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**THE ENVIRONMENT, TOURIST TRANSPORT
AND THE SUSTAINABLE DEVELOPMENT OF TOURISM**

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Abstract

The article explores the complex relationships between the natural environment, tourist transport and sustainable tourism development. In order to research the impact of natural resources on tourism activity, on the one hand, and the influences of tourism on the environment, on the other hand, statistical and mathematical methods of analysis and forecast were used, namely, the analysis of the dynamics of significant indicators of the natural environment and of tourist activity, the correlation method, the Markov chains method. The analyses made lead us to the conclusion of the existence of a positive evolution of significant indicators of the natural environment, with an impact on tourist activity, such as natural parks. It has been emphasized; also, that this positive evolution has a direct influence on the attraction of visitors, specifically, foreign ones, but the intensity of this influence is average. The intensification of the actions of promotion of natural parks and, generally, of protected areas in Romania, would be a direction for attracting an increased number of visitors, with all the favourable economic consequences.

On the other hand, the research has outlined the fact that, as far as the means of transportation used by tourists to visit Romania are concerned, on the first places we can see road and air transport, means of transportation which, aside from the obvious advantages for tourists, have a strong negative impact on the environment.

The forecast made with the help of the Markov chains method has shown a negative trend, from the point of view of the impact on the environment, namely an increase in the share of road and air transport in the preference of foreign visitors to Romania.

The current research represents a contribution to the efforts of measuring, through statistical and mathematical models, of the complex influences, in both senses, between the environment and tourist activity. Thus, an objective radiography has been made of these influences, for significant indicators of the natural environment and of tourism activity, with the aim of formulating directions of action for the increase of the positive impact and the diminishing of the negative effects.

Keywords: the environment, tourist transport, sustainable tourism development, environmental pollution, climate change.

JEL Classification: C53, L83, Q53, Q57.

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Introduction

Studying the multiple interdependencies of tourism activity with the environment have been and still are in the attention of an important number of researchers and international and national bodies, especially in the context of the intensification, in recent decades, of the preoccupations regarding the sustainable development of tourism.

Environmental protection issues, the reduction of pollution, the superior use and saving of natural resources with a view to ensuring welfare not only for the present generation, but for future generations as well are the subject of numerous studies, programs and sustainable development strategies in almost all the countries of the world, Romania included.

Thus, transports and tourism represent key industries for economic development and the increase of the quality of life, but are also responsible for numerous forms of environmental pollution and the major climate changes we face at present.

The current research has as a goal measuring, through objective, statistical-mathematical methods, the influence of the natural environment on tourist activity, as well as the impact of tourism on the environment. In order to reach the objectives of the research, indirect research methods have been used, methods which have at the basis the information obtained through statistical evidence (Ionciã, 2006). The analysis of the dynamic and comparative evolution of significant indicators of the natural environment and of tourism have allowed for the highlighting of the trends and correlations between the indicators. The extrapolation of some of these tendencies was also made, as well as the forecast, on a short term, of the evolution of the changes in the structure of some tourist services, with a strong impact on the environment, namely the tourist transport services.

The first part comprises a succinct presentation of the theoretical considerations on the relations between the natural environment and tourism, the second part includes a research based on the use of statistical-mathematical methods of the two-way relations between the natural environment and tourism development, and the proposal of measures of mitigation of the negative impact of the uncontrollable development of tourism on the environment ends our study.

1. Literature review

The environment represents for tourism a sine-qua-non condition of the running and development of its activity, without neglecting, of course, the importance of other factors, such as: the human factor, the general and specific infrastructure, the innovations, technological changes etc. It has been confronted in the last century with numerous natural catastrophes, and the economic loss caused by natural disasters increased significantly. This increase can be explained through a multitude of factors, among which the increase in the risk of climate disasters (Ionciã and Petrescu, 2016).

Climate, as well as the natural environment, has always been changing. What is now different is that human influence on natural systems is so extensive that geologists now refer to our contemporary period as the Anthropocene (Oldfield and Steffen, 2014 cited in Hall et al., 2015).

There has been broad scientific consensus for several years that climate change will cause impacts such as higher temperatures, sea-level rise and greater weather extremes. However, there is now growing realization that this will require all sectors of society to take action to adapt and develop resilience to such impacts (IPCC, 2014 cited in Burbidge, 2016). Climate

change is extremely significant for tourism because of its influences on the economic viability of tourist destinations and activities, tourist behavior, and its ramifications for the entire tourism system (Hall et al., 2015).

The research in recent decades has shown that there are different causes which determined climate change: deforestation, the uncontrolled exploitation of water resources, the increase in the emissions of greenhouse gases. Tourism, in a complex relationship with the environment, is both a negative factor, and a vector of ecological policies and strategies (Popescu et al., 2014)

The mountains, forests, protected areas, the seaside, the rivers, lakes, fauna, flora, art monuments, etc. represent first class tourist resources, being the main attractions for millions of tourists. The more varied and complex, and, more importantly, unaltered, these resources are, the higher the tourist interest, and the more valuable the activities they generate (Bran, Marin and Simon, 1998).

Natural parks and other protected areas in the world, especially, represent regions of nature with a special value as far as the natural environment is concerned, as well as with a huge tourist potential (Țigu et al., 2011).

Representing approximately 12% of land worldwide, the system of protected areas is increasingly present in the favorite holiday destinations, which justifies the concerns regarding their scientific management, having as an objective the striking of a balance between the results obtained and the efforts to protect the environment. In time, protected areas have proven to be among the most efficient means of preserving biodiversity and, in a larger context, the environment and its natural and anthropic components (Hornoiu et al, 2014).

On the other hand, in the conditions of an uncontrollable tourism development, of neglecting the fact that natural resources are not unlimited, and their waste and degrading have long-term effects, affecting not only current generations, but the future ones as well, the negative effect of tourism is felt. Thus, the development of tourism can put pressure on natural resources, in the conditions in which they have proven to be limited.

Among the resources which are affected the strongest by tourism development, we can mention: water resources, food, energy, mineral resources, forests, construction materials a.s.o. (United Nations Environment Programme –UNEP, 2015).

Water, and especially fresh water, is one of the most critical natural resources. The tourism industry contributes to the consumption of water resources for hotels, swimming pools etc. Moreover, this increase in the consumption of water through tourist activity generates a higher volume of residual water which needs to be drained.

Similar considerations can be mentioned related to other categories of the above-mentioned resources.

Pollution represents another major aspect of the negative impact of tourism on the environment. Lately, the concerns regarding ecology and the green economy have known an increasing trend and have led to the change of people's attitude regarding the effects of products and operational processes on the environment (Evans, Campbell. and Stonehouse, 2003). Less than other branches, such as the chemical industry, mining, iron and steel industries etc., tourism can however cause different forms of pollution, such as: air pollution, water pollution, soil pollution, visual (aesthetic) pollution.

Tourism is a significant contributor to climate change. Tourism and travel contribute to climate change through emissions of GHGs, including CO₂, methane (CH₄), nitrous oxides (NO_x), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). There are also various short-lived GHGs that are important in the context of aviation and, to a lesser extent, cruise ships (Scott et al., 2012 cited in Hall et al., 2015). Tourism transport, accommodation, and activities are estimated by two independent analyses to have contributed approximately 5% to global anthropogenic emissions of CO₂ in the year 2005 (Scott et al., 2010; UNWTO-UNEP-WMO, 2008; World Economic Forum - WEF, 2009 cited in Hall et al., 2015).

Among tourist services, tourist transport, just as transports in general, is remarked through the negative effects on the environment. Thus, the transports sector is known as one of the main culprits for air pollution and climate change (Neto, 2003). It is responsible for more than 60% of the emissions of carbon monoxide and dioxide. The majority of CO₂ emissions are associated with transport, with aviation accounting for 40% of tourism's overall carbon footprint, followed by car transport (32%) and accommodation (21%) (UNWTO-UNEP-WMO, 2008 cited in Hall et al., 2015).

Aircraft contribute to climate change in two principal ways – through the emission of greenhouse gases such as CO₂, NO_x and radiatively significant particles such as soot, and through the generation of contrails which in turn may have an impact on the global heat balance. The International Civil Aviation Organization (ICAO) has created a Group on International Aviation and Climate Change, mandated by the Assembly of ICAO in 2007 to pursue a globally harmonized framework for tackling greenhouse gas emissions from international aviation through an ICAO Programme of Action on International Aviation and Climate Change (Love, Soares and Püempel, 2010).

Cruise ships provide an estimated 19.2 Mt CO₂ and account for around 1.5% of global tourism emissions (Eijgelaar, Thaper, and Peeters, 2010; WEF, 2009 cited in Hall et al., 2015).

Moreover, transports are the main noise generator; in the countries in which research has been made in this sense, 80% of noise pollution is attributed to transports (Ionciã, Petrescu and Popescu, 2004).

Regarding tourism, 72% of CO₂ emissions are estimated to come from transports, 24% accommodation, and 4% from local activities (Peeters and Dubois, 2010).

Air transports are responsible for about 55% of the CO₂ emissions of tourist transport, or 40% of the total tourism emissions (Gossling et al., 2010).

In the case of visual pollution, the main problem is the deterioration of the aesthetic resource of the environment. This resource or, more exactly, the aesthetic function of the environment is a complex phenomenon depending on a series of factors such as: the extraction of natural resources, the urban activity of people, the tourist and leisure time activities (Ionciã, Petrescu and Popescu, 2004).

At the same time, tourism has the potential to create beneficial effects on the environment, contributing to the protection and the conservation of natural resources.

Sustainable tourism through the development of its multiple forms of concrete manifestation, of tourism management and marketing, ensures the natural and economic integrity of the environment and uses natural and cultural resources rationally, yet preserves

the necessary potential for the future generations and practically identifies with a state of dynamic equilibrium of demand and supply, which outlines any modern tourist market.

The income from tourism can contribute to the financing of the protection of natural resources and to the increase of their economic importance. Due to their attractiveness, protected areas represent the main visiting motivations for numerous categories of tourists (Minciu et al., 2012).

Tourism can contribute significantly to the conservation and maintaining of biological diversity and to the sustainable use of natural resources. The regulation measures, the control of the number of tourism activities and of the movement of visitors in protected areas can limit the impact on the ecosystem and can help maintain the integrity and the vitality of the site.

Other measures pertaining to the planning and controlled management of the development of tourist activity and which can lead to the mitigation of the negative impact of tourism on the environment are: the use on non-polluting construction materials, the systems of energy saving and its production from renewable resources, the promotion of policies of reduction of the pollution caused by tourist transports, of the policies of ecological education of tourists etc.

A quantitative research conducted within the Enhance project in May 2015, using directed interviews among the Romanian population and insurance companies and brokers (the sample being formed of 461 homeowners and 117 insurance specialists and brokers) has shown that the environmental protection measures and of prevention against natural catastrophes considered as being highly important are: observing security standards when building houses, the consolidation of buildings and of existent infrastructure, legislative restrictions regarding deforestation, reforestation, dam building and insuring properties against natural disasters.

2. The methodology of the research

The research is based on the gathering of information from statistical evidence about indicators representative for the natural environment, on the one hand, and for the tourism activity with an impact on the environment, on the other hand. The information has been processed by resorting to statistical and mathematical models, allowing for the obtaining of relevant results, with a high degree of objectivity and credibility.

An important objective in the study is represented by the analysis of the correlation between the evolution of natural parks in Romania in the period 2000-2015 (ha) and the evolution of foreign tourist arrivals in Romania, in the 2000-2015 period, considering the direction, intensity and statistical significance of the connection between the two variables. The independent variable is the area of natural parks in Romania in the period 2000-2015 (ha), and the dependent variable is the number of foreign tourist arrivals in Romania, in the 2000-2015 period, the two variables studied being recorded in proportional scales. In the case of metric scales (intervals or proportional), the measurement of the distances between the alternatives is also possible, and the analysis of the direction, intensity and statistical significance of the degree of association between the two variables has at the basis the *Pearson correlation coefficient, r* (Cătoi et al., 2009).

The computation of the correlation coefficient is used in the case of the simple linear connection, its sign indicating the direction, and the value showing the intensity of the connection (Țițan, 2003). The correlation shows the degree to which the changes in one variable (the dependent variable) are associated with changes in the other variable (McDaniel and Gates, 2008). The *Pearson correlation coefficient*, r allows for the setting of the size of the change in a variable, following the modification of another variable, regardless of the units used for their measurement (Cătoiu et al., 2009).

The formula used for the computation is (Ionciță et al., 2006):

$$r = \frac{n \sum_{i=1}^n x_i y_i - \sum_{i=1}^n x_i \sum_{i=1}^n y_i}{\sqrt{[n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2] * [n \sum_{i=1}^n y_i^2 - (\sum_{i=1}^n y_i)^2]}} \quad (1)$$

where:

n = number of years;

x_i = area of natural parks in Romania (ha);

y_i = arrivals of foreign visitors to Romania (thousands).

The sign of the Pearson correlation coefficient indicates the direction of the connection (Burns and Bush, 2006), a positive value shows a direct linear connection and a negative value shows an inversed connection: when a variable grows, the other variable drops.

The value of the Pearson correlation coefficient, r can be situated between -1 and 1, the value 1 indicating a perfect direct linear connection, while -1 shows a perfect reverse linear correlation. The closer the value of the Pearson correlation coefficient to ± 1 , the stronger the connection between x and y (McDaniel and Gates, 2008). Usually, the value 0 shows the lack of a connection between variables (Țițan, 2003; McDaniel and Gates, 2008; Burns and Bush, 2006).

If r , the correlation coefficient, is squared, the result is the coefficient of determination, r^2 , which indicates the proportion of the variation of one of the variables explained by the other variable (Cătoiu et al., 2009).

The scatter diagram helps in interpreting the Pearson correlation coefficient, r .

A hypothesis of this study is that there is a correlation between the evolution of natural parks in Romania (ha) and the evolution of the foreign visitors' arrivals in Romania, in the period 2000-2015, the connection being a direct one. The checking of the hypothesis is made through a bi-varied analysis.

So as to test the degree of statistical significance of the correlation coefficient the null hypothesis H_0 is formulated: for the statistical population under research $r=0$ and the alternative hypothesis H_1 : for the statistical population under research $r \neq 0$. The null hypothesis H_0 is accepted if $-Z_{\text{theoretical}} \leq Z_c \leq Z_{\text{theoretical}}$. The formula for determining the calculated value Z_c is (Cătoiu et al., 2009):

$$Z_c = \frac{1,1513 + \log_{10} \left(\frac{1+r}{1-r} \right) - 0}{1/\sqrt{n-3}} \quad (2)$$

Another objective of the study is to forecast using *the Markov chains method the structure of arrivals of foreign visitors to Romania by transportation means used*. Based on the evolution of foreign visitors by categories of means of transportation used, a forecast was made, using the Markov chains method, on the place of means of transport in the preferences of foreign visitors to Romania in 2020.

The Markov chains method, which allows for the analysis and prediction of structural changes, implies the following of several stages, namely: calculating the transition matrices for the years considered, calculating the total transition matrix, calculating the matrix of the transition probabilities and calculating the predicted structure (Ionciã et al., 2006). So as to make the forecast, in the first stage the transition matrices are calculated (n-1 transition matrices are calculated, where n is the number of years considered). In the second phase, the total transition matrix is calculated, by adding up the partial matrices, and in the third stage the matrix of the transition probabilities is computed, by dividing each element of the total transition matrix to the total on the line. In the last stage, the fourth, the predicted structure is established, by multiplying the transposed matrix of the transition probabilities with the vector of the structure of the last known year.

These methods made it possible to highlight the trends for some significant indicators for the natural environment and for tourism and for the correlations between these indicators. It was also possible to extrapolate some of these trends and forecast, on the medium term, the evolution of some important components of tourism activity, with an impact on the environment, namely tourist transportation services.

3. The analysis of the dynamics and correlation of significant indicators for the environment and tourist circulation

Among the important indicators of the environment, with a positive impact on tourist activity, we can mention those referring to protected areas: reservations of the biosphere, national parks, scientific reservations, natural reservations, monuments of nature etc.

Among the protected areas, natural parks are of special interest for the development of tourist activity, both internationally, and in our country.

In 2000-2015, the average surface covered by natural parks in our country was of approximately 661,000 ha, representing about 3.0% of the surface of the country. In this period, the surface of natural parks has increased by about 36,725 ha, 3.5 times respectively, reaching in 2015 the figure of 768,842 ha as compared to 218,969 ha in 2000 (see figure no. 1 and table no. 1).

Among the indicators of tourist circulation, highly important through its positive effects on economic development, hence on social welfare, is the one represented by *foreign visitors' arrivals*.

This indicator has had a generally ascending trend, with some oscillations, in the 2000-2015 period (see figure no 2). Thus, *foreign visitors' arrivals to Romania* have recorded an average annual value of about 6.7 million, rising from approximately 4,900 thousands in 2000 to over 9,300 thousands in 2015, namely with an annual average of about 271,000 arrivals, respectively with approximately 77% (see figure no. 2 and table no. 1).

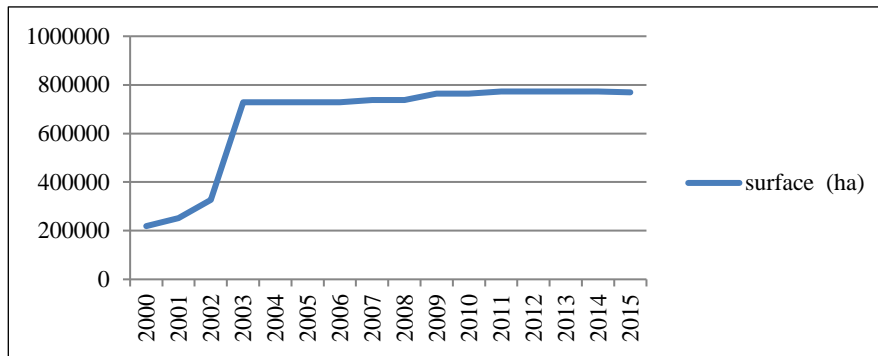


Figure no. 1: The evolution of natural parks in Romania in 2000-2015

Source: INSSE data (The statistical database - Tempo - Online time series), 2016

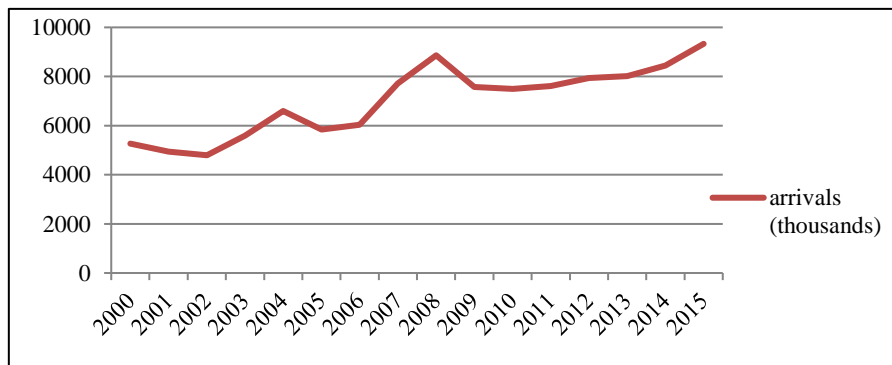


Figure no. 2: The evolution of foreign visitors' arrivals in Romania, in 2000-2015 (thousands)

Source: INSSE data (the statistical database – Tempo – Online time series), 2016

With a view to measuring the impact of the evolution of the surface of natural parks on tourist activity, we determined by using the *Pearson correlation coefficient*, r , the correlation between the indicators: *the surface of natural parks and the arrivals of foreign visitors to Romania*.

The value of the Pearson correlation coefficient, r is of 0.7262 and highlights a direct connection of an average intensity between the two indicators x_i and y_i .

Some researchers consider that the association between the variables is strong if the value of the correlation coefficient is from ± 0.81 to ± 1 , moderate if it is between 0.61 and 0.80 (Burns and Bush, 2006), others appreciate that a value between $\pm 0,60$ and $\pm 0,99$ indicates a strong correlation (Datculescu, 2006).

Table no. 1: The evolution of natural parks in Romania (ha) and the evolution of the arrivals of foreign visitors (thousands) to Romania, in 2000-2015

Years	Surface (ha) x_i	Surface – Dynamics indices with a fixed basis (%)	Surface – Dynamics indices with a mobile basis (%)	Arrivals of foreign visitors (thousands) y_i	Arrivals – Dynamics indices with a mobile basis (%)	Arrivals – Dynamics indices with a mobile basis (%)
2000	218969	100.00%	-	5264	100.00%	-
2001	251632	114.92%	114.92%	4938	93.81%	93.81%
2002	326306	149.02%	129.68%	4794	91.07%	97.08%
2003	728272	332.59%	223.19%	5595	106.29%	116.71%
2004	728272	332.59%	100.00%	6600	125.38%	117.96%
2005	728272	332.59%	100.00%	5839	110.92%	88.47%
2006	728272	332.59%	100.00%	6037	114.68%	103.39%
2007	737428	336.77%	101.26%	7722	146.69%	127.91%
2008	737428	336.77%	100.00%	8862	168.35%	114.76%
2009	763894	348.86%	103.59%	7575	143.90%	85.48%
2010	763894	348.86%	100.00%	7498	142.44%	98.98%
2011	772810	352.93%	101.17%	7611	144.59%	101.51%
2012	772810	352.93%	100.00%	7937	150.78%	104.28%
2013	772810	352.93%	100.00%	8019	152.34%	101.03%
2014	772810	352.93%	100.00%	8442	160.37%	105.27%
2015	769842	351.58%	99.62%	9331	177.26%	110.53%

Source: INSSE data (The statistical database - Tempo - Online time series), 2016

So as to facilitate the interpreting of the Pearson correlation coefficient, r the scatter diagram is used (figure no. 3).

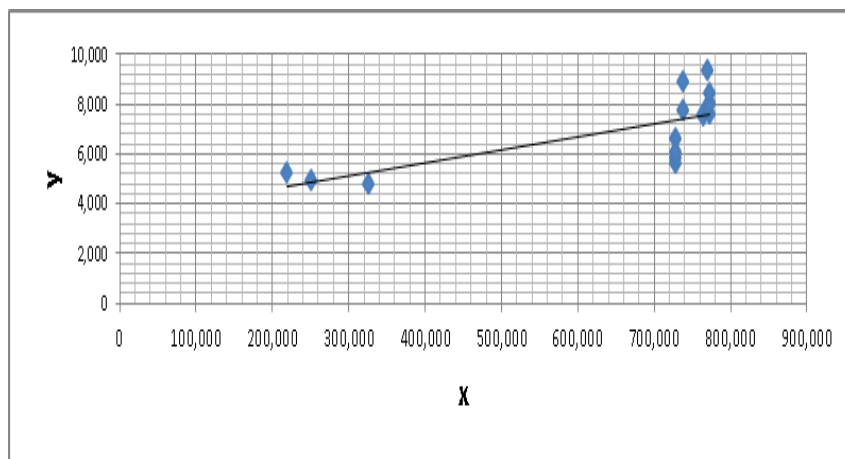


Figure no. 3: The scatter diagram for the surface of natural parks (x) and the foreign visitors' arrivals to Romania (y) for 2000-2015

The determination coefficient, r^2 is of 0.53 and indicates the proportion of the variation of one variable explained by the other variable (Cătoi et al., 2009), respectively the proportion of the variation of foreign visitors' arrivals to Romania explained by the variation of the surface of natural parks.

So as to test the degree of statistical significance of the correlation coefficient for a level of trust of 0.99, when the value of the coefficient $Z_{\text{theoretical}}$ is of 2.58, the calculated value Z_c of 7.03 was determined, the conclusion being that H_1 is accepted: the value of the correlation coefficient in the researched statistical population differs significantly from zero.

Thus, the hypothesis according to which there is a correlation, a direct link between the evolution of natural parks in Romania (ha) and the evolution of foreign tourist arrivals in Romania, in the period 2000-2015, is confirmed. This leads to the idea that the promotion of national parks in our country needs to be intensified so that they represent a stronger attraction to foreign visitors.

4. The analysis of the indicators of tourist activity with an impact on the environment

Among the indicators of tourist activity, we deem the ones referring to tourist transportation to be significant from the point of view of their implications on the natural environment.

In this sense, the evolution of the arrivals of foreign visitors to Romania by transportation means used was analyzed, based on the data in figure no. 4 and table no. 2.

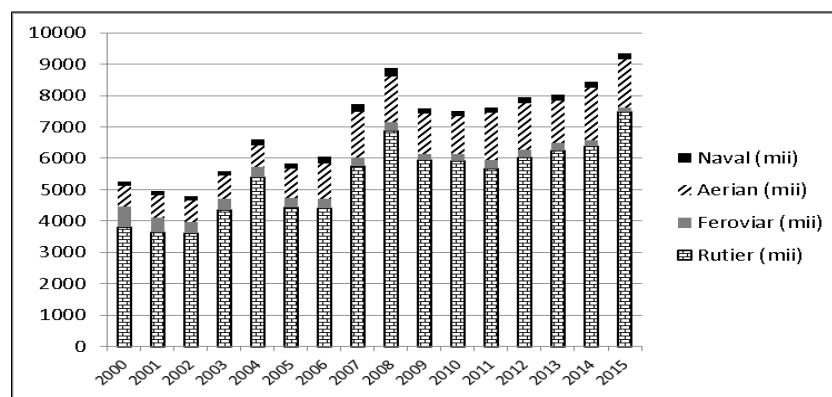


Figure no. 4: The arrivals of foreign visitors to Romania by means of transportation used for 2000-2015

Source: INSSE data (*The statistical database - Tempo - Online time series*), 2016

The analysis of the structure of arrivals by means of transport used shows that arrivals by road transport hold the largest share (the average of the period being 76.4%). The share held by road transport in the transport preferences of foreign visitors to Romania has risen from 72.4% in 2000 to 80.1% in 2015. This privileged place held by road transport can be explained through the advantages it offers travelers, namely: swiftness, increased comfort, flexibility, and the possibility of arriving in places less accessible by other means of transportation, a lower price compared to air transport etc.

A factor to consider is the quality and dynamics of the infrastructure of road transport. Thus, it is true that in 2015, Romania had 86,080 km of public roads as compared to 78,479 km in 2000 (INSSE, 2016), which represents an increase by 7601 km, respectively with approx. 507 km on average annually. This dynamics could be considered positive, if we did not take into consideration the fact that cobbled and dirt roads sum up 32,303 km, 37.5% of the total, a share close to that of modernized roads (37.9%, 32,641 km respectively), and the highway network stretches only on 747 km (4.2% of the total).

Table no. 2: Foreign visitors' arrivals to Romania (thousands) and the share of foreign visitors' arrivals by means of transport used in Romania in 2000-2015 (%)

Years	Total (thousands)	Road	Air	Railroad & naval
2000	5264	72.40%	12.40%	15.20%
2001	4938	73.40%	14.30%	12.30%
2002	4794	75.00%	14.40%	10.60%
2003	5595	77.60%	13.50%	8.90%
2004	6600	81.80%	10.70%	7.50%
2005	5839	75.80%	15.80%	8.40%
2006	6037	72.70%	18.60%	8.70%
2007	7722	74.50%	18.90%	6.60%
2008	8862	77.70%	16.50%	5.80%
2009	7575	78.20%	16.90%	4.90%
2010	7498	78.80%	16.20%	5.00%
2011	7611	74.60%	19.80%	5.60%
2012	7937	75.90%	18.50%	5.60%
2013	8019	77.90%	16.80%	5.30%
2014	8442	75.70%	20.00%	4.30%
2015	9331	80.10%	16.50%	3.40%

Source: *INSSE data (The statistical database - Tempo - Online time series), 2016*

Arrivals by plane, with a share of 16.5% in the year 2015, hold in our country the second place as share (after road transport), the average of the period analyzed being of 16.2%. The situation of air transport among the means of transportation preferred by tourists, especially in international travel, is due to the fact that they are the fastest, offer increased comfort, favor the connection with regions lacking other means of transport etc. At the same time, the managerial innovations, such as the spread of the low-cost formula, make air transport competitive from the point of view of price as well.

Arrivals by naval transport is situated on the third place as share, decreasing from 2.7% in 2000 to 1.9% in 2015, the average of the period being 2.6%.

Railroad transport comes in the last place as share in the preferences of visitors to our country. Although it is the least polluting means of transportation, it is the only means of transport which has recorded a negative evolution both in absolute value and as share in the period analyzed. Thus, the arrivals of foreign visitors using the train as means of transport has decreased from 660 thousands in 2000 (representing 12.5% of total arrivals) to 143 thousands (1.5%) in 2015. This could be due to the disadvantages of this type of transport in international transport, such as issues of comfort and access to some tourist destinations and a ratio which is not always satisfactory between the price of transport and the quality of services.

So as to make the forecast, we have considered the structure of foreign visitors' arrivals to Romania, in the years 2000, 2005, 2010 and 2015, and the means of rail and naval transport (with the smallest shares) have been considered together. The data based on which the forecast of changes in the structure of arrivals of foreign visitors to our country by means of transportation used was made is presented in table no.2.

So as to make the forecast, in the first stage the transition matrices were computed, in the case of this research, 3 transition matrices were computed. In the second stage, the total transition matrix was computed, by adding up the two partial matrices. The third stage

involved the computing of the transition probabilities matrix P, by dividing each element of the total transition matrix to the total on the line.

$$P = \begin{matrix} & \begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{matrix} \\ \begin{matrix} 0.26923 & 0.14336 & 0.58741 \end{matrix} & \end{matrix} \quad (3)$$

In the last stage, the fourth, the forecasted structure was calculated, by multiplying the matrix of the transition probabilities with the vector of the structure of the last year known (2015). The forecast made with the help of the Markov chains method for the year 2020 highlights the following structure of foreign visitors to Romania by means of transport used:

- Road transport: 81.0%;
- Air transport: 17.0%;
- Railroad and naval transport: 2.0%.

According to the forecast made, the trend of road transport is of increase as share in the total tourist transport, which represents a negative aspect from the point of view of the impact on the environment. Air transport continues its growth trend, an aspect which, from the point of view of the influence on environmental pollution, also appears negative. The trend of decrease in the share of railroad and naval transport is also negative.

5. Proposals for the reduction of the negative impact of tourist activity on the environment

Following the analyses and forecasts made based on the evolution of significant indicators regarding, on the one hand, the environment, and, on the other hand, tourist activity, an important contribution to the *reduction of the negative impact of tourist activity on the environment* could be obtained by:

- Continuing the preoccupations regarding the increase in the number and surface of protected areas. In financing the projects destined to this goal, a major role could be played by attracting funds from the European Union.
- Promoting ecological tourism, especially in underprivileged areas, which have an exceptional natural and anthropic potential. Examples in this sense are regions in the North-East and the South-West of the country, in rural areas, in the regions where an important number of employees have been made redundant through the restructuring of the mining sector, the bankruptcy of industrial complexes etc.
- Policies of mitigating the negative effects of tourist transport on the environment.
 - policies of regulation and control of the pollution caused by means of transportation: fiscal instruments, such as taxes for pollution, differentiated insurance policies, subsidies for replacing the old polluting cars with new, environmentally-friendly ones (Ionciă et al., 2012).
 - policies of stimulation of the forms of transport with a smaller negative impact on the environment (road transport, using the bicycle etc.).
- Policies of saving water, energy, fuel in tourist activity.

- Policies of ecological education of tourists aimed at informing and raising awareness about the gravity of environmental problems and their change in behavior as tourists.

Of course, the range of directions of action regarding the improving of the impact of tourist activity on the natural environment is much more vast and implies the involvement not only of state authorities, but also of tourism organizations and, not lastly, of tourists.

Conclusions

The relations between the natural environment and tourism are complex and go both ways. The research has highlighted the fact that in Romania there are concerns for the protection of the natural environment. An example in this sense is represented by the creation of natural parks with a positive impact on tourist activity. Thus, the surface of natural parks has increased, in the 2000-2015 period, with about 551,000 ha, by 36,725 ha on average annually. This increase has had, we found as a result of the research, a positive impact but of a weak intensity on the attraction of foreign visitors to Romania. This result has led us to the conclusion that intensifying the promotion of protected areas in our country so as to attract a larger number of tourists is of the essence.

Regarding the impact of tourist transport on the environment, the research has highlighted a negative situation, in the sense that the most polluting forms of transport, namely road and air transport hold the highest share in the arrivals of foreign visitors in Romania. The forecast of the structural changes of the preferences of tourists in choosing the means of transport are not encouraging either from the point of view of the impact on the natural environment. Thus, the results of the forecast made with the help of the Markov chains method have shown a slight trend of decrease in the share of road transport, but a continuation of the increasing trend in air transport.

These results are strong arguments in favor of the promotion of policies meant to improve the current situation. In this sense, the proposals formulated following our research are aimed both at improving environmental conditions through the increase in the number and surface of protected areas, as well as at the diminishing of the negative impact of tourist activity on the environment through policies of regulation and control of the development of transport services, ecological education of tourists, restoring the historical sites of art monuments etc., saving resources in the tourist activity.

Of course, our research has certain limitations, in the sense that a limited number of indicators were subjected to analysis, of the hundreds which can be utilized for studying the complex relations between the environment and tourism.

The research should be continued, also, through the use of direct research methods (interviews, questionnaires a.s.o.) addressed both to tourists and to managers and tourist employees. Another important direction of study would be the conducting of concrete analyses at the level of tourist destinations and at the level of territorial units.

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