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Rural tourism in line with green and technological development: EU perspectives

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Abstract

Purpose – Considering the need to diversify activities in the EU rural areas, as well as significant greenhouse gas emissions from tourism, this paper aims to examine the importance of sustainable rural tourism based on green and smart technologies for the economic development of the EU. **Methodology** – OLS panel regression was used to examine the impact of rural tourism and the factors that contribute to its development on the economic development of the EU. The development of rural tourism compared to urban tourism in the EU was evaluated using the Mann-Whitney U test, while the Friedman test was used to monitor the trend of rural tourism in the period 2012-2023. **Findings** – Rural tourism and the factors that contribute to its development, such as internet users and employment in rural areas, have a positive impact on the economic development of the EU, while greenhouse gas emissions have a negative impact. Rural tourism is more developed than tourism in urban areas, but only in recent years has it reached its pre-pandemic level of development. **Implications** – Important EU strategic documents dealing with rural development, such as the LEADER program, the EU Green Deal, the EU Common Agricultural Policy and the European Strategy should implement the recommendations related to rural tourism development in line with smart, sustainable and inclusive growth.

Keywords: rural tourism, sustainable tourism, green tourism, smart tourism, smart technologies
JEL classification: O18, O33, O52, Q56, Z32

Ruralni turizam u skladu sa zelenim i tehnološkim razvojem: EU perspektive

Sažetak

Svrha – S obzirom na potrebu za diverzifikovanjem delatnosti u ruralnim područjima EU, ali i značajne emisije štetnih gasova od turizma, cilj rada je da ispita značaj održivog ruralnog turizma baziranog na zelenim i pametnim tehnologijama za privredni razvoj EU. **Metodologija** – OLS panel regresija je korišćena za ispitivanje uticaja ruralnog turizma, kao i faktora koji imaju značajnu ulogu u njegovom razvoju, na privredni razvoj EU. Mann-Whitney U test je korišćen za poređenje razvijenosti ruralnog u odnosu na urbani turizam

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EU, dok je Friedman test korišćen za praćenje trenda ruralnog turizma u periodu 2012-2023. **Rezultati** – Ruralni turizam, kao i faktori koji doprinose njegovom razvoju poput internet korisnika i zaposlenosti u ruralnim područjima imaju pozitivan, dok emisija štetnih gasova ima negativan uticaj na privredni razvoj EU. Ruralni turizam je razvijeniji od turizma u urbanim područjima, a tek je poslednjih godina dostigao pretpandemijski nivo razvoja. **Implikacije** – Važna strateška dokumenta EU koja se bave ruralnim razvojem, poput LEADER programa, Evropskog zelenog dogovora, Zajedničke agrarne politike EU i Evropske stretegije treba da primene preporuke koje se odnose na razvoj ruralnog turizma u skladu sa pametnim, održivim i inkluzivnim rastom.

Ključne reči: ruralni turizam, održivi turizam, zeleni turizam, pametni turizam, pametne tehnologije
JEL klasifikacija: O18, O33, O52, Q56, Z32

1. Introduction

Rural areas are increasingly overcoming the paradigm that was related to the exclusive connection with agriculture and are increasingly turning to connections with tourism, vacation, the consumption of local specialties, e-commerce, etc. This leads to the development of integral rural tourism and the increasing connection of tourism with regional and local resources (Saxena et al., 2007). Since the 1970s, rural tourism has been growing in many the EU countries. Now it has entered a new phase of development, which is reflected in the impact on the environment and the destinations of the hosts (Fotiadis et al., 2019). Until 1960, rural areas were mainly associated with agriculture, while now in many rural areas, other activities such as tourism are developing, and agritourism represents one of the main opportunities for rural development (Ahlmeyer & Volgmann, 2023). In the late 1970s and early 1980s, rural tourism started to develop. In the beginning, agritourism dominated, with farmers diversifying their services. In the mid-1990s, the importance of sustainable rural tourism was recognized, and the EU participated in its development through the LEADER program (Lane et al., 2022). The LEADER program in the EU's rural development policy contributes to the promotion of employment, growth, social inclusion and local development in rural areas, as well as opportunities in the green economy and the development of digital technology (Sekulić et al., 2023).

The EU has a program for rural development that supports sustainable rural tourism development. The LEADER program is recognized as the leader for sustainable tourism development, as well as the rural and local development of the EU. It also contributes to the development of entrepreneurial activities in the rural tourism field. All this has led to the decline in agricultural production, the development of rural tourism and an increase in the income of rural households. The EU has established several models of rural development that should lead to a better quality of life for the local population, but also affect the protection of the environment (Apostolopoulos et al., 2020). Remote rural areas of the EU face huge challenges such as internet speed, infrastructure, access to basic services, aging and declining population, household income, etc., while these areas can also contribute with their landscapes and ecosystems to new offers that are in line with the EU Green Deal (Castillo et al., 2024). Given the presence of various cultural and natural resources, as well as traditions, many rural landscapes across Europe have established themselves as places for tourism, vacation and recreation (Joshi et al., 2024).

Tourism plays an important role in the economic, cultural, and social heritage of countries through a positive impact on employment, increasing income, infrastructure, etc. Due to its rapid growth, tourism has become a significant factor in the world GDP. Due to the

preservation of cultural heritage, traditions and ecological dimensions, rural areas play an important role in the development of tourism. The importance of rural areas in the EU is reflected in the size of the territory that occupy (91%) and the population living in these areas (59%) (Muresan et al., 2016). Tourism development in these areas should be based on available resources and sustainable development. Sustainable rural tourism must take into account the economic, ecological and social dimensions. The interest in sustainable tourism development in rural areas is gaining more and more attention because it respects the interests of the environment and limited resources on the earth (An & Alarcón, 2020).

Rural tourism can significantly influence the development of rural areas, agriculture in these areas, and the reduction of rural depopulation. Sustainable development of rural tourism requires appropriate investments and financing of such development. In 1994, The European Commission Directorate-General for Agriculture began implementing measures aimed at the sustainable development of rural tourism. Based on Agenda 2000, the reform of the Common Agricultural Policy (CAP), the EU introduced a rural development policy. Thus, alternative sources of income and forms of employment for farmers were formulated, such as the rural tourism development (Radović et al., 2020).

The subject of this paper is the development of the EU rural tourism in relation to tourism in urban areas. The aim of this paper is to examine the importance of rural tourism development for the economic development of the EU, as well as the factors that have a significant impact on the development of rural tourism.

2. Background

Rural tourism is paying more and more attention to sustainable development, making sustainable rural tourism a current and relevant trend in rural areas. In this regard, there are increasing opportunities that contribute to this, such as the development of green and smart tourism, as well as smart and green technologies.

Sustainable tourism represents the development of tourism that protects the ecological resources of a certain area for future development. Green tourism is fully compatible with sustainable tourism. The Internet is a very important and effective channel for the development of sustainable and green tourism, considering that hotels use this channel to advertise directly. Therefore, information and digital technologies play an important role in the development of green tourism and business efficiency. Also, the gap between the place of advertising in the form of websites, where an insufficient number of hotels publish information on environmental issues, and the end user can be overcome by using the Internet. New digital technologies are increasingly being used in the green tourism development (Misso et al., 2018). Sustainable rural tourism development should be viewed through the development of green tourism, as well as smart technologies and smart tourism.

Green tourism is a component of sustainable development, but it is also a component of rural tourism and regional development. Green tourism can affect rural areas and the economic development (Lagodiienko et al., 2022). Green tourism development in rural areas can contribute through the development of entrepreneurship of the local agricultural population, which, in addition to the ecological dimension, would have a direct impact on the increase of economic and social efficiency (Kalchenko et al., 2021). Europe is the world's leading tourism destination, with Germany, France and Great Britain standing out in terms of tourism's contribution to economic development and employment. Tourism destination in Europe are increasingly turning to green destinations and accommodation, the application of circular economy methods and environmental protection, thereby gaining a competitive advantage over other destinations (Erdiaw-Kwasie et al., 2023). Green tourism development

requires the development of innovative technologies such as IoT (Internet of Things), renewable energy, energy-efficient buildings, green infrastructures, etc. (Chiang et al., 2024).

The digital revolution has led to the emergence of the term smart tourism destination and smart tourism, which are developing by introducing innovations in their operations. The development of information and communication technologies (ICT) has led to a change in the traditional understanding of the destination and brought smart destinations. In this regard, smart tourism destinations are knowledge-based destinations where information can be instantly exchanged using ICT technology platforms, which has an important role in the application of Cloud Computing, Internet of Things (IoT) and other modern technologies in tourism (Jovicic, 2019). E-tourism is one of the examples of the application of technology in the tourism industry. E-tourism represents an innovation in the provision of tourism services that is used in all aspects of travel and life. Smart tourism destinations that use these technologies represent the future in smart tourism (Shafiee et al., 2019). Smart tourism has progressed from E-tourism based on ICT to the establishment of business-client relationships with the help of the Internet of Things (IoT), privacy protection, cloud computing, social media and other available technologies (Hamid et al., 2021).

In order to reduce regional differences and the lack of convergence between central and peripheral regions within the EU, as well as differences in relation to key trading partners, the concept of smart, inclusive and sustainable growth was adopted within the Europe 2020 strategy. Some of the main challenges of smart growth are identifying advantages at the regional level, as well as connecting these policies with green growth, green innovation and mitigating climate change. Europe is a predominantly rural area, which is why the goal is to prioritize smart specialization in European regional policy. Smart EU rural development should be based on innovation, research and development (R&D) and knowledge in these areas. The EU bases its growth on a smart economy based on knowledge, innovation, R&D, entrepreneurial activities, etc. The natural and recreational facilities of these areas are another perspective for development (Naldi et al., 2015).

Sustainable development of rural areas is often neglected. Indicators of smart mobility and tourism have great importance in rural areas, encouraging economic development. Sustainable rural tourism can be improved with the help of green mobility services. Tourism in rural areas contributes to employment and the quality of life of the local population, thereby reducing rural poverty. To ensure the sustainable and smart development of EU rural tourism, the negative impacts on the environmental, social and economic aspects of rural communities should be minimised. In order to achieve a smart and sustainable development of tourism in rural areas, the application of smart technologies such as IoT, AI, cloud technologies, etc. is needed (Hussain et al., 2023). Based on all of this, the following research hypotheses were defined:

H_1: Rural tourism has a positive impact on the economic development of the EU.

H_2: Tourism in line with the technological development of rural areas has a positive impact on the economic development of the EU.

H_3: Rural tourism should be developed in line with green technology and environmental protection.

H_4: Rural tourism in the EU is more developed than tourism in urban areas.

3. Materials and methods

The research was conducted for the period 2012-2023 on a sample of the EU-27 countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, as well as the EU-27 at total.

Table 1 shows the variables used in the study, along with their abbreviations and description.

Table 1: Variable definition

Label	Definition
GDP	Gross domestic product in million euro
est_rur	Establishments in rural areas (number)
nights_rur	Overnight stays in accommodations in rural areas (number)
internet	Individuals who have ever used the internet in rural areas (percentage of individuals)
emp	Employment rate in rural areas (percentage)
GHG	Greenhouse gases (tonne)
est_urban	Establishments in cities (number)
nights_urban	Overnight stays in accommodations in cities (number)

Source: Eurostat, 2025

The research was conducted in several steps. First, the impact of rural tourism on the economic development of the observed countries was examined by OLS panel regression. Then, the robustness of the set models was examined, replacing the rural variable, i.e. by introducing a new rural variable into research models. The Hausman test was used to determine the random/fixed effects of the research models and in all models it indicated the use of fixed cross-section effects. This part of the research was conducted in the Eviews program.

The regression equations used for the research are (Table 2):

$$GDP_{i,t} = \alpha + \beta_1 est\_rur_{i,t} + \beta_2 internet_{i,t} + \beta_3 GHG_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$GDP_{i,t} = \alpha + \beta_1 nights\_rur_{i,t} + \beta_2 internet_{i,t} + \beta_3 GHG_{i,t} + \varepsilon_{i,t} \quad (2)$$

The robustness of the set models was checked using the following regression equations (Table 2):

$$GDP_{i,t} = \alpha + \beta_1 est\_rur_{i,t} + \beta_2 emp_{i,t} + \beta_3 GHG_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$GDP_{i,t} = \alpha + \beta_1 nights\_rur_{i,t} + \beta_2 emp_{i,t} + \beta_3 GHG_{i,t} + \varepsilon_{i,t} \quad (4)$$

Table 2: Matrix of variables in regression models of influence

Models		Dependent Variables	Rural independent variables				Control variable
			est_rur	nights_rur	internet	emp	GHG
Initiate models	Model 1	GDP	■		■		■
	Model 2	GDP		■	■		■
Robust models	Model 3	GDP	■			■	■
	Model 4	GDP		■		■	■

Source: Author's research

In the second part of the research, the Mann-Whitney U test was used to compare tourism development in rural and urban areas. Kolmogorov-Smirnov and Shapiro-Wilk tests showed that the observed variables do not have a normal distribution, which required the use of a non-parametric test for group comparison.

Based on the same criteria, the non-parametric Friedman test was used to show the movement of establishments and nights in rural areas for measurement on several occasions, i.e. during the observed period, in order to observe the oscillations and movements of these variables during this period. The SPSS program was used for these studies.

4. Results and discussion

Before conducting the regression analysis, the Hausman test was performed to determine the random/fixed effect of the research models.

Table 3: Hausman test

Test Summary	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	Chi-Sq.	Sig.	Chi-Sq.	Sig.	Chi-Sq.	Sig.	Chi-Sq.	Sig.
Cross-section random	1698.29	0.00	2232.86	0.00	1492.93	0.00	1721.07	0.00

Source: Author's research, based on Eurostat, 2025

The Hausman test showed the use of fixed research models (Table 3). OLS panel regression was used to examine the impact of rural tourism, as well as other indicators in rural areas associated with the development of rural tourism, on the economic development of the EU countries.

Table 4: Impact of rural tourism on the economic development the EU

Label	**Dependent variable GDP**			
	Model 1	Model 2	Model 3	Model 4
intercept	2301748. (19.58)***	1925805. (17.22)***	2976621. (15.46)***	2550101. (14.01)***
est_rur	9.70 (2.85)***		13.17 (2.72)***	
nights_rur		0.01 (13.59)***		0.01 (11.21)***
internet	2261.30 (2.28)**	3358.14 (2.96)***		
emp			4053.99 (1.98)**	6039.06 (2.62)***
GHG	-0.01 (-41.68)***	-0.01 (-34.22)***	-0.01 (-36.46)***	-0.01 (-29.46)***
Adjusted R^2	0.99	0.99	0.99	0.99
F-statistic	3787.11***	2998.94***	3283.22***	2501.35***

Note: Beta coefficients in front of parentheses, t-values in parentheses
, * indicate statistical significance at the 5% and 1% levels, respectively
Source: Author's research, based on Eurostat, 2025

Based on all four research models from Table 4, the impact of rural tourism on the economic development of the EU countries was examined. Model 3 and Model 4 were used to check

the robustness of the research by replacing and introducing new variables into the models. All models are statistically significant and in a high percentage describe the reality as measured by Adjusted R^2.

Based on Model 1 and Model 2 from Table 4, it is concluded that establishments and nights in rural areas have a statistically significant and positive impact on the economic development of the EU countries. Internet users in rural areas also has a statistically significant and positive impact, while GHG has a statistically significant and negative impact on the economic development of EU countries.

Establishments and nights in rural areas have a statistically significant and positive impact on the economic development of the EU countries in models 3 and 4, which means that the robustness of the research model has been proven, i.e. that rural tourism has a significant impact on the economic development of the observed EU countries. In these models, employment in rural areas is also positively reflected on economic development, while GHG is again negatively reflected on the economic development of the EU countries.

Rural tourism is of great importance not only for reducing poverty and improving the living standard of the local community, but also for increasing economic development (Liu et al., 2023). Rural tourism can increase employment in rural areas and reduce the depopulation of those areas (López-Sanz et al., 2021). Tourism has an important role in diversifying the rural economy and sustainable development of these regions. The relationship between socio-cultural, economic, ecological and tourism development is significant (Nooripoor et al., 2021). In addition to economic development, rural tourism contributes to the cultural and socio-economic development of local communities and entire regions (Lazović et al., 2024).

Bearing in mind the negative impact of greenhouse emissions on economic development, rural tourism should be developed in line with ecological standards and environmental protection. In this connection, the development of green tourism is becoming more and more current. Green and smart technologies have an important role in sustainable development. Bearing in mind that the CO2 emitted by tourism is not small compared to other sectors, green tourism represents tourist activities that should minimize environmental impact, reduce energy use and greenhouse emissions. Also, smart technologies in information and communication technology (ICT) era, such as wireless sensor networks (WSNs) and internet of things (IoT), influence the development of information networks in accordance with sustainable tourism (Pan et al., 2018). For the development of smart tourism, the problem of Internet access in many rural areas should be overcome, considering the importance of effective Internet access in rural areas (Ruiz-Martínez & Esparcia, 2020). High-speed Internet improves the economic performance of rural areas, as well as overall economic development through improved productivity, jobs and income (Mack et al., 2024). The development of smart tourism and technologies in accordance with Tourism 4.0 contributes to the positive experience of tourists, competitiveness and the efficiency of tourism destination (Gajdošík & Orelová, 2020). The importance of 4G networking in remote areas and the establishment of a tourist information center that would serve to improve travel, accommodation, food, etc. is emphasized (Sun et al., 2024). Accordingly, digital literacy is of particular importance for members of rural tourist households (Paraušić et al., 2025).

For the second and third part of the research, the normality of the variables distribution was first examined (Table 5).

Table 5: Tests of Normality

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	df	Sig.	Statistic	df	Sig.
Establishments	.372	616	.000	.332	616	.000
Nights	.352	616	.000	.368	616	.000
Establishments in rural areas	.353	308	.000	.381	308	.000
Nights in rural areas	.351	308	.000	.366	308	.000

Source: Author's research, based on Eurostat, 2025

Kolmogorov-Smirnov and Shapiro-Wilk tests showed that the observed variables do not have a normal distribution (Table 5). Because of that, the non-parametric techniques for comparing groups (Mann Whitney U test) and repeated measurements (Friedman test) were applied in further research.

Table 6: Tourism development in the EU - rural areas vs. cities

Label	**Establishments**	**Nights**
Rural areas	368.24	337.79
Cities	250.76	329.21
Mann-Whitey U	29590.50***	540.16

Note: Values expressed in Mean Rank
*** indicate statistical significance at the 1% level
Source: Author's research, based on Eurostat, 2025

Table 6 shows that establishments in rural areas are statistically significant and higher than establishments in cities, while nights in rural areas are also higher compared to nights in cities, but this difference is not statistically significant. Certainly, based on the previous comparison, it can be concluded that rural tourism is significantly more developed than urban tourism.

Tourism is a measure of increasing the attractiveness of both rural and urban areas (Pateman, 2011). Tourism leads to the development of both rural and urban areas through the possibility of preservation of cultural heritage, new employment, processing of local products and the preservation of natural resources (Wijijayanti et al., 2020). Given that rural areas cover the majority of the EU territory, as well as that rural tourism is more developed than urban tourism, and that it has an important role in economic development, the EU pays great attention to this sector and its development.

In the last part of the research, the development of rural tourism during the observed time period was examined, for which the Friedman test of repeated measurements was used. Table 7 shows the movement of establishments and nights in rural areas during the observed period 2012-2023. Statistical significance was not recorded for the movement of establishments in rural areas, while it was recorded for nights in rural areas. In the case of establishments in rural areas, no significant deviation of the observed data was recorded during this period, while in the case of nights in rural areas, there is a significant drop in 2020. Observed through this indicator, rural tourism began to recover in 2021, since it has been constantly increasing from year to year, reaching a record amount of 9.85 in 2023, which is even higher than the one year before the Covid pandemic, in 2019, which was 9.81.

Table 7: Development of the EU rural tourism in the period 2012-2023

Year	Establishments in rural areas	Nights in rural areas
2012	8.33	4.08
2013	8.00	4.46
2014	7.67	5.08
2015	4.67	6.35
2016	5.00	8.27
2017	7.33	7.42
2018	5.00	8.69
2019	6.00	9.81
2020	5.67	1.73
2021	5.83	3.62
2022	7.17	8.65
2023	7.33	9.85
Chi-square	4.17	157.41***

Note: Values expressed in Mean Rank
*** indicate statistical significance at the 1% level
Source: Author's research, based on Eurostat, 2025

The number of nights in tourist accommodation in the EU decreased by 51% in 2020 compared to 2019. The accommodation sector in the EU began to recover in 2021. However, the some EU countries have not reached the level of rural tourism development of 2019 (Damian et al., 2024). Tourism has great potential to restore rural businesses and infrastructure that have been severely affected by the pandemic (Maliuta et al., 2021).

5. Conclusion

Bearing in mind that the rural areas of the EU occupy a large part of the territory, as well as that the majority of the population lives in them, the development of these areas is becoming increasingly important, which is channeled through the various EU strategic documents that play a significant role in their development. Therefore, the development of rural tourism and the shift from the exclusive pursuit of agriculture to diversifying activities, employment in tourism and other activities related to it play an increasingly important role in rural areas.

Rural tourism undoubtedly plays a significant role in the economic development of countries. However, considering that the tourism sector is one of the major polluters, and that greenhouse emissions have unwanted consequences for the environment, and economic development itself, the role of sustainable rural tourism has become increasingly important. In this regard, it is understood that rural tourism develops in line with the preservation of the environment and ecological standards, which assigns a significant role to green tourism and technologies. In order to develop sustainable rural tourism, smart technology is increasingly being used, which results in the consistency of smart and green tourism.

Given the significant role of employment in rural areas, as well as the fact that an increasing number of jobs are created within the tourism sector, which affects the improvement of the living standards of the local population, rural tourism has a significant impact on the economic development of the EU, thus proving the first hypothesis of the research. Also, bearing in mind that internet users in rural areas, who serve as the basis for the development of smart technologies in these areas, have a positive impact on the economic development, rural tourism should develop in accordance with technological development, which proves the second hypothesis of the research. In addition, there is a noticeable negative impact of the

greenhouse emissions on the environment and economic development, which is why rural tourism should be harmonized with ecological standards and move in the direction of the development of green tourism based on the natural resources of rural areas, thus proving the third hypothesis of the research. Considering all of the above, as well as the fact that rural tourism is more developed than urban tourism within the EU, thus proving the last hypothesis of the research, special emphasis in future the EU strategic documents should be given to the development of rural tourism in accordance with green and technological development.

The limitations of the research lie in the fact that the influence of developed countries in relation to developing countries was not specifically examined, as well as that no comparison was made with countries outside the EU, which can serve as a recommendation for future research. Also, future research can include an examination of urban tourism, and the EU strategic documents that deal with these issues.

Conflict of interest

The author declares no conflict of interest.

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