigration and economic growth in Jordan: FMOLS approach. *International Journal of Humanities Social Sciences and Education (IJHSSE)*, 1(9), 85-92. <https://api.semanticscholar.org/CorpusID:214780840>
- Bamidele, R., Ozturk, I., Gyamfi, B. A., & Bekun, F. V. (2022). Tourism-induced pollution emission amidst energy mix: evidence from Nigeria. *Environmental Science and Pollution Research*, 1-10. <https://doi.org/10.1007/s11356-021-17233-8>
- Bayramli, G., & Karimli, T. (2024). Driving factors of CO2 emissions in South American countries: An application of Seemingly Unrelated Regression model. *Regional Sustainability*, 5(4), Article Number 100182. <http://doi.org/10.1016/j.regus.2024.100182>
- De Vita, G., Katircioglu, S., Altinay, L., Fethi, S., & Mercan, M. (2015). Revisiting the environmental Kuznets curve hypothesis in a tourism development context. *Environmental Science and Pollution Research*, 22, 16652-16663. <https://doi.org/10.1007/s11356-015-4861-4>
- Emam, A., & Ali-Dinar, H. (2024). Tourism's Influence on Economic Growth and Environment in Saudi: Present and Future. *Sustainability*. <https://doi.org/10.3390/su16219554>
- Faisal, S., Khan, A. M., Zulfikar, Z., & Bafaqeer, S. M. (2024). Saudi Arabia's Green Vision: Examining the Kingdom's Path to Sustainability, Covering Energy, Economy, Tourism, and Carbon Dynamics. *International Journal of Energy Economics and Policy*, 14(3), 154-161. <https://doi.org/10.32479/ijeep.15784>
- Ghaderi, Z., Saboori, B., & Khoshkam, M. (2023). Revisiting the environmental Kuznets curve hypothesis in the MENA region: the roles of international tourist arrivals, energy consumption and Trade openness. *Sustainability*, 15(3), 2553. <https://doi.org/10.3390/su15032553>
- Global Footprint Network. (n.d.). Country trends: Earth [Data set]. Retrieved February 23, 2025, from https://data.footprintnetwork.org/?_ga=2.252497482.2106383458.1740313602-1635043613.1733575297#/countryTrends?type=earth&cn=194
- Holden, A. (2016). *Environment and tourism*. Routledge. ISBN 9781138785762302 Pages 15 B/W Illustrations <https://www.routledge.com/Environment-and-Tourism/Holden/p/book/9781138785762?srsId=AfmBOoqTmh32JCgMQTSQKWC6t3lNB1NEGd0Zx5fkHwgSFLWXxNNhEPXe>
- İşik, C., Ahmad, M., Pata, U. K., Ongan, S., Radulescu, M., Adedoyin, F. F., Bayraktaroğlu, E., Aydın, S., & Ongan, A. (2020). An Evaluation of the Tourism-Induced Environmental Kuznets Curve (T-EKC) Hypothesis: Evidence from G7 Countries. *Sustainability*, 12(21), 9150. <https://doi.org/10.3390/su12219150>

- Kilinc-Ata, N., & Barut, A. (2024). The Influence of Tourism on the UAE's Energy-Related Climate Goals: Cointegration Analysis. *Journal of Hospitality & Tourism Education*, <https://doi.org/10.1080/10963758.2024.243306>
- Li, Y., Nassani, A. A., Al-Aiban, K. M., Rahman, S. U., Naseem, I., & Zaman, K. (2024). Beyond the numbers: Unveiling the environmental impacts of international tourism and the role of renewable energy transition. *Current Issues in Tourism*, 27(22), 3908-3923. <https://doi.org/10.1080/13683500.2024.2313057>
- Managi, S., Hibiki, A., & Tsurumi, T. (2008). Does trade liberalization reduce pollution emissions. *Discussion papers*, 8013, 2008. <https://doi.org/10.1016/j.jeem.2009.04.008>
- Ministry of Tourism Saudi Arabia. (n.d.). Sustainable Tourism Global Center and WTTC unveil pioneering global research on travel and tourism. Retrieved March 7, 2025, from <https://mt.gov.sa/about/media-center/news/157/Sustainable-Tourism-Global-Center-and-WTTC-Unveil-Pioneering-Global-Research-on-Travel-and-Tourism>
- Nosheen, M., Iqbal, J., & Khan, H. U. (2021). Analyzing the linkage among CO2 emissions, economic growth, tourism, and energy consumption in the Asian economies. *Environmental Science and Pollution Research*, 28, 16707-16719. <https://doi.org/10.1007/s11356-020-11759-z>
- Ozturk, I., Aslan, A., & Altinoz, B. (2022). Investigating the nexus between CO2 emissions, economic growth, energy consumption and pilgrimage tourism in Saudi Arabia. *Economic Research-Ekonomska Istraživanja*, 35(1), 3083-3098. <https://doi.org/10.1080/1331677X.2021.1985577>
- 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. <https://doi.org/10.1016/j.tourman.2013.06.012>
- Segarra, V., Brida, J.G., & Cárdenas-García, P.J. (2024). On the relationships between tourism demand, carbon dioxide emissions and economic growth: a literature review. *Journal of Policy Research in Tourism Leisure and Events* <https://doi.org/10.1080/19407963.2024.2331792>
- Tabash, M. I., Farooq, U., El Refae, G. A., Al-Faryan, M. A. S., & Athamena, B. (2023). Impact of religious tourism on the economic development, energy consumption and environmental degradation: evidence from the Kingdom of Saudi Arabia. *Tourism Review*, 78(3), 1004-1018. <https://doi.org/10.1108/TR-07-2022-0347>
- Ucal, M., & Bilgin, M. H. (2009). Income Inequality and FDI in Turkey: FM-OLS (Phillips-Hansen) Estimation and ARDL Approach to Cointegration. *Applied Economics*, 48(11), 1030-1045. <https://doi.org/10.1080/00036846.2015.1093081>
- Vision 2030. (2024). Saudi Green Initiative and Sustainable Tourism. <https://www.vision2030.gov.sa>
- Zhang, N., Ren, R., Zhang, Q., & Zhang, T. (2020). Air pollution and tourism development: An interplay. *Annals of Tourism Research*, 85, 103032. <https://doi.org/10.1016/j.annals.2020.103032>

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