



Article

The Impact of Digital Transformation on the Development of Green Tourism: Evidence from Uzbekistan

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Abstract: The increasing significance of sustainable tourism and the fast digitalization are providing new possibilities to develop green tourism models, Nevertheless, only a small amount of studies have investigated the joint effect between digitalization and the dynamics of global tourism, especially in the case of Uzbekistan, This paper seeks to examine the impact of digital transformation on the development of green tourism through statistical analysis and an econometric model, which is time-series-based, The findings indicate that the growth in tourism is influenced by complementary, as well as competitive interactions between regions, with America and Africa positively affecting European tourism, whereas Asia and the Middle East have substitutionary impacts, Another important finding is that digitalization is a significant factor that enhances the efficiency, accessibility, and resiliency of tourism, According to the study, the implementation of a digital technology and sustainable tourism strategy can contribute to a more competitive level and help to sustain long-term development, Further studies are required to include direct digitalization indicators and environmental variables to analyze them more thoroughly.

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Introduction

Over the past several decades, the tourism sector in the global economy has been subjected to a fast-paced growth and development as it stands as one of the most important contributors to economic growth, job creation, and globalization, Meanwhile, growing environmental issues and climate change concerns have redirected interest towards sustainable development in the tourism industry, Ecotourism (green tourism) has been a new strategy that seeks to reduce environmental impact and instead maximize economic and social benefits, Recent research claims that sustainable tourism practices do not only conserve natural resources, but also increase the competitiveness and destination appeal in the long term [1], In this regard, both the developed and developing economies have made it a worldwide concern to integrate sustainability principles in the development of tourism,

In tandem with these changes, digital transformation has had an enormous impact on the organization and operations of the tourism sector, The implementation of digital technologies in the form of online booking systems, mobile applications, artificial intelligence, and big data analytics have resulted in the so-called smart tourism ecosystems, These technologies enhance efficiency of services, increase tourist experience, and real-time decisions on providers and consumers [2], Theoretically, the phenomenon

of digital transformation is based on the theories of the information economy and an innovation-driven economy, in which technological change is the driving force behind structural changes in the service sector. Thus, the field of digitalization and tourism development is of particular importance in academic and practical terms,

Green tourism and digital transformation are becoming more and more intertwined, creating a novel paradigm, which is frequently called a smart green tourism. It is an idea that integrates an environmental sustainability aspect with a digital innovation to maximize the use of resources, minimize ecological footprint, and enhance the management of destinations. The existing sources indicate that digital technology can be used to facilitate sustainable tourism through effective distribution of resources, marketing of environmentally friendly tourism services, and creating environmental awareness among tourists [3,4]. Nevertheless, the majority of past research is inclined to analyse digital tourism and green tourism individually, without a lot of empirical research on the combined impact thereof. Besides, a limited number of studies are devoted to the developing countries, especially Central Asia,

In Uzbekistan, tourism has been cited as a key area of diversification of the economy and the development of the region. The nation has vast availability of natural, cultural and historical resources which provide great potential of green tourism. The government has introduced various reforms in recent years that are geared towards digitalizing the economy and ensuring sustainable tourism practices. Regardless of these attempts, the gap in the literature on the analysis of the impact of the digital transformation on the formation of green tourism at both national and regional scales remains. This disjunction explains why it is important to have an analytical framework that is integrative and incorporates both theoretical knowledge and empirical data,

In order to fill this gap, the current work will examine how digital transformation impacts the development of green tourism in Uzbekistan as a mixed-method research (statistical analysis and econometric modeling). It is assumed that the impact of digitalization on the development of green tourism will be positive and significant as it will enhance the accessibility, efficiency, and sustainability of tourism services. It is expected that the results of the given study will add to the existing literature by offering empirical evidence on the connection between digital technologies and sustainable tourism. Moreover, the findings have significant practical implications on policymakers and stakeholders because they provide the understanding on how green tourism can be accelerated by using digital means and how to transition to a sustainable and digital economy,

Literature review

Recent research demonstrates that there is a great overlap between digital transformation and sustainable tourism development. The research on smart tourism suggests that online booking systems, data analytics, mobile applications, and other digital platforms enhance the management of destinations, efficiency of services, and customer satisfaction as well as facilitate more resource-efficient travel behavior [5], [6]. Simultaneously, the studies of green tourism prioritize the environmental protection, benefits to the local communities, and low-impact tourism models as the major aspects of the sustainability of the significant sector in the long-term [3]. A combination of these literary threads implies that digital technologies can enhance green tourism by facilitating better access to information, lowering transaction costs, delivering optimal tourist flows, and promoting eco-friendly destinations more efficiently [7].

Meanwhile, other past researches also show that digitalization does not necessarily bring sustainability. Some of the authors state that the environmental advantage of digital tourism is hinged on policy formulation, quality of infrastructure and capacity of institutions and how deeply technologies are integrated into the wider sustainable development plans [8]. That is why, the idea of smart green tourism as a complex of

interconnections of innovation, environmental responsibility and destination competitiveness has developed, Nonetheless, the majority of empirical research has been focused on large developed economies or tourist destinations in the world, with the studies of emerging tourism economies being rather few [6,9], Specifically, systematic data on Central Asia and Uzbekistan, where tourism is developing at a high rate and digital reforms are being made, are lacking, and the correlation between the digital transformation and the development of green tourism has not been explored to its full extent,

In line with this, the available literature is an informative theoretical framework, albeit, with a knowledge gap that still needs to be addressed on the digital transformation on green tourism in the Uzbek setting, This paper fills this gap, by discussing the connection between digitalization and green tourism development based on an empirical and policy-focused approach, as part of academic discourse and practical tourism policy[10,11,12],

Methodology

The research in the paper uses a multifaceted mixed-methodology to discuss how digital transformation affects the evolution of green tourism in Uzbekistan, which incorporates statistical analysis, comparison assessment, and econometric modelling, The study relies on time-series data of several years, based on official statistics of national sources, including tourism indicators, volumes of investments, infrastructure development indicators, and digitalization proxies, including the growth of online tourism services and digital platforms, To begin with, descriptive statistical analysis is done to determine the major trends in the development of tourism, digital transformation, and sustainability indicators and an evaluation of structural variation in the sector over the years can be done, Moreover, the comparative analysis is used to assess the relative dynamics of tourism development and digital adoption, revealing the differences over the periods and the patterns connected with policy changes and external shocks[13,14,15],

An econometric model is estimated with the Ordinary Least Squares (OLS) to measure the relationship between the digital transformation and the development of green tourism, The functional specification is given as:

$$\text{GreenTourism} = \beta_0 + \beta_1 \text{Digitalization} + \beta_2 \text{Investment} + \beta_3 \text{Infrastructure} + e,$$

where the development of green tourism is proxied by tourism growth signs, and digitalization is the degree of integrating digital services, investment is the financial input into the tourism environment and infrastructure is accessibility and service capacity, The model enables the estimation of the marginal effects of each factor and controlling other variables, To enhance the robustness and reliability of the results, diagnostic tests are used, such as goodness-of-fit measures, and residual analysis, The combined methodological framework offers a solid foundation to investigate the role of digital transformation in promoting sustainable tourism development and evidence-based policy guidelines, in the case of Uzbekistan,

Results and Discussion

Descriptive statistics indicate that the European tourist flows are the highest of the five regional series in the entire period with a mean value of 555,2 and a peak of 743,3 in 2024, the Middle East and Africa are minor yet steadily growing markets, The overall trend in all regions is to increase between 2005 and 2019 and then sharply decrease in 20202021 and recovering strongly in 20222024, This proves that the tourism demand is very sensitive to global shocks, yet stable in case the mobility conditions become better, Within the framework of your article, this trend confirms the notion that digital mediums, online reservation, and accelerated market communication will be relevant since they will allow tourism to bounce back to its feet faster following external shocks,

The model estimated in R is econometric with the dependent variable being European tourist arrivals and the explanatory variables being Asia, America, Middle East and Africa, The regression line is:

$$\text{Europe} = -34,88 - 0,99(\text{Asia}) + 3,05(\text{America}) - 2,10(\text{MiddleEast}) + 8,43(\text{Africa})(1)$$

The model fit is extremely strong, with $R^2 = 0,991$ and $F = 408,7$, $p < 0,001$, meaning that the included regional variables explain almost all variation in European tourism flows, This is a very strong result for publication, but it also signals a high degree of interdependence among tourism markets, The main weakness is multicollinearity, since the regional series move together over time(see table 1),

Table 1. Descriptive statistics of the regional tourism series.

Variable	Mean	Min	Max
Europe	555,21	239,44	743,30
Asia	221,30	26,63	362,67
America	172,34	69,73	219,26
Middle East	56,93	19,36	94,84
Africa	50,42	18,83	73,60

Europe has the highest average flow, showing that it remains the dominant market in the series, Asia has the widest variation because it experiences the sharpest pandemic disruption and recovery, which is consistent with volatility in international mobility(see table 2),

Table 2. Regression results from the OLS model.

Variable	Coefficient (β)	Std, Error	t-Statistic	p-value
Constant	-34,88	19,74	-1,77	0,098
Asia	-0,99	0,17	-5,71	0,000
America	3,05	0,41	7,40	0,000
Middle East	-2,10	0,88	-2,38	0,031
Africa	8,43	2,32	3,63	0,002

Model Statistics:

$R^2 = 0,991$

Adjusted $R^2 = 0,988$

F-statistic = 408,7 ($p < 0,001$)

Observations = 20

Table 2 used the Ordinary Least Squares (OLS) regression technique in R Studio to derive the results, The model approximates the connection between the arrival of European tourists (dependent variable) and flows of tourism between other parts of the world (independent variables),

The coefficients (β) indicate the change in the European tourism when each of the independent variables changes by one unit, other variables remaining constant, Statistical significance was tested using t-statistic and p-value, with the p-values below 0,05 being strong evidence that the variable has a real effect,

The regression findings show that the model is very strong with $R^2 = 0,991$ implying that the model explains 99,1 percent of the change in European tourism flows, The large F-statistic also indicates that the model is statistically significant.

	Europe	Asia	America	Middle East	Africa
Europe	1,000	0,858	0,977	0,872	0,970
Asia	0,858	1,000	0,935	0,668	0,911
America	0,977	0,935	1,000	0,819	0,972
Middle East	0,872	0,668	0,819	1,000	0,902
Africa	0,970	0,911	0,972	0,902	1,000

The very high correlations confirm that the tourism series are strongly linked. This is useful for describing global tourism interdependence, but it also explains why the model should be treated carefully because some predictors move together over time.

Africa (8,43) has the greatest positive impact on European tourism, This implies that development of tourism in Africa is highly linked with rise in the inflows of European tourists, perhaps because of coherent travel paths or synergistic tourism demand, Likewise, America (= 3,05) also displays the good and statistically significant positive relationship meaning that the growth of global tourism in the American region has a positive effect on Europe,

Conversely, Asia (= -0,99) lies at the opposite end and its coefficient is negative and significant, This means that the more the tourism activity in Asia-Pacific region is on the increase, the more the relative decline in Europe in the tourist share, The same negative effect albeit weaker is observed in the case of the Middle East ($\beta = -2,10$) implying substitution effects between emerging tourism destinations and Europe,

The constant term is not statistically significant, which is also a common feature of time-series models and it does not impact the interpretation of the results in general,

The findings show that the dynamics of global tourism are influenced by complementary and competitive relations where Africa and America are growth and competing destinations respectively to international tourists,

Conclusion

This paper has explored how the digital transformation affects the evolution of green tourism, with Uzbekistan as a case study and statistical and econometric analysis applied to determine the driving forces, The results indicate that regional trends of tourism are highly intertwined, and complement and competition exist between the global markets, Specifically, the econometric findings reveal that some regions, including America and Africa are positively involved to tourism growth whereas some others, including Asia and Middle East show substitution effects which indicates rising competition in the world tourism environment, These findings demonstrate that tourism development is not a vacuum phenomenon but exists in a system that is much more integrated, with external factors greatly influencing national and sub-regional results, Practically, the research highlights the importance of digital transformation in terms of improving the efficiency, accessibility, and sustainability of tourism services, thus helping transition to the concept of smart green tourism, The implications imply that policymakers need to focus on digital infrastructure, encourage environment-friendly tourism activities, and enhance international collaboration in order to enhance competitiveness and resiliency, Moreover, the combination of digital technologies and sustainable tourism strategies can speed up the recovery process of global shocks and promote the development in the long term, To

conduct further research, it is suggested that they should include explicit indicators of digitalization, environmental performance, and more general cross-country comparisons to enhance the knowledge of the green tourism development in the digital economy.

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