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CONTENTS

Volume XVII, Issue 2 / December 2018

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December** 2018), pp. **111-117**
http://dx.doi.org/**10.5775/fg.2018.073.d**

Study of landscape evolution in North Koel River Basin, Jharkhand, India: tectonic and structural implications based on hypsometric analysis

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Abstract

Hypsometry is widely used for inferring tectonic effects and erosion status of landscapes. Tectonics, structural inhomogeneity, lithologic differences, and climatic variations lead to topographic undulations discerned into discrepancies in the values. Hypsometric index (and curve), indicative of frequency distribution of proportional elevation with the respective proportional area, is used as a tool to describe characteristics of landscape morphology, lithological variability, and degree of fluvial dissection. Many workers have used to infer comparison of rates of erosion with tectonic uplift rates. However, there are many other factors reported to influence topographic undulations other than tectonics which lead to a variety of hypsometries. Morphotectonic index, hypsometric integral, calculated using digital elevation models (DEMs) in GIS environment has been widely used for inferring tectonic effects, status of erosion, and structural controls. The present study is conducted in the North Koel River basin. This river rises in the Ranchi plateau and joins the Son River a few miles north-west of Haidarnagar, is the right bank tributary of the Son River. Along its entire course of flow, North Koel river (260 km) flows through plateau region mostly formed of metamorphic rocks. Hence, structural control seems to be the primary control on the landscape evolution of this sub-basin. In this study, hypsometric integral (and curve) has been calculated for third order and upper order streams to look whether this morphotectonic index shows any sign of tectonic, structural, or lithologic control on the landscape evolution in the North Koel River basin.

Keywords: *Hypsometric integral, Morphotectonic, GIS, North Koel River*

Rezumat. Studiu privind evoluția peisajului în bazinul raului Koel de Nord, Jharkhand, India: implicații tectonice și structurale bazate pe analiza hipsometrică

Hispometria este larg utilizată în indicarea efectelor tectonice și a stadiului de eroziune al reliefului. Tectonica, neomogenitatea structurală, diferențele litologice și variațiile climatice duc la undulații topografice marcate în discrepanțe ale valorilor. Indicele hipometric (și curba), care indică distribuția frecvenței altitudinii proporționale cu aria proporțională corespunzătoare, este folosit ca instrument pentru a descrie caracteristicile morfologiei peisajului, variabilitatea litologică și gradul de disecție fluvială. Mulți muncitori au folosit-o pentru a deduce compararea ratelor de eroziune cu ratele tectonice de ridicare. Cu toate acestea, există mulți alți factori care au influențat undulațiile topografice, altele decât tectonica, care au dus la o varietate a hipsometriilor. Indicele morfotectonic, integrala hipsometrică, calculat folosind modele altimetrice digitale (DEM) în mediul SIG, a fost folosit pe scară largă pentru a deduce efectele tectonice, starea eroziunii și controalele structurale. Prezentul studiu este făcut pentru bazinul hidrografic al râului Koel de Nord. Acest râu izvorăște din platoul Ranchi și unește cu râul Son, aflat la câțiva kilometri nord-vest de Haidarnagar, fiind afluent de dreapta al râului Son. De-a lungul întregului său curs, râul Koel de Nord (260 km) curge prin regiunea de platou formată mai ales din roci metamorfice. Prin urmare, controlul structural pare a fi controlul primar privind evoluția peisajului din acest sub-bazin. În acest studiu, a fost calculată integrala (și curba) hipsometrică pentru cursurile de ordinul trei și cele de ordin superior pentru a vedea dacă acest indice morfotectonic indică vreun semn de influență tectonică, structurală sau litologică asupra evoluției peisajului din bazinul râului Koel de Nord.

Cuvinte-cheie: *integrala hipsometrică, morfometrie, SIG, râul Koel de Nord*

Introduction

The geomorphology of Jharkhand state is characterized by a big number of tectonically origin rivers networks passing through the hills and valleys. The rock types are metamorphic which are less prone to soil erosion in rainy season. The North Koel River rises on the Ranchi plateau and enters Palamau division, below Netarhat near Rud. After flowing nearly due west for about 32 kilometres (20 mi), it turns north at an almost complete right angle through a gorge at Kutku, and flows through the centre of the district until it falls into the Son a few miles north-west of Haidarnagar. River basins are the important elements of the fluvial landforms and a large quantity of study has focused on their geometric behaviors and characteristics, which contain the topology of the stream networks and quantitative analysis of drainage texture, pattern, shape, and relief characteristics (Abrahams1984; Huggett and Cheesman 2002).

The region is rich in various natural resources; most parts of the areas remain not accessible due to the mountainous nature of the land. Conservation of land and water resources is an important aspect of

basin management. A drainage basin is an area from where all precipitation flows to a particular water body, such as tributary stream, river or sea and it can be considered as an important geomorphic unit. Therefore, analysis of the basin contributes to understand the landform evolution through successive stages of geological time, fluvial process, lithologic character and hydrological behavior of a basin as well as tectonic activity of a region.

Hypsometry of a region provides measurement of land elevation sea level. A hypsometric curve is essentially a graph that illustrates the proportion of land area that exists at various elevations by plotting relative area against relative height. Strahler (1952) and Schumm (1956) utilized hypsometric (or area-altitude) analysis to differentiate between eroded lands at different stages in their evolution. This kind of study involves calculating the percentage of drainage basin area above each of a series of given altitudes.

Hypsometric analysis is a useful method to identify the stage of a drainage basin in the present cycle of erosion and evaluates the erosional condition of a basin, and also populates the denudational processes over a region. Besides erosional condition of landform evolution, the influence of activity and lithological factors controlling on landform evolution can be calculated from hypsometric examination (Lifton and Chase, 1992; Moglen and Bras, 1995; Willgoose and Hancock, 1998; Hurtrez and Lucazeau, 1999; Chen et al., 2003; Huang and Niemann, 2006). Thus, hypsometric investigation can be used as an estimator of erosional condition of a drainage basin and prioritize them for taking up soil and water conservation measures, which is the prerequisite for planning and management of the basin. Geographic information system (GIS) and digital elevation model (DEM) have played a vital role in in drainage basin analysis (Rai et. al. 2014; Rai et.al. 2016 & Rai et.al. 2017). Therefore, GIS technique is used as an appropriate tool for hypsometric examination. The objective of this study to look whether the morphotectonic index, hypsometric integral (and curve), calculated for third order and upper order streams, shows any sign of tectonic, structural, or lithologic control on the landscape evolution in the North Koel River basin.

Characteristics of the Study Area

The North Koel River, which rises in the Ranchi plateau and joins the Son River a few miles north-west of Haidarnagar. It is the right bank tributary of the Son River. Along its entire course of flow, North Koel river (260 km) flows through plateau region mostly formed of metamorphic rocks. Hence, structural control seems to be the primary control on the landscape evolution of this sub-basin. The study area stretches between 23°00' N, 83°30' E to 24°30' N, 85°00 E. The total area of the study area is 11418 sq. km. The maximum elevation is 1177 m while minimum elevation of the basin is 122 m.

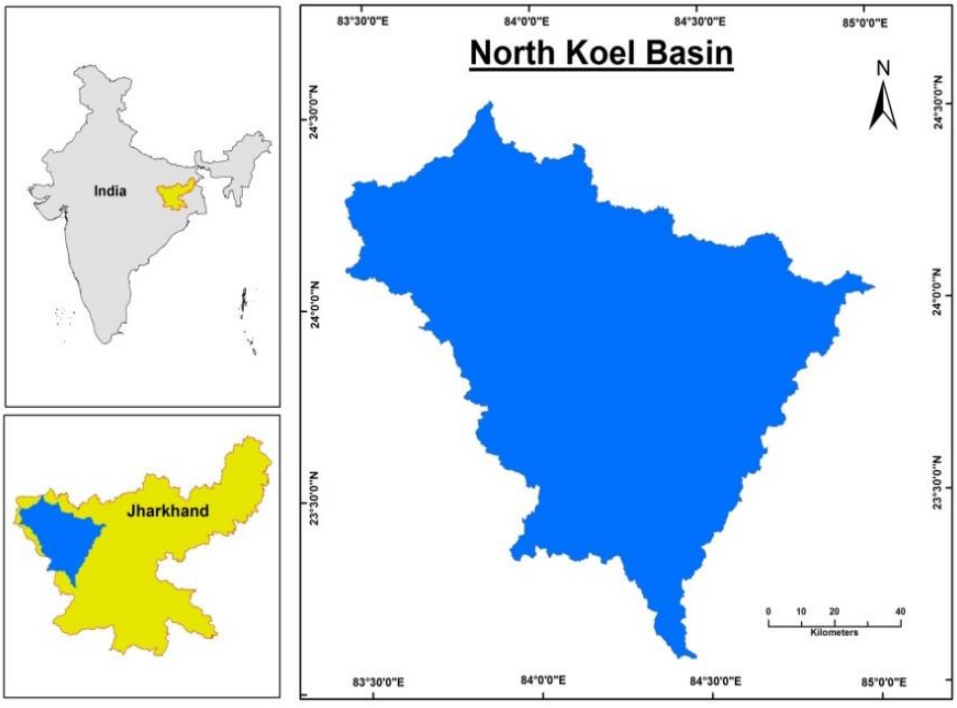

Fig. 1: Location Map of the Study Area

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December 2018**), pp. **111-117**
http://dx.doi.org/**10.5775/fg.2018.073.d**

Materials and Methods

This study analyzes the Hypsometric Integral in the North Koel basin using Shuttle Radar Topography Mission (SRTM) satellite data- Digital Elevation Model (DEM) of 30 m resolution shown in Figure No. 02. ArcGIS hydrology and spatial analysis tools have been used for the study. For the hypsometry integral MS excel has been used to plot the diagram of calculated statistics. Map layouts have been generated in the ArcGIS Desktop. The complete process flow diagram is illustrated in Figure 3a & 3b. The hypsometric curves for the North Koel basin and its sub-basins were prepared based on Strahler (1952) method. Hypsometric integrals of all sub-basins have been calculated using empirical formula proposed by Pike and Wilson (1971).

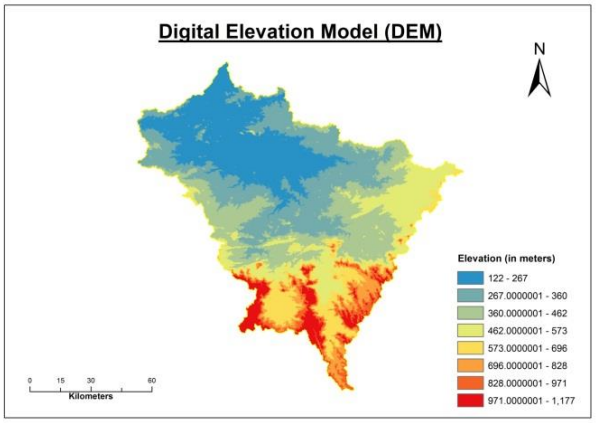

Fig. 2: Digital Elevation Map of the Study Area

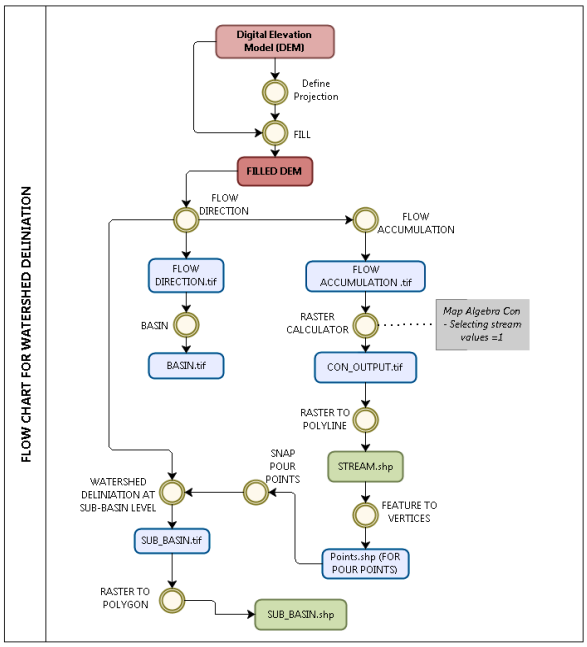

Fig. 3a: Process Flow for delineation of Watershed

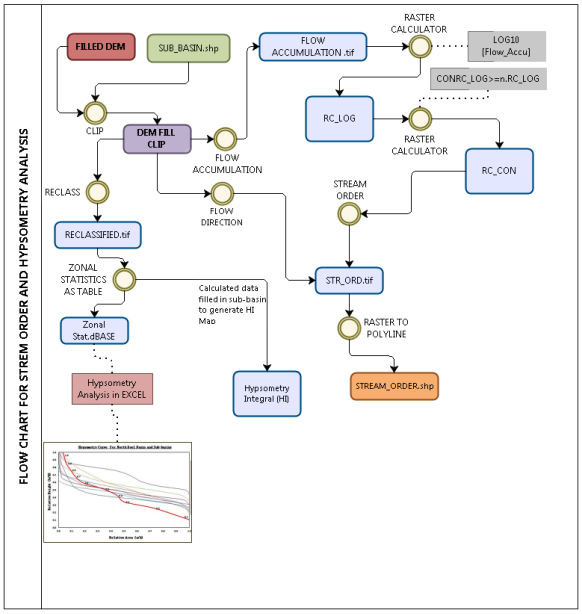

Fig. 3b: Process Flow for Hypsometry

The complete methodology has been divided in two parts for better understanding of the methods utilized in the study. In the first part, figure no. 03a, watershed delineation (fig. 4) has been done while in the other part results have been calculated (fig. 3b).

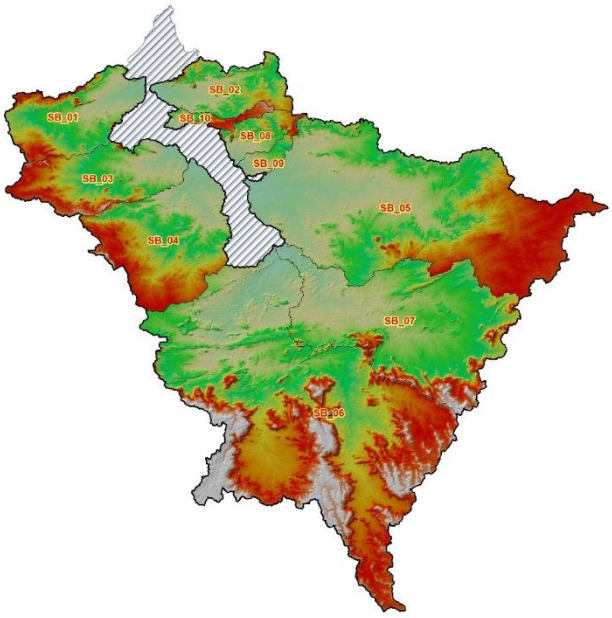

Fig. 4: Delineated ten watersheds of the study area

The stream order morphometry (fig. 5) shows the stream order structures and their total length and share in the basin shown in Table 1.

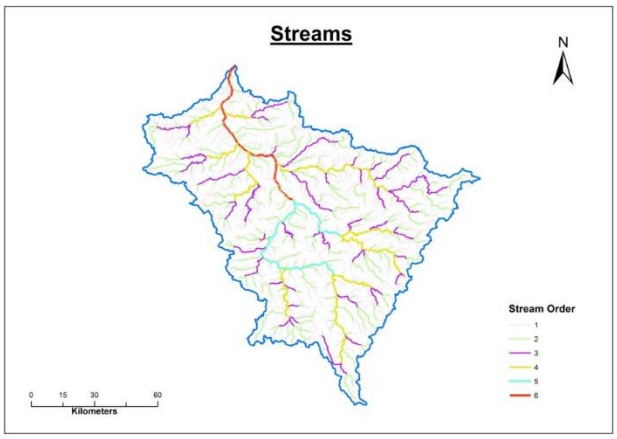

Fig. 5: Stream Order of the Study Area

Table 1: Stream Order Morphometry

Stream Order	Total Length (km.)	% age Share
1	2902.54	51.20
2	1462.87	25.80
3	687.27	12.12
4	397.27	7.01
5	125.49	2.21
6	93.58	1.65

The total Stream length is 5669.01 km up to 6th order of the streams. Generally, the total length of stream segments decrease as the stream order increase. It can be inferred from the table no. 01 that the total length of stream segments is maximum (2902.54 km) in first order streams and decreases as the stream order increases.

Results and Discussion

Hypsometry can be evaluated through the hypsometric curve and hypsometric integral. The shapes of the hypsometric curve and the values of hypsometric integral are important elements in the landform analysis. These can be explained in terms of degree of landscape dissection and relative landform age. The hypsometric curves and hypsometric integral values of the North Koel basin and its sub-basins are discussed below.

Hypsometric curve

The hypsometric curve defines the distribution of elevations across an area of land, which has been used to estimate the evolutionary status of landforms. It is related to the volume of the soil mass in the basin and the amount of erosion that had done in a basin against the remaining mass (Hurtrez et al., 1999, Ahmed F. et al., 2016). Hypsometric curves are related to geomorphic and tectonic evolution of the basins in terms of their arrangements and developments (Schumm, 1956; Strahler, 1964; Leopold et al., 1964; Hurtrez et al., 1999). A useful characteristic of the hypsometric curve is that drainage basins of different sizes can be matched with each other because area and elevation are plotted as functions of the total of both variables. Strahler (1952) has classified three types of landforms on the basis of shapes of the hypsometric curve, denoting the three typical stages, (i) young (ii) mature and (iii) old stages. Convex shaped curves are associated with young stage of basin, indicate that the area is slightly eroded and not eroded much, mature stage is resemble to S shaped curves being concave upwards at higher elevations and convex downwards at lower elevations characterized by moderately eroded regions and old stage of basin is related to concave shaped curves indicate highly eroded and deeply dissected landscapes (Ahmed et al., 2016).

Plotting of hypsometric curves

In the study hypsometry analysis has been performed at basin level as well as at sub basin level for better and detailed outcome. Table no. 02 explains the elevation and area details for the North Koel Basin.

Table 2: Hypsometry Calculation of the North Koel Basin

Elevation Interval (m)	Area Proportion (q. km)	Area Accumulate (sq. km)	Area Accumulation (%)	Proportion of Height	Proportion of Area
122-300	3049.66	11418.01	100.00	**0.1**	**1.0**
300-400	2635.78	8368.35	73.29	**0.3**	**0.7**
400-500	608.46	5732.57	50.21	**0.3**	**0.5**
500-600	1176.23	5124.11	44.88	**0.4**	**0.4**
600-700	1822.50	3947.88	34.58	**0.5**	**0.3**
700-800	668.99	2125.38	18.61	**0.6**	**0.2**
800-900	410.36	1456.39	12.76	**0.7**	**0.1**
900-1000	372.38	1046.03	9.16	**0.8**	**0.1**
1000-1100	294.11	673.65	5.90	**0.8**	**0.1**
1100-1177	379.54	379.54	3.32	**1.0**	**0.0**

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December 2018**), pp. **111-117**
http://dx.doi.org/**10.5775/fg.2018.073.d**

Hypsometry curves were also generated for ten sub basins, figure no. 04, of the study area. Figure no. 08 is showing the curves for all sub basins and also the main basin curve is included in the same figure for better illustration and understanding of the North Koel basin. The 'S' shape curves at sub-basin level are also showing the same diminishing trend which was generated in figures 6 & 7.

The diminishing trends for sub-basins and main basin show that the rivers in the basin are at their old stage. From the curves it can be depicted that the hills of the study area got eroded at large scale and continuously it is getting at base level.

For comparison study two kinds of hypsometry curves have been generated for the whole basin, first curve (fig. 6) generated on the basis of area proportion (in %) and the second one, figure no. 06, made on the basis area proportion ratio. Both curves show same diminishing trend for the whole basin.

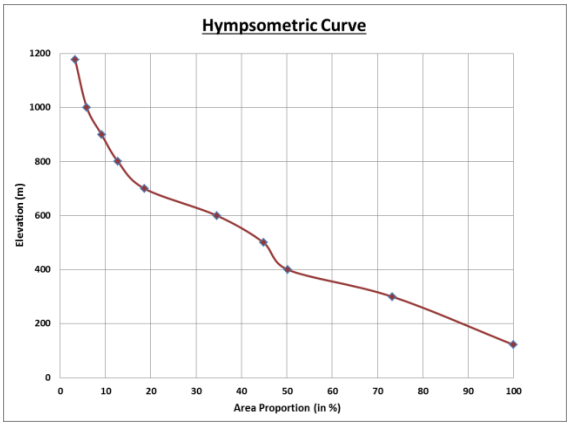

Fig. 6: Hypsometry Curve (Area Proportion %)

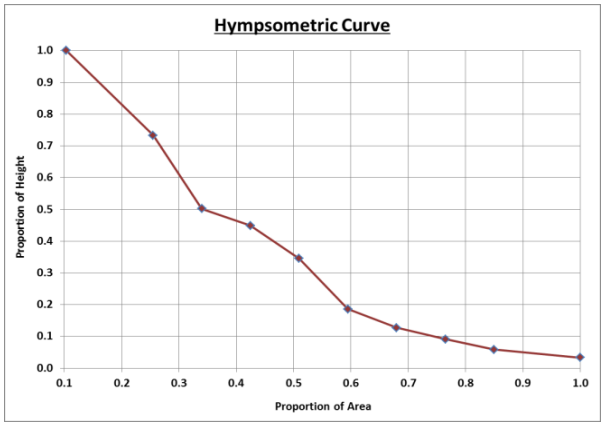

Fig. 7: Hypsometry Curve (Area Proportion Ratio)

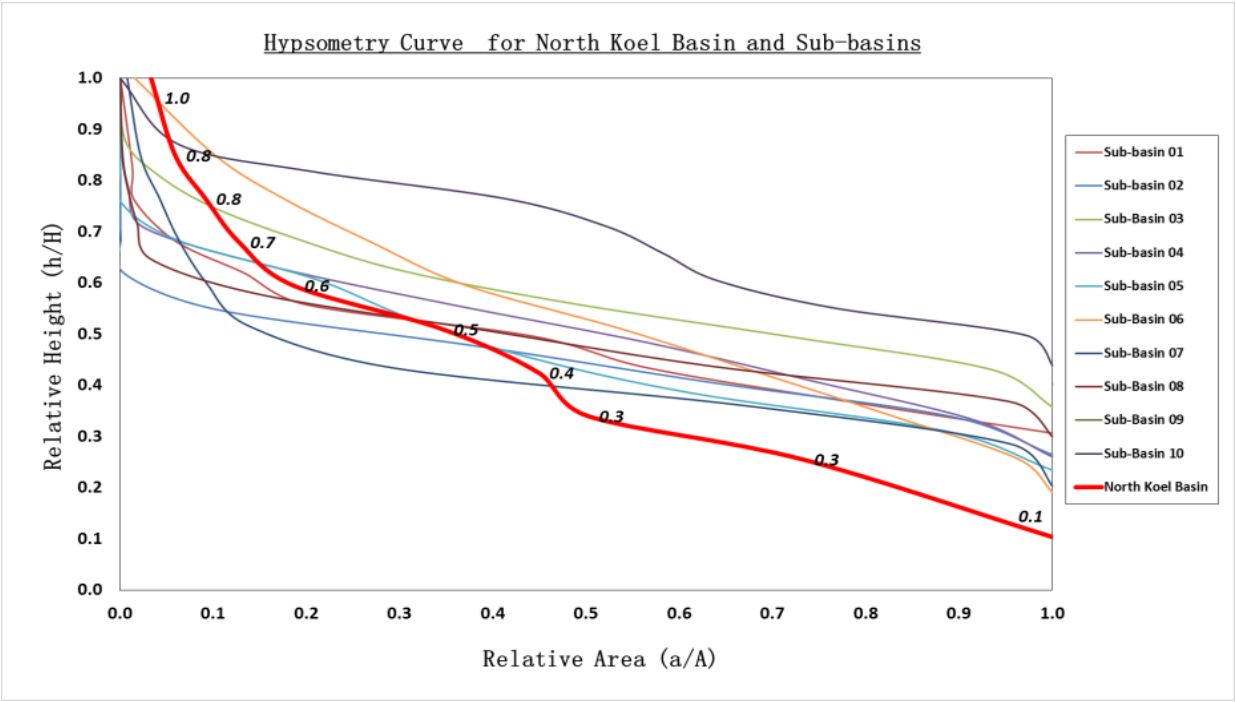

Fig. 8: Hypsometry Curves (Area Proportion Ratio) for Sub-basins

Estimation of hypsometric integral

Integration of the hypsometric curve gives the hypsometric integral (HI), which is equivalent to the elevation-relief ratio (E) as proposed by Pike and Wilson (1971). Mathematically, it is defined as

$$E \approx H_{si} = \frac{Elev_{mean} - Elev_{min}}{Elev_{max} - Elev_{min}}$$

Where,

E_{mean} = Mean elevation value (from summary statistics for watershed raster; not median)

E_{max} = Maximum elevation value

E_{min} = Minimum elevation value (outlet)

In simple word, the HI is just the mean incision of a basin ($E_{mean} – E_{min}$) divided by the basin's relief ($E_{max} – E_{min}$).

The hypsometric integral value is defined by basin geometry, relief and area of drainage basin (Lifton and Chase, 1992; Masek et al., 1994; Hurtrez et al., 1999; Chen et al., 2003). Hypsometric integral is inversely correlated with the total relief, slope steepness, drainage density and channel gradients (Strahler; 1952). The geologic stages of development of landforms and erosional condition of the basins are calculated by hypsometric integral. High value of hypsometric integral specifies the youthful stage of less eroded areas and decreases as the landscape is denuded towards the maturity and then old stages. The HI is articulated as a percentage and is an indicator of the excess of the present volume as compared to the original volume of the basin (Ritter et al., 2002). The hypsometric integral is also a sign of the 'cycle of erosion' (Strahler, 1952; Garg, 1983). The cycle of erosion is demarcated as the total time required for reduction of a land topological unit to the base level i.e. the bottom level. This entire period of the cycle of erosion can be grouped into three categories, each representing the three distinctive stages of the geomorphic cycle, viz. (i) the monadnock stage if HI ≤ 0.35, in which the basin is fully alleviated; (ii) the equilibrium or mature stage if 0.35 ≤ HI ≤ 0.60, in which the basin development has attained steady state condition and (iii) the inequilibrium or young stage if HI ≥ 0.60, where the basin is highly susceptible to erosion and is under development (Strahler, 1952).

The hypsometrical integral (HI) analysis for the study area shows that the current stage of the basin is in its old stage. Table no. 03 describes HI for all ten sub basins of the study area. In eight sub basins the HI value comes below 0.35 which represent the old stage for the basin while two sub basins show middle maturity stage have 0.42 and 0.45 HI value.

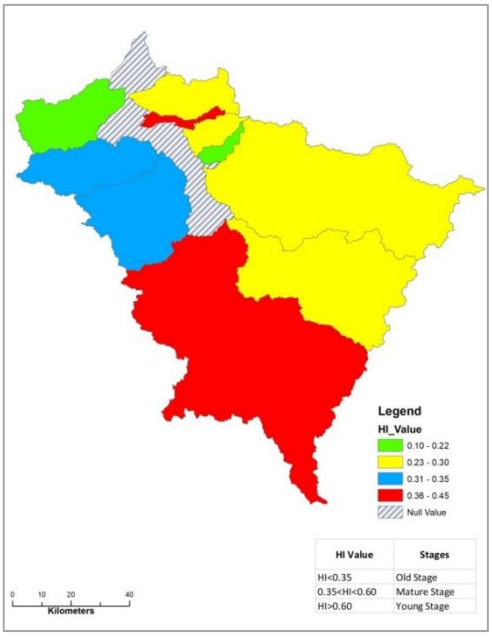

Fig. 9: Hypsometric Integral for the study area

Table 3: Hypsometry Integral at Sub-basin level of the North Koel Basin

Sub-Basin Name	Area (sq. km)	Max Elevation (m)	Min Elevation (m)	Mean Elevation (m)	Hypsomet-ric Integral (HI)	Geological Stage
SB_01	399.53	567	150.0	242.7	0.22	Old Stage
SB_02	560.17	486	149.0	251	0.30	Old Stage
SB_03	621.83	467	167.0	268	0.34	Old Stage
SB_04	935.25	665	173.0	334	0.33	Old Stage
SB_05	2574.00	807	189.0	369	0.29	Old Stage
SB_06	3602.00	1177	224.0	624	0.42	Middle Maturity
SB_07	1584.31	1086	221.0	455.4	0.27	Old Stage
SB_08	164.07	574	172.0	278	0.26	Old Stage
SB_09	81.45	453	182.0	242	0.22	Old Stage
SB_10	84.20	374	164.0	258.2	0.45	Middle Maturity

Conclusion

From the analysis it can be concluded that; the North Koel River is a main tributary of Son River and comprises of dendritic and parallel streams with the average altitude of 400 m. Hypsometric curves for main basin as well as for sub-basins show the 'S' shape curves, indicates old or tending to old age of the basin. Also, the Hypsometric Integral analysis shows eight sub-basins are in old stage while remaining two sub-basins are in middle maturity stage. The basin has dissected landforms, and eroding continuously, prove the same. It has been also inferred that the basin has more lithological control than tectonic or structural controls.

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Application of wireless sensor networks in flood detection and river pollution monitoring

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Abstract

In this paper, we propose a system for river monitoring based on wireless sensor network (WSN) technology. This system consists of sensor nodes that periodically measure several environmental parameters such as flow rate, water level, rainfall and pollution level. Each type of sensor node has two threshold values and measured data is compared with them at the end of the reporting interval.
Based on the current situation in WSN and measured data velocity sensors can use three different frequencies of reporting. Simulation of river monitoring system is done using Matlab software tool and the results of river maintenance during one WSN life cycle are presented. Two possible hierarchical system architectures are considered and their performance is compared. The optimal system architecture for this WSN application is discussed based on the obtained results.

Keywords: *environmental management, flood detection, river pollution, wireless sensor networks*

Rezumat. Utilizarea rețelelor de senzori wireless în detectarea inundațiilor și monitorizarea poluării fluviale

În această lucrare propunem un sistem de monitorizare a râurilor pe baza rețelelor de senzori wireless (tehnologiei WSN). Sistemul constă din noduri de senzori care măsoară periodic mai mulți parametri, cum ar fi debitul, nivelul apei, precipitațiile și nivelul de poluare. Fiecare tip de nod are două valori de prag și datele măsurate sunt comparate cu acestea la sfârșitul intervalului de raportare.
Pe baza situației actuale din WSN și a vitezei de măsurare, senzorii pot utiliza trei frecvențe diferite de raportare. Simularea sistemului de monitorizare a râurilor este realizată folosind un instrument software Matlab și sunt prezentate rezultatele analizei pe parcursul unui ciclu de viață WSN. Sunt luate în considerare două posibile arhitecturi ierarhice de sistem, iar performanța acestora este comparată. Arhitectura optimă a sistemului pentru această aplicație WSN este discutată pe baza rezultatelor obținute.

Cuvinte-cheie: *managementul mediului, detectarea inundațiilor, poluarea râurilor, rețelele de senzori wireless*

Introduction

In many industrial, scientific and medical applications, there is a need for intense and extensive data collection from the physical environment for monitoring purposes. In Serbia, about 13% of the territory (1.6 million ha) is endangered by floods and more than 2.08 million ha must be protected from floods of external and internal waters. It is necessary to drain the existing 2.67 million ha (Gavrilović, 1975; Serbian Ministry of Agriculture, Forestry and Water Management, 2001; Dragićević et al., 2009; Đorđević, 2009). Although significant protection systems have been built from the decades-long flood struggle, some of the erosion and torrential types can endanger about 90% of the territory.

Significant improvements regarding the sustainable use, protection and development of water resources in the Republic of Serbia have been made with the establishment of Water Management Information System of Serbia. The synchronization with relevant EU documents has been made, in particular with Directive 2007/60/EC of the European Parliament and the Council of the European Union from 23rd October 2007 on the assessment and management of flood risks (EFD 2007/60/EC) and with SOFPAS (*Study of Flood Prone Areas in Serbia*) project (*Indikativna mapa područja rizika od poplava*, 2016; Đorđević, 2017).

However, legacy systems for river monitoring based on complex sensor devices that use point-to-point communication for sending data did not provide the necessary flexibility, scalability and they required high operational and maintenance cost. Further development of communication technologies has enabled the application of wireless sensor networks (WSN) (Dargie & Poellabauer, 2011).

WSN applications are based on usage of small, low-cost and multi-functional sensor platforms. These platforms have the ability to form ad-hoc wireless networks in the area of interest, communicate with each other and deliver collected data to the end user. A river monitoring schemes based on WSN technology have been already studied in (Morias et al., 2005; Seal et al., 2012; Ahmad et al., 2013; Pasi & Bhave, 2015).

The rest of the paper is organized as follows. In the second section, the WSN architecture and its principles of work are defined. The third section contains description of the proposed simulated model for river monitoring. The main part of this paper is explained in the fourth section, where the simulation results are presented. Based on the obtained results, conclusions are pointed out in the fifth section.

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http://dx.doi.org/**10.5775/fg.2018.097.d**

Wireless Sensor Networks

For the needs of collecting and transmitting data in WSN, a multifunctional platform called sensor node (SN) is used. By placing a large number of SNs within the area under the observation, a sensor field is formed. In general, SNs are scattered within the sensor field in order to perform local measurements of the observed phenomenon. The collected information is transmitted through mutual communication between SNs to the Sink. Sink represents the destination of all packets that transmit data from SNs and enables two-way communication between the end user of WSN with all SNs. Sink is considerably more complex than SN, it has larger size and greater possibilities for data processing. Communication with the end user of WSN is realized using the available network infrastructure in the area of interest. In most cases, Sink is a Base Station of the corresponding mobile network that transmit data collected from SNs to external network (Internet) (Buratti & Verdone, 2008). One possible WSN communication architecture with two sensor fields is shown in Fig. 1.

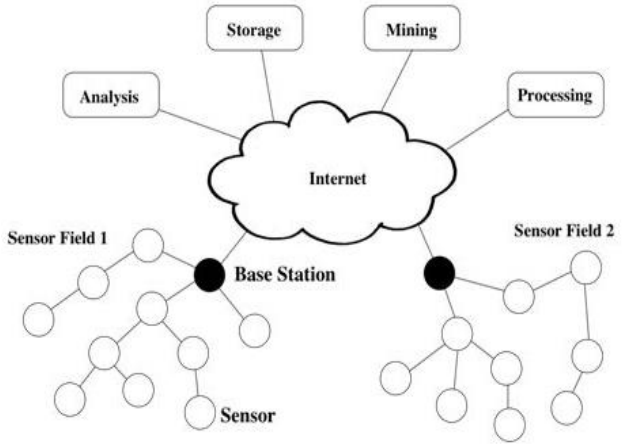

Figure 1: WSN communication architecture

Data collected by SN is forwarded to Sink over a large number of SNs and routed through the ad-hoc multi-hop WSN architecture. In many applications, it is not necessary that all SNs in the network deliver data to Sink. In order to reduce the amount of traffic and energy consumption in WSN, the combined information obtained by combining the data of more SNs is delivered. Successful data aggregation can be achieved by the formation of mutually separated groups of SN clusters (Duan & Yuan, 2006). The cluster consists of several SNs, one of which has the role of a cluster coordinator - cluster head (CH). Other SNs in cluster communicate only with CH while CH coordinates the process of communication and collection of sensor data and performs data aggregation. A set of all CHs in WSN that communicate with each other and perform routing of data and packets from and to Sink represents a higher layer of two-layer WSN hierarchical architecture. The lower layer consists of SNs within a single cluster without the possibility of mutual communication. The choice of CH is done according to the criterion of the lowest energy consumption possible, as well as in accordance with the application of WSN, traffic requirements of the network and data routing needs (Yadav et al., 2007; Cengiz & Dag, 2017).

Simulation Model

We consider the use of WSN for monitoring the parameters of the river basin in each cell (cluster) that covers the area shown in Fig. 2 (Marković & Drajić, 2015; Lukić & Lukić, 2017). Simulation environment supports two Sink positions: in the centre of the sensor field and at the centre of the lower edge of the sensor field. WSN consists of two cell types: RMC (River Monitoring Cells) and RFC (Rain Fall Cells). RMC cells includes five RMSN (River Monitoring Sensor Node) with sensors for tracking the river flow rate FRS (Flow Rate Sensors), current water level WLS (Water Level Sensors) and river pollution level PLS (Pollution Level Sensors). In addition, there are four RFSN (Rain Fall Sensor Node) with rainfall sensors RFS (Rain Fall Sensors) in each RMC cell on the ground by the river. Each cell has one SN that performs the calculations, it is called computational node (CN), and at the same time represents a permanent CH for that cell. To track the river basin for possible rise in water level - Flood Detection Monitoring (FDM) function and pollution level - River Pollution Monitoring (RPM) function, it is necessary to send the information collected by each CH to the Sink located at some distance. For this reason, additional RFC cells are formed, through which the data from the RMC cells are routed to the Sink. Since these nodes would not only be used for transmission, they also contain RFSN sensors and thus measure the amount of rain fall on a much wider surface. Each RFC cell includes nine RFS sensors and one of them is CH located in the middle of the cell.

For all parameters measured by FRS, WLS, RFS and PLS sensors two values are defined: actual value and the measured value with the given accuracy of the measurement. FRS, WLS and RFS sensors perform measurements every 15 minutes and PLS sensors every 30 minutes and they process the received data in the given observation interval. Depending on the situation in WSN the length of observation period can be 15 minutes (alarm for FDM function), 1h (increased alertness for FDM function), 6h (normal operation for FDM function), 2h (alarm for RPM function), 6h (increased alertness for RPM) and 12h (normal operation for RPM function). At given time intervals, SNs send data with reports that contain a minimum, maximum and medium value for the collected measurement result.

SNs for each measured parameter value have defined two thresholds so they can have three states: below the lower threshold, between two thresholds and above the upper threshold.

Depending on the current state and the change in measured values it is possible to define the status of the sensor for FDM and RPM function, according to which SN can independently decide to send reports more often to its CH. Depending on the results collected during the current observation period CH can independently change the status of reporting in the cell. In that way, for each FDM and RPM function three cell states can be defined: normal operation (very rare reporting), increased alertness (slightly more frequent reporting) and alarm (frequent reporting).

Two hierarchical WSN architectures are examined: single-hop and multi-hop. In a single-hop architecture CH sends data collected from cluster members directly to the Sink. In a multi-hop architecture CHs form a higher network layer and through multiple jumps by mutual communication send data from their cluster to the Sink. Simulation of the river monitoring system is performed with Matlab software tool. Fig. 2 contains a graphical representation of WSN model simulated in Matlab.

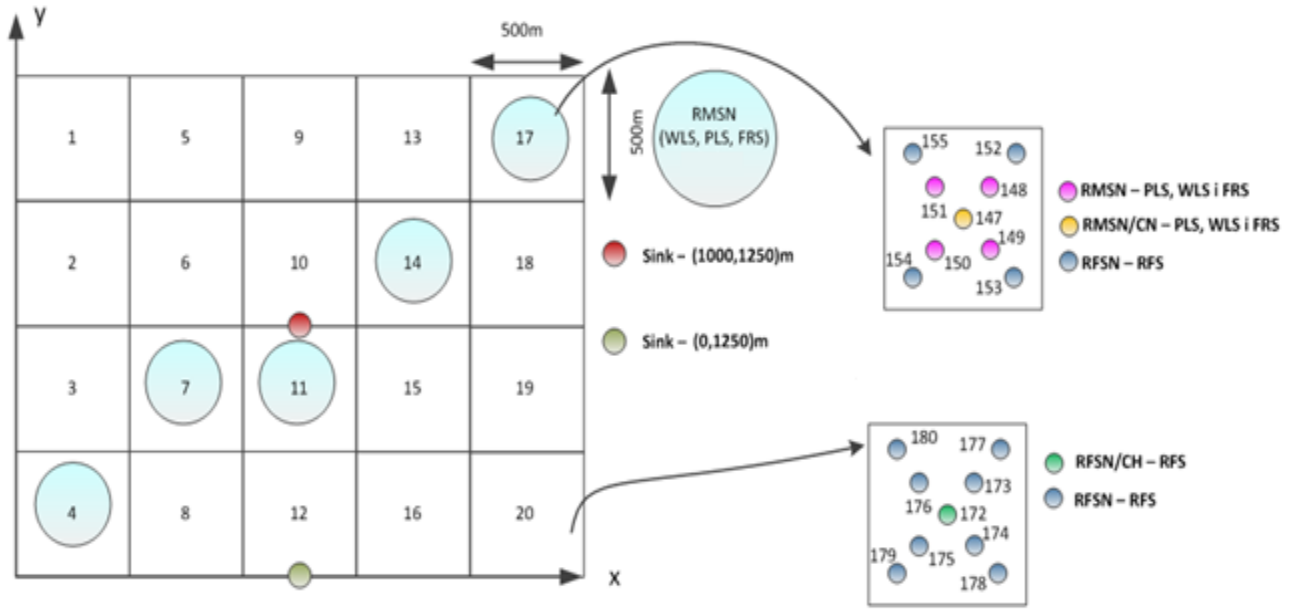

Figure 2: Simulated WSN model with RMC and RFC cells

Results

The WSN work is designed in 15-minute time frames. Observation lasts one month so there are 2880 time frames during the network life cycle. At the beginning of each time period, the output variables obtained in the previous reporting interval are set as initial values for the current period.

During the specific reporting interval, identical procedures for both FDM and RPM function are executed and they include the following: calculating the minimum, maximum and mean data values collected from the corresponding sensor type, defining of the SN state and cell state based on measured data and counting the number of packets sent from SN to CH and the number of aggregated packets sent from CH to the Sink.

Simulation model is implemented in a way that makes SN change its state to increased alertness or alarm state if at least one sensor type within the FDM and RPM function exceeds the lower or upper threshold, respectively. It has also been assumed that the cell state changes if the state of at least half of the SNs in that cell has changed. In order to examine the reliability of the event detection, the root-mean-squared error (RMSE) of the measured values is calculated for each sensor type.

At the end of the simulation the number of packets sent by each SN during the network life cycle is stored in vector SN_sent. The number of aggregated packages sent by each CH to the rest of the network is stored in the corresponding vector CH_sent. The residual energy of SNs can be found in vector SN_E_new. The values of these vectors during the WSN work is graphically represented in Fig. 3 in case of a single-hop WSN architecture.

The same procedure is performed on a multi-hop WSN architecture. Corresponding vector values are calculated and presented in Fig. 4. The number of packets sents from SN to CH and the number of aggregated packets sent from CH to the Sink is decreased in relation to the single-hop case.

Forum geografic. Studii și cercetări de geografie și protecția mediului
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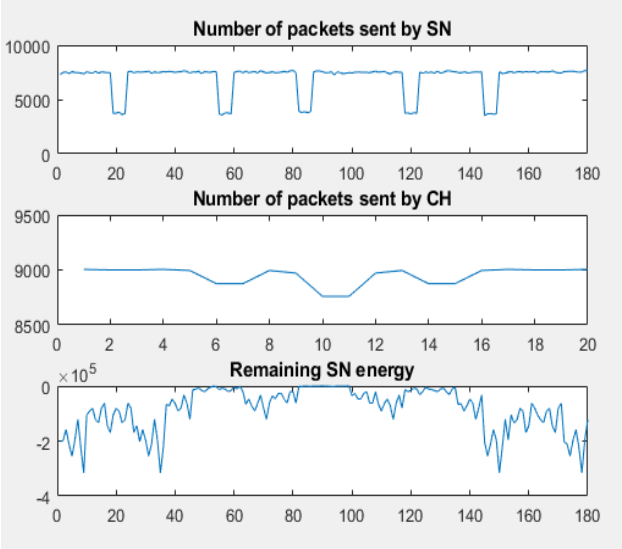

Figure 3: Content of *SN_sent*, *CH_sent* and *SN_E_new* in case of a single-hop WSN architecture

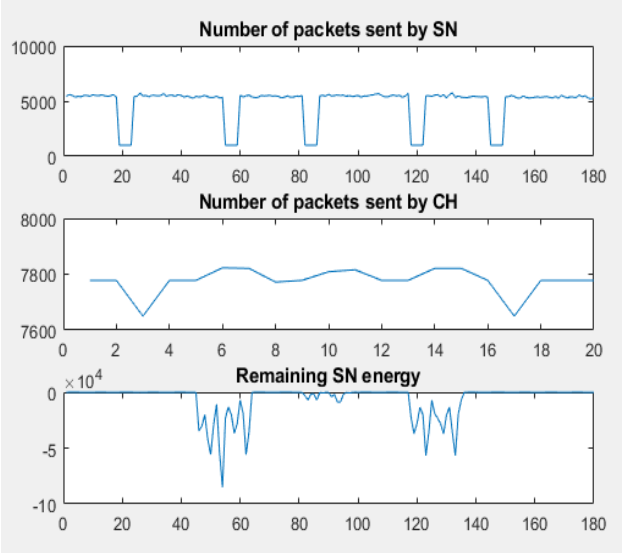

Figure 4: Content of *SN_sent*, *CH_sent* and *SN_E_new* in case of a multi-hop WSN architecture

In a multi-hop scenario CHs are communicating with each other so the total number of aggregated packets is distributed among CHs in WSN which results in the lower average number of packets sent by CH to the Sink. Also, the remaining energy of SNs is much higher compared to a single-hop WSN architecture due to the very nature of a multi-hop communication in WSN.

For both hierarchical system architectures the RMSE of data collected by each sensor type is obtained. These values are shown in Fig. 5 and 6 for a single-hop and a multi-hop WSN architecture, respectively. Results are very similar although deviation between values predicted by simulation model and observed values is slightly higher in a single-hop case.

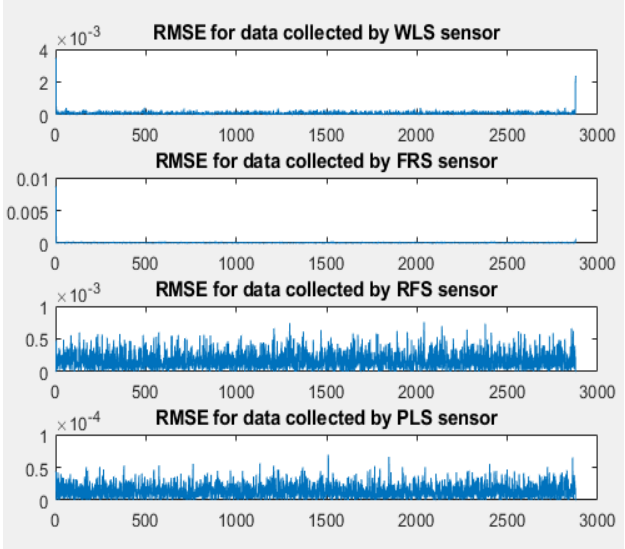

Figure 5: RMSE values for data measured by SNs in case of single-hop WSN architecture

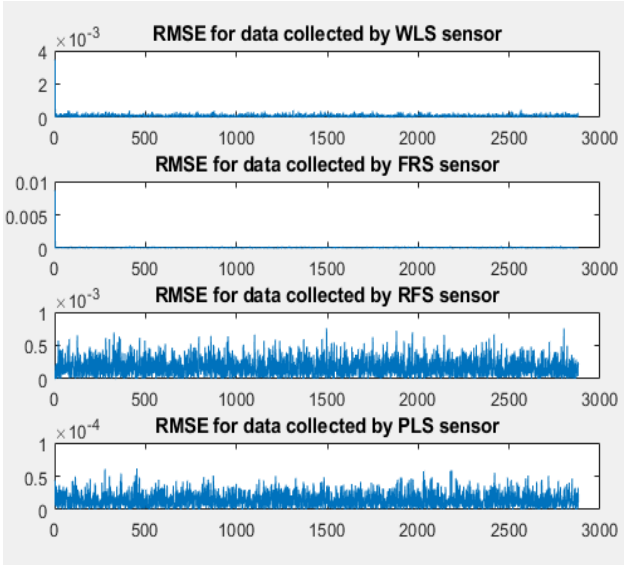

Figure 6: RMSE values for data measured by SNs in case of multi-hop WSN architecture

Conclusion

This paper considers usage of WSN technology in the river maintenance. Proposed simulation model gives very precise results and it shows that environmental parameters were accurately measured during the observation period.

Moreover, it was concluded that a multi-hop architecture is more efficient in terms of energy consumption compared to the single-hop architecture and that it increases overall network life span. Based on the obtained results the multi-hop hierarchical architecture represents the optimal system architecture for this WSN application.

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The impact of human activities on the environment in the Romanaţi Plain (Romania), during the postcommunist era

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Abstract

The purpose of the article is to present the impact of human activities on natural landscapes in the Romanati Plain. With the change of the communist regime, the form of ownership of the land has changed due to the disappearance of agricultural cooperatives. This has led to land breaking and changing the way it is used. By ccalculating some human environmental pressure indicators, based on statistical data, maps were made using GIS programs, which were then compared and interpreted, thus following the evolution of anthropic environmental impact during the period 1992-2017.

Keywords: *human pressure, Romanați Plain, population density, anthropic activities*

Rezumat. Impactul activităților umane asupra mediului natural în Câmpia Romanațiului (România), în perioada postcomunistă

Scopul articolului este acela de a prezenta impactul activităților umane asupra peisajelor naturale în Câmpia Romanațiului. Odată cu schimbarea regimului comunist, s-a schimbat și forma de proprietate a pământului prin dispariția cooperativelor agricole. Acest lucru a dus la fărâmițarea terenurilor și schimbarea modului de utilizare a acestora. Prin calcularea unor indicatori de presiune umană asupra mediului, pe baza datelor statistice, s-au realizat hărți cu ajutorul programelor GIS, acestea fiind apoi comparate și interpretate, urmărindu-se astfel evoluția impactului antropic asupra mediului, în perioada 1992-2017.

Cuvinte-cheie: *presiunea umană, Câmpia Romanațiului, densitatea populației, activități antropice*

Introduction

The need to assess the human impact on the environment has led to the development and introduction of environmental quality indicators in the international literature, this thing being done by Maruszczak (1988) and Pietrzak (1998), when they assessed environmental quality in the Polish Carpathians.

Pătroescu et al. (2000) made the first hierarchy of the Romanian Plain landscapes and introduced these indicators of environmental quality assessment as a result of the impact of anthropogenic pressure in Romania's literature. In the following years, a number of papers on the environmental quality assessment were published for some of the larger relief units: Oltenia Plain (Dumitraşcu, 2006), Bălăciţa Piedmont (Ionuș et al., 2011), Dăbuleni Plain (Simulescu and Zamfir, 2015), the northern part of the Someşan Plateau (Bogan et al., 2015), or smaller areas: the basin of the Bâsca Chiojdului river (Zarea and Ionus, 2012), Almăj Land (Ianăş, 2013), Ghioroiu commune (Boengiu et al., 2016), the Nera Gorges-Beușnița National Park (Ianăș and Germain, 2018), etc.

Study area

The Romanați Plain (named after the former county of Romanați) represents the eastern subunit of the Oltenia Plain and has an area of approximately 3156 sq. km (being the largest subunit - Badea et al., 2011). It extends between the floodplains of Jiu (west), Olt (east) and Danube (south) rivers, while the northern boundary to the Olteț Piedmont is not so clear, being generally given by the alignment of the localities Craiova - Pieleşti - Balș - Piatra -Olt. Geographically, the plain is situated approximately between the parallels of 43°35' and 44°25' north latitude and the meridians of 23°45' and 24°50' east longitude.

Located in south-western part of Romania, the Romanați Plain has a predominantly agricultural character, so the impact of human activities has played over time a significant role in changing the natural environment. The ancient population of the plain has been highlighted by the numerous archaeological discoveries on its territory, namely the Paleolithic settlements on the Olt valley and the Neolithic settlements in Vădastra commune (Geografia României vol. V, 2005).

The altitudes of the plain descend from north to south, the highest altitudes (190 m) being on the interfluve between Jiu and Teslui rivers, in the northern part of the Leu-Rotunda Plain subunit, and

descend to 20-30 m at the contact of the plain with the Danube's floodplain (Fig. 1).

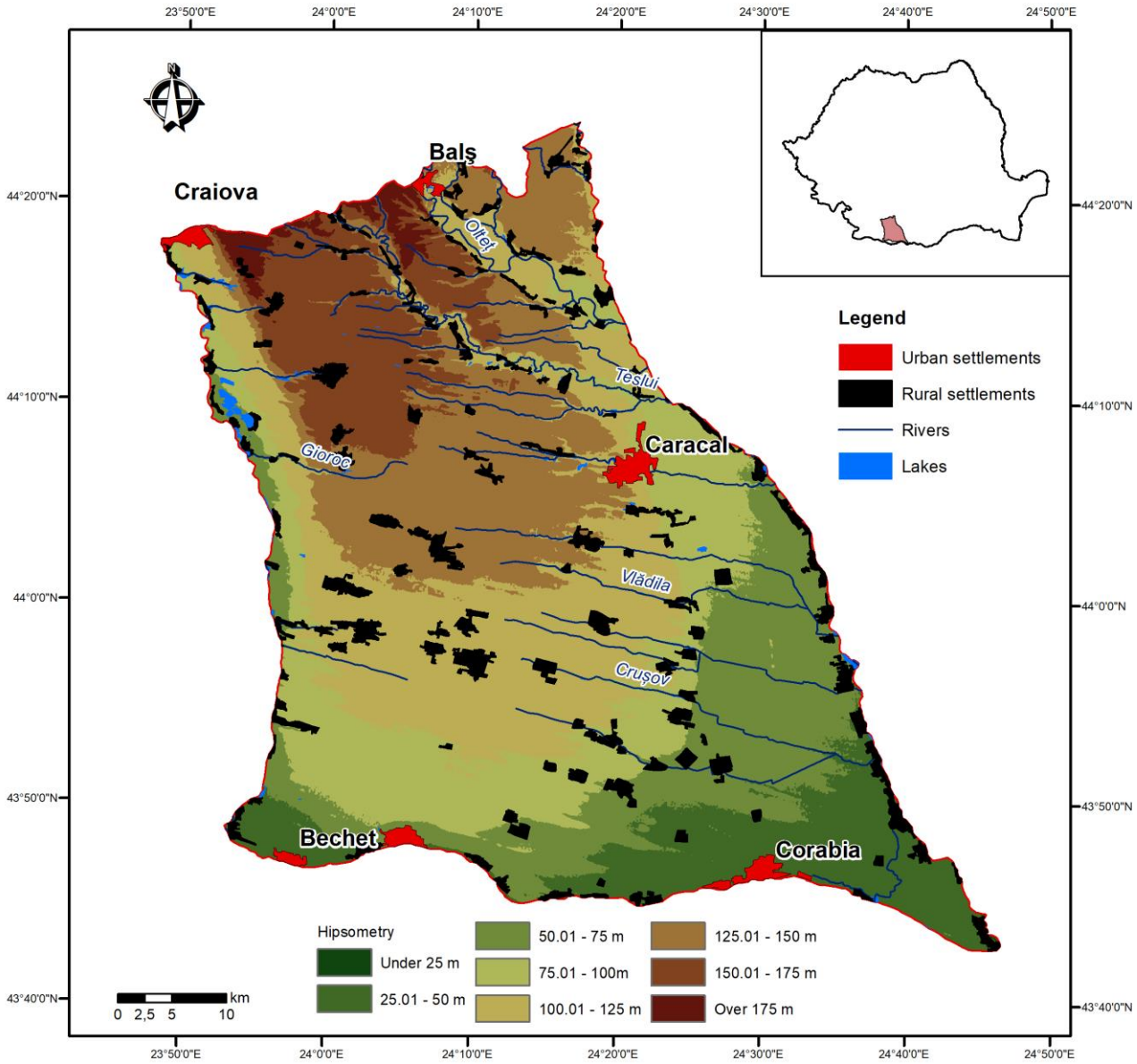

Figure 1: The Romanați Plain – study area

The Romanați Plain is a piedmont plain, with a corrugated surface due to the accumulation of aeolian sands from the Jiu, especially, and the Danube's floodplains, which is affected by deflation and accumulation processes, that shape the areas which are not protected by vegetation.

The deficient internal water resources of the plain corroborated with the high temperatures in the warm season, and the predominantly sandy soils, lead to frequent occurrence of drought phenomenon (Vlăduț, 2007). The De Marton moisture index of 25-26 and the aridity index of 160-210 mm highlight the fact that the Romanați Plain (especially its southern part) has the semiarid and excessively dry type of climate (Vlăduț, 2010; Dragotă et al., 2011).

So, water and climate stress, as well as the intensive cultivation of land, had a bad effect on the initial vegetal formations, leading to a drastic reduction in the number of species and individuals in the flora and fauna species. At present, the natural vegetation covers less than 5% of the study area (Dumitrașcu, 2006).

Thus, in order to assess the anthropic changes on the environment in the Romanați Plain, a number of indexes were selected from the above mentioned literature, such as: population density, landscape artificialization index, naturality index, environmental change index, the index of human pressure on the environment through land use (agricultural, forestry, pasture and hayfields, vineyards, orchards).

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Volume **XVII**, Issue **2** (**December 2018**), pp. **123-134**
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Data and methods

In order the calculate the indexes for assessingthe anthropic impact on the quality of the environment, 3 reference years were chosen, namely the Censuses of Population and Housing from 1992 and 2002, and the year 2017, the latter in order to present the current situation. The statistical data was provided by the Dolj, Olt and Teleorman County Statistics Offices.

If for the years 1992 and 2002 the values were calculated for 69 administrative-territorial units, for the year 2017 values were calculated for 78 administrative-territorial units, this being due to the Law No. 84/2004, which provided the administrative reorganization of several communes throughout the country, and the emergence of new administrative-territorial units.

Statistical data were processed using GIS techniques, yielding values for the 3 reference years, for a series of indexes addressing anthropic pressure on the natural environment. The resulting maps and values were then compared and interpreted to give an overview of the impact of human activity on the environment in the Romanați Plain, in the post-socialist era.

For the calculation of the human pressure indicators on the environmental, the following formulas were used:

- Population density

P_d = *No. inhabitants / Total area*

- Naturality index

N_i = *Forest area / Total area*

- Environmental change index

E_{ch} = *Forest + pasture + hayfield area / Built-up area*

- Landscape arficialization index

A_i = *Built-up + industry + communication roads / Total area*

- Human pressure through agriculture

P_a = *Agricultural area / No. inhabitants*

- Human pressure through forest

P_f = *Forest area / No. inhabitants*

- Human pressure through orchards

P_o = *Orchard area / No. inhabitants*

- Human pressure through vineyards

P_v = *Vineyard area / No. inhabitants*

- Human pressure through pasture and hayfields

P_{ph} = *Pasture + hayfield area / No. inhabitants*

Results and discusions

Population density is the first index that was determined and represent the number of inhabitants that live in an area of 1 square kilometer (Fig. 2):

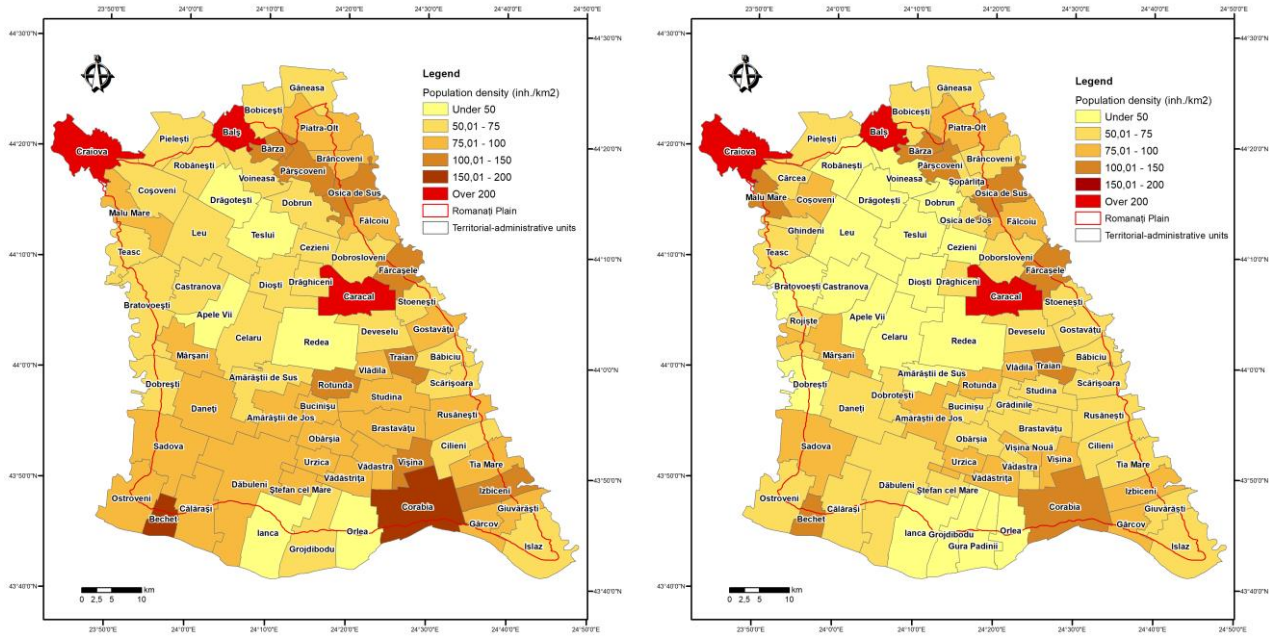

Figure 2: Population density in Romanați Plain (a-1992; b-2017)

In 1992, the total population of the 69 administrative-territorial units comprised in the Romanați Plain amounted 680.126 persons. Most inhabitants were registered in the towns of Craiova (308,810 inh.), Caracal (39,660 inh.), Balș (24,146 inh.), Corabia (22,602 inh.) and Dăbuleni commune (15,048 inh.), while the lowest values, less than 2500 inhabitants, were registered in six communes.

The average population density for the 69 ATUs was 167.69 inh./km^2, the highest values being recorded in the towns of Craiova (5251.87 inh./ km^2), Balș (587.07 inh./km^2), Caracal (569.5 inh./km^2), Corabia (180.86 inh./km^2) and Bechet (150.07 inh./km^2). The lowest values, under 50 inh./ km^2 were recorded in Ianca (45.67 inh./km^2), Orlea (44.62 inh./km^2), Apele Vii (44 inh./km^2), Teslui (42.67 inh./km^2), Drăgotești (42.41 inh./km^2) and Redea (29.26 inh./km^2).

Compared to the year 1992, the total population in 2002, for the 69 ATUs registered a slight increase, up to 685,006 persons, the average population density decreasing from 167.69 inh./km^2 (1992) to 147.36 inh./km^2 (2002). The expansion of some cities, lead to the substantial increase of the total area, thus explaining the high average population density decrease.

As a result of the territorial reorganization in 2004, in 2017, the Romanați Plain included 78 ATUs. The total population has decreased in the studied area by approximately 60,000 persons compared to 2002, to 628,285 persons. The largest number of inhabitants was still recorded in the towns of Craiova (307,290 inh.), Caracal (35,742 inh.), Balș (21,445 inh.), Corabia (18,614 inh.) and Dăbuleni (12,409 inh.). The communes ranking last had less than 1500 inhabitants (3 communes – Șopârlița, Grădinile and Vădastra) and it is worth mentioning the fact that they are not the ones with the lowest values in 1992. This significant drop in population was due to the negative natural growth in rural areas and the migration of young people to cities and aslo to emigration in the better developed countries from Western Europe, in search of a better life.

The average population density decreased from 147.36 inh./ km^2 (2002) to 126.51 inh./ km^2 in 2017, with the highest values being obviously in towns, although decreasing, while in more than half of the communes it was less than 77 inh./ km^2, with values as low as 23.17 inh./km^2 (Redea).

The naturality index represents the ratio between the forest area and the total area (thus determining the degree of afforestation), being calculated at the level of administrative-territorial unit.

Taking into account the values obtained from calculating this index, Ionescu et al. (1989) categorized the degree of landscape damage in 6 categories:

- landscape with ecological balance close to the original one (> 0.60);
- landscape with relatively stable ecological balance (0.45-0.60);
- landscape with weak affected ecological balance (0.30-0.45);
- landscape at the ecological balance limit (0.20-0.30);
- landscapes with strong affected ecological balance (0.10-0.20);
- landscape with very strong affected ecological balance (<0.10).

Being a plain unit and having a predominantly agricultural character, the values obtained for the naturality index (for all 3 reference years), fall within the last four categories of classification, respectively from the landscape with weak affected ecological balance, to the one with very strong affected ecological balance (Fig. 3).

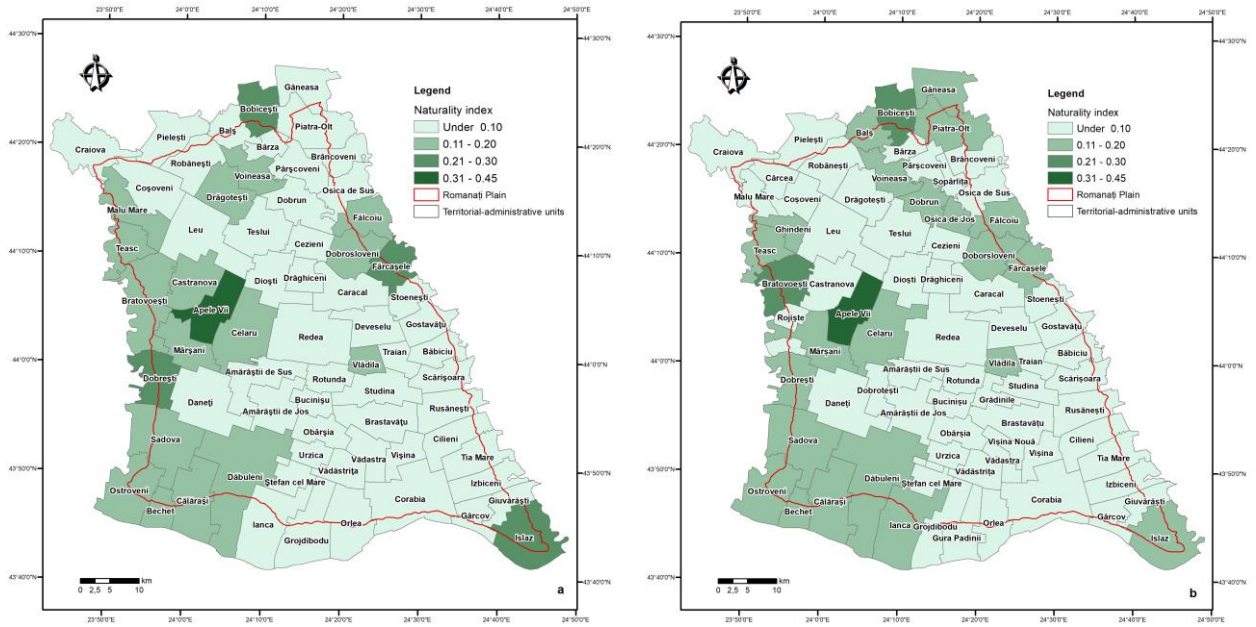

Figure 3: Naturality index in Romanați Plain (a-1992; b-2017)

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For the year 1992, the average value of this index was 0.08, the total area occupied by forests being 34,018 ha. The highest values of the naturality index were recorded by the just a few communes (only five registering an index above 0.20). The lowest values were recorded in the ATUs without forests, namely Bucinişu, Craiova, Găneasa, Pieleşti, Redea, Rotunda and Vişina.

Thus, 49 ATUs had a landscape with very strong affected ecological balance, 17 a landscape with strong affected ecological balance, 2 a landscape at the ecological balance limit and only 1 a landscape with weak affected ecological balance.

In 2002, the average value of the naturality index was maintained at 0.08, with the forest area increasing to 35,585 ha.

Regarding the framing in the above-mentioned categories, 48 ATUs had a landscape with very strong affected ecological balance, 18 a landscapes with strong affected ecological balance, 2 a landscape at the ecological balance limit and only 1 a landscape with weak affected ecological balance.

Also in 2017 the average value of the naturality index of the landscape remained constant (0.08), the area occupied by forests slightly increasing to 36,520 ha.

The highest values were recorded in the communes of Apele Vii (0.33), Bobiceşti (0.26), Bratovoeşti (0.26), Fărcăşele and Osica de Jos (0.20). The lowest values were also registered in the communes that didn't own forests, namely Redea, Rotunda, Traian, Vădastra and Vişina Nouă.

Out of the 78 ATUs, 55 had a landscape with very strong affected ecological balance, 20 a landscapes with strong affected ecological balance, 2 a landscape at the ecological balance limit and only 1 a landscape with weak affected ecological balance.

Therefore, between 1992 and 2017, the naturality index remained the same, but the area covered by forests increased from 34,018 ha to 36,520 ha. This was because of the many voluntary actions of afforestation conducted in some communes (Sadova, Dăbuleni, Apele Vii) by diferent NGOs and by the „Rebirth of the Forest" Association, which was formed in Mârșani, with the aim to reforest the unproductive lands from this commune.

The environmental change index was calculated as the ratio between the natural and the anthropic surfaces (Fig. 4). This index was coined by the Polish researchers Maruszczak (1988) and Pietrzak (1998), and was used to assess the environmental changes in the Carpathian region in Poland, and it was calculated using the following formula:

E_{ch} = Forest + pasture + hayfield area / Built-up area

Taking into account the agricultural specificity of the Romanați Plain, Dumitraşcu (2006) adapted the formula for calculating the environmental change index as follows:

E_{ch} = Forest + pasture + hayfield +aquatic area / Built-up + arable + vineyards + orchards area

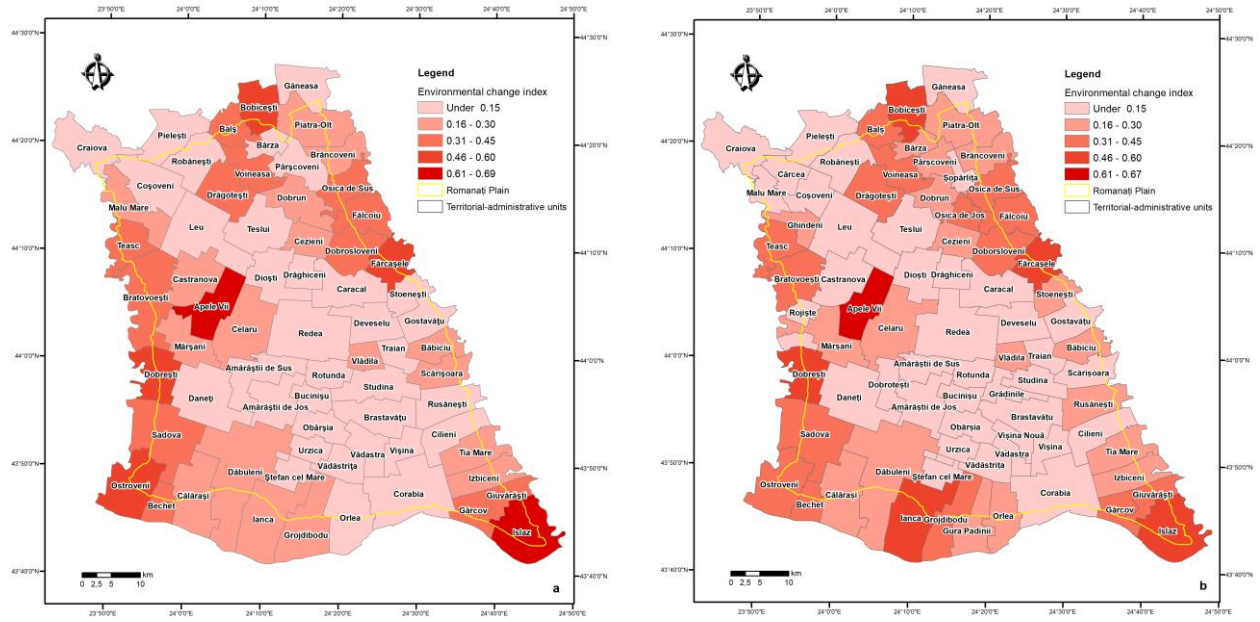

Figure 4: Environmental change index in Romanați Plain (a-1992; b-2017)

In 1992, the average value of the environmental change index was 0.20.

The highest values of this index were recorded in just 6 communes, scattered throughout the entire

analysed area, while 4 other communes and Craiova have an index of less than 0.02. Of the cities and communes included in the studied area, 35 ATUs were included in the category under 0.15, 16 ATUs in the category 0.16-0.30, 12 ATUs in the category 0.31-0.45, 4 ATUs in the category 0.46-0.60 and 2 ATUs in the category over 0.61.

In 2002 and 2017, the average value of the environmental change index remained constant at 0.20. Also, the highest and lowest values of the index remained largely unchanged, as well as the number of administrative-territorial units in each category of values.

Of the 78 administrative-territorial units, 39 were included in the category under 0.15, 18 ATUs in the category 0.16-0.30, 17 ATUs in the category 0.31-0.45, 4 ATUs in the category 0.46-0.60 and 1 ATU in the category over 0.61.

The ***landscape artificialization index*** completes the landscape naturality index and represents the ratio between the built-up areas and the total area of the administrative-territorial unit (Fig. 5).

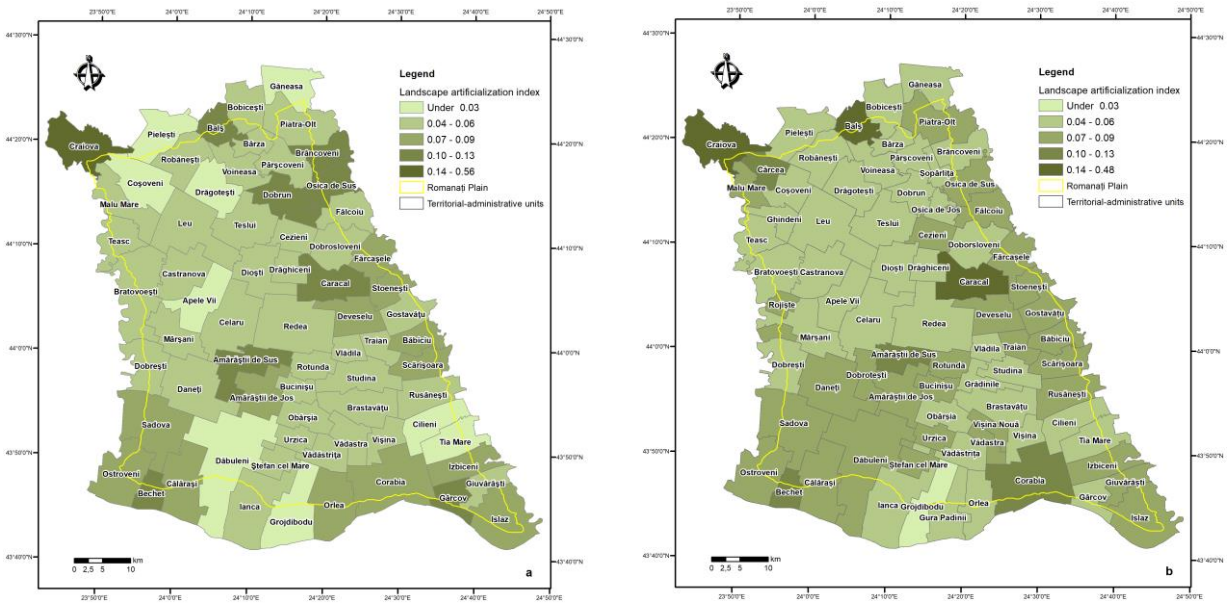

Figure 5: Landscape artificialization index in Romanați Plain (a-1992; b-2017)

In 1992, the average value of the landscape artificialization index in the Romanați Plain had a value of 0.05, the built-up area being about 25,013 ha. The highest values of this indexindex were recorded in Craiova (0.56), Caracal, Osica de Sus and Dobrun (0.13), and the lowest in Coşoveni, Dăbuleni, Pieleşti, Găneasa (under 0.02).

Regarding the framing in the 5 categories of values, 15 ATUs were categorized under 0.03, 36 ATUs in the category 0.04-0.06, 11 ATUs in the category 0.07-0.09, 6 ATUs in the category 0.10-0.13 and 1 ATU in the category over 0.14.

In 2002, the average value of the landscape artificialization index slightly increased to 0.06, and the built-up area increased to 26,120 ha. Craiova (0.47), Caracal, Osica de Sus and Dobrun (0.13) were the localities with the highest values of this indexindex, while Apele Vii, Grojdibodu, Coşoveni and Dăbuleni (under 0.02) recorded the lowest values of the artificialization indexindex of the landscape.

Taking into account the value of this indexindex, 13 ATUs recorded values under 0.03, 38 ATUs values between 0.04-0.06, 11 ATUs values between 0.07-0.09, 6 ATUs values between 0.10-0.13 and 1 ATUs value over 0.14.

Compared to the years 1992 and 2002, the average value of the landscape artificialization indexindex in 2017 slightly increased to 0.07, and the built-up area to 29,725 ha.

In the cities of Craiova (0.48), Caracal (0.16) and Balș (0.14) were recorded the highest values of the landscape artificialization indexindex, while in Orlea, Redea, Tia Mare, Coşoveni (0.03) and Grojdibodu (0.02) the lowest values.

Concerning the classification in value groups, 5 ATUs were in the category under 0.03, 47 ATUs in the category 0.04-0.06, 19 ATUs in the category 0.07-0.09, 3 ATUs in the category 0.10-0.13 and 3 ATUs in the category over 0.14.

Thus, the built-up area increased from 25,013 ha to 29,725 ha, because of the expansion of the built-up areas in cities (Caracal, Corabia, Balș) and rural

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settlements (mainly in the Dăbuleni Plain - south-western part of the Romanați Plain).

Human pressure through agricultural land is an indexindex that represents the intensity of anthropic activity on the environment through the agricultural use of the land in the studied area (Fig. 6). Pătroescu et al. (2000) highlights that human pressure on the environment is even higher as the share of the agricultural area per capita is higher.

According to FAO/UNESCO classification published in "La carte mondial des sols" (1964) 4 categories of landscapes were established:

- territories situated at the limit of maintaining the relative balance of the natural components of the landscape (<0.40 ha/inh.);
- moderately balanced and very weak unbalanced rural landscapes (0.41 - 1 ha/inh.) - characterized by the alternation of cultivated areas and areas with other uses (forests, built-up surfaces);
- heavily unbalanced rural landscapes (1.01 - 2 ha/inh.) - characterized by agricultural crops (the presence of sporadic forest clusters);
- very strong unbalanced rural landscapes (> 2 ha/inh.) - areas where agriculture is intensively practiced.

Dumitraşcu (2006) indicates that the limit imposed by FAO in order to maintain the balance of the environment is 0.4 ha/inh. arable land.

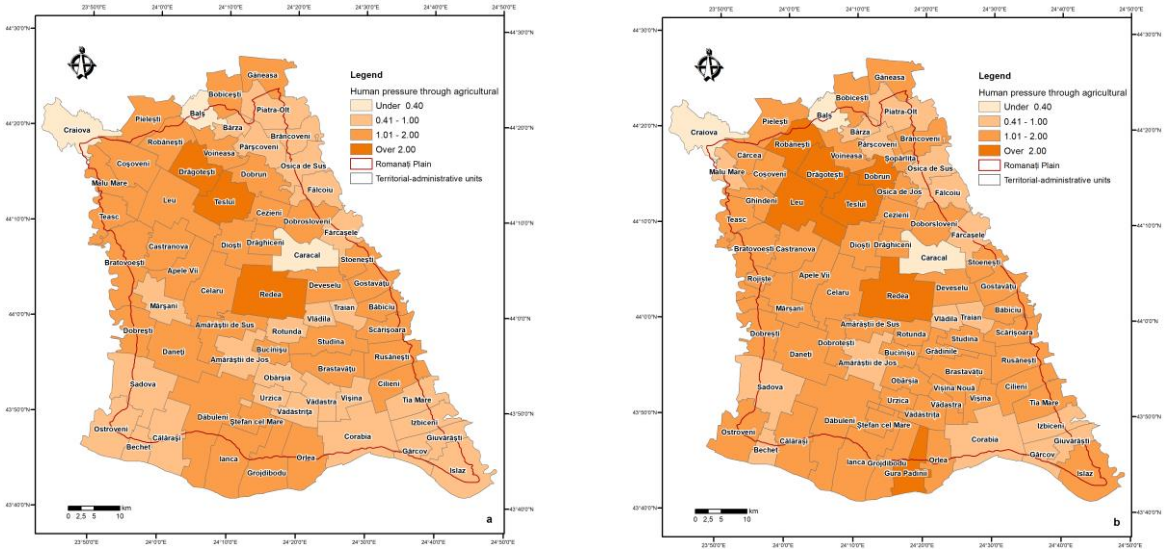

Figure 6: Human pressure through agricultural land in Romanați Plain (a-1992; b-2017)

In 1992, the average value of the human pressure indexindex through agricultural land use was 1.13 ha/inh. The highest values were registered in the communes of Redea (3.24 ha/inh.), Teslui (2.10 ha/inh.) and Drăgotești (2.03 ha/inh.), while the lowest values were in the cities of Caracal (0.15 ha/inh.), Balș (0.13 ha/inh.) and Craiova (0.01 ha/inh.).

According to the obtained values for this indexindex, 3 administrative-territorial units had a relative balance of the natural components of the landscape, 28 ATUs had a moderately balanced and very weak unbalanced landscape, 35 ATUs a heavily unbalanced landscapes and 3 ATUs a very strong unbalanced rural landscapes (Drăgoteşti, Redea, Teslui).

In 2002, the average value of the human pressure index through agricultural land use remained the same, namely 1.13 ha/inh..

As in 1992, the highest values were registered in the communes of Redea (3.74 ha/inh.), Teslui (2.33 ha/inh.) and Drăgotești (2.21 ha/inh.), and the lowest in Caracal (0.15 ha/inh .), Balş (0.14 ha/inh.) and Craiova (0.01 ha/inh.).

Also the classification in the 4 categories of landscapes remained the same, respectively 3 administrative-territorial units had a relative balance of the natural components of the landscape, 28 ATUs had a moderately balanced and very weak unbalanced landscape, 35 ATUs a heavily unbalanced landscapes and 3 ATUs a very strong unbalanced rural landscapes (Drăgoteşti, Redea, Teslui).

The year 2017 brings an increase in the average value of the human pressure index through agricultural land use in the studied area, this being 1.33 ha/inh..

The highest values were recorded in Redea (4.10 ha/inh.), Teslui (2.76 ha/inh.), Gura Padinii (2.63 ha/inh.), Drăgotești (2.42 ha/inh.), and the lowest in Caracal (0.16 ha/inh.), Balş (0.14 ha/inh.) and Craiova (0.01 ha/inh.).

The obtained values revealed that 3 ATUs had a relative balance of the natural components of the landscape, 16 ATUs had a moderately balanced and very weak unbalanced landscape, 53 ATUs a heavily unbalanced landscapes and 6 ATUs a very strong unbalanced rural landscapes (Dobrun, Drăgotești, Gura Padinii, Redea, Robănești, Teslui).

Analyzing the index of human pressure on the environment through agricultural use of the land, it can be observed and increase in the average value of this index, from 1.13 ha/inh. to 1.33 ha/inh.. The highest change in the land use was registered in the Leu-Rotunda Plain (the north part of it), and it was caused by the deforestation of vineyards, orchards and forests, and transforming this land into agricultural land.

Human pressure through forests is an index showing the anthropic pressure on the environment through land use as forests in the studied area (Fig. 7).

The FAO/UNESCO (1964) minimum limit for maintaining the balance of the environment is 0.3 ha of forest per capita.

In 1992, the average value of the human pressure index on the environment through forests was 0.11 ha/inh. (34,018 ha of forests).

The only administrative-territorial units that were above the FAO's established minimum limit were the Apele Vii (0.77 ha/inh.), Bobiceşti (0.40 ha/inh.), Dobreşti (0.38 ha/inh.), Voineasa (0.30 ha/inh.).

The lowest values were recorded in the very poor afforested ATUs (under 0.01 ha/inh.), namely Redea, Pielești, Bucinişu, Găneasa, Vişina, Rotunda and Craiova.

In 2002, the average value of this index was also 0.11 ha/inh., due to both the increase of the number of inhabitants to 685,006 (from 680,126) and the surface occupied by forests (35,585 ha).

The year 2017 brings an increase in the average value of the human pressure index through forests, at 1.13 ha/inh.

This was due to the increase of the afforested surface in the studied area, to 36,520 ha, but also to the decrease of the number of inhabitants by approximately 60,000 persons compared to 2002.

The highest values were registered in the communes Apele Viii (0.90 ha/inh.), Ianca (0.55 ha/inh.), Bobiceşti, Bratovoeşti (0.43 ha/inh.), and the lowest values (under 0.01 ha/inh.) were in Redea, Vădastra, Rotunda, Vişina Nouă and Traian. In this year, 7 administrative-territorial units have exceeded the minimum value (0.30 ha/inh.) of the human pressure index through forests.

The surface covered by forest incresead from 34,018 ha in 1992 to 36,520 ha in 2017, mainly in rural area , in Ianca, Bratovoești and Apele Vii.

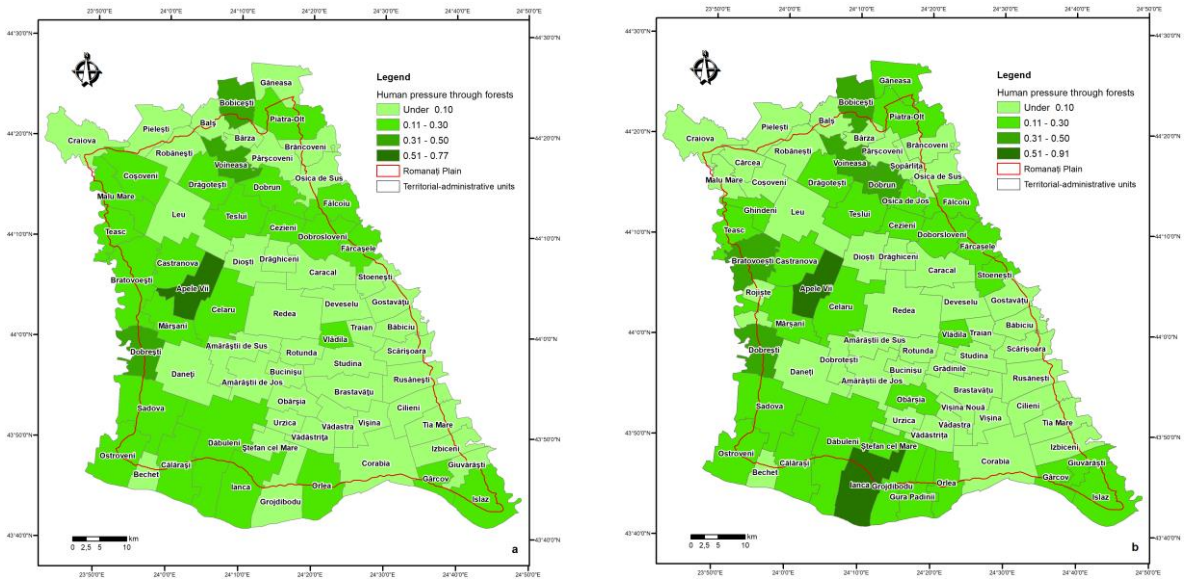

Figure 7: Human pressure through forests in Romanați Plain (a-1992; b-2017)

The human pressure through orchards and fruit tree nurseries is an index of anthropic pressure on the environment through the land use as orchards and fruit tree nurseries (Fig. 8).

In 1992, the average value of the human pressure index through orchards was 0.02 ha/inh., the total area covered by orchards and fruit tree nurseries being of 7782 ha.

Areas with significant surfaces of orchards were found in the south-western part of the Romanați Plain, with the administrative-territorial units in this part recording the highest values of this index: Grojdibodu (0.21 ha/inh.), Orlea (0.20 ha/inh.), Ianca (0.18 ha/inh.), Dobreşti (0.16 ha/inh.), Sadova and Călăraşi (0.10 ha/inh.), mainly in the Dăbuleni Plain.

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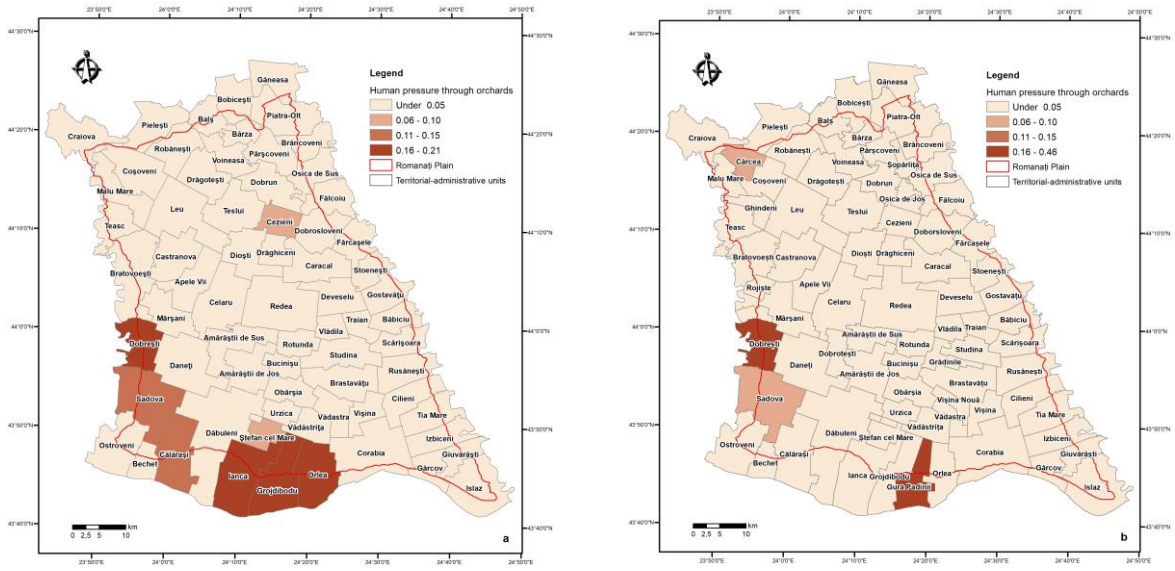

Figure 8: Human pressure through orchards in Romanați Plain (a-1992; b-2017)

In 2002, the average value of the index remained the same, of 0.02 ha/inh., and the total area occupied by orchards and fruit tree nurseries grew slightly, from 7782 ha to 7965 ha.

The most important areas used as orchards and fruit tree nurseries were also located in the southwest of the plain, in the Dăbuleni Plain subunit (Simulescu and Zamfir, 2015).

Compared to previous years, 1992 and 2002, in 2017, the average value of the index decreased to 0.01 ha/inh. The total area occupied by orchards has dropped dramatically to 3257 ha. As a result of the land fund division, most of the orchards and fruit tree nurseries were grubbed, the surfaces occupied by them being currently used mainly as arable land, but also as built-up land, pastures and hayfields.

Compared to the previous years, compared to 6 communes in which the value of the human pressure index on the environment through orchards and fruit tree nurseries was at least of 0.10 ha/inh., in 2017 there were only 2 communes where the value of this index exceeded this threshold, namely in Gura Padinii (0.46 ha/inh.) and Dobreşti (0.17 ha/inh.).

The surface occupied by orchards and orchard nurseries suffered an important decline, this being caused by the deforestation of orchards in order to make way for agricultural land.

The human pressure through vineyards and vineyard nurseries is another index of anthropic pressure on the environment through the land use as vineyards and vineyard nurseries (Fig. 9).

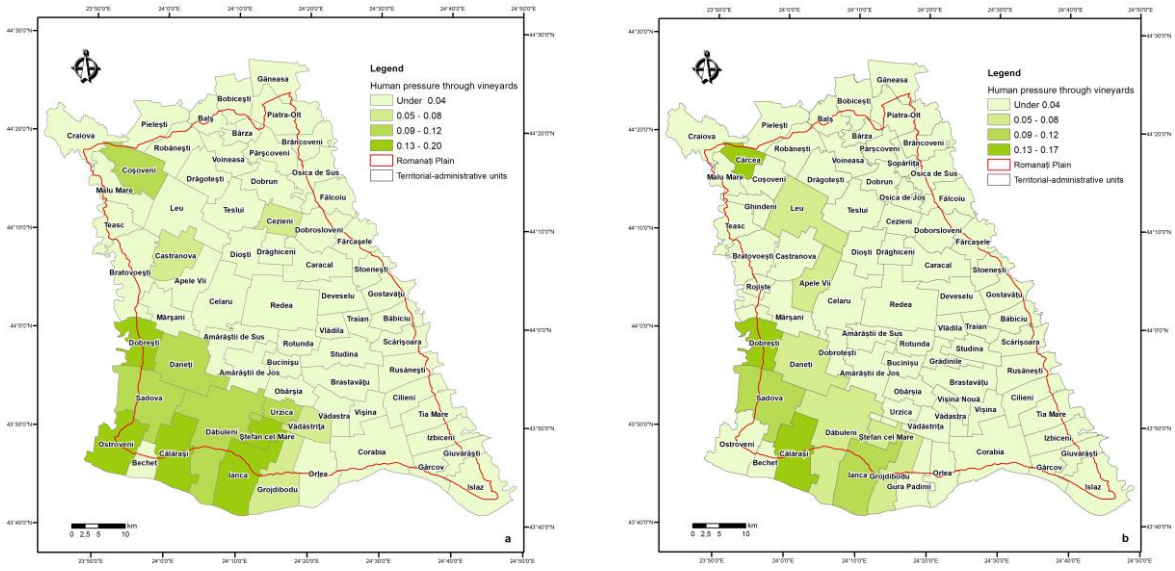

Figure 9: Human pressure through vineyards in Romanați Plain (a-1992; b-2017)

In 1992, the average value of the human pressure index on the environment through vineyards and vineyard nurseries was 0.03 ha/inh., and the total area occupied by these was 11,272 ha.

The highest values were obtained by Călărași (0.20 ha/inh.), Dobreşti (0.16 ha/inh.), Ianca (0.15 ha/inh.), Ostroveni (0.13 ha/inh.), Ştefan cel Mare, Sadova (0.12 ha/inh.), Dăbuleni (0.10 ha/inh.).

In 2002, the average value of the human pressure on the environment through vineyards index was 0.03 ha/inh., while the total surface occupied by these fell slightly, from 11,272 ha to 10,458 ha.

The widest distribution of vineyards and vineyard nurseries, as well as in the case of orchards and fruit tree nurseries, is also represented by the Dăbuleni Plain (southwestern subunit of Romanați Plain).

In 2017, the average value of the human pressure index on the environment through vineyards was the same as in 1992 and 2002 (0.03 ha/inh.), while the total area occupied by these decreased vertiginously, from 10,458 ha to 8466 ha.

If in previous years, high values of this index (at least 0.10 ha/inh.) were recorded in 7 administrative-territorial units, last year, high values were obtained in Dobreşti (0.17 ha/inh.), Călăraşi (0.15 ha/inh.), Cârcea (0.13 ha/inh.) and Sadova (0.12 ha/inh.).

Also, the area covered by vineyards and vineyard nurseries suffered a dramatic loss, the surface decreasing from 11,272 ha in 1992 to 8466 ha in 2017. This was due to the change of land use in the Dăbuleni Plain, from vineyards to agricultural land but also to pastures and hayfields.

Human pressure through pastures and hayfields represents another index of the anthropic pressure on the environment through the land use as pastures and hayfields (Fig. 10).

For the year 1992, the average value of the human pressure index on the environment through pastures and hayfields was 0.07 ha/inh.

The total area occupied by these was 20,383 ha (20,136 ha of pastures and 247 ha of hayfields).

The highest values were obtained in the communes Drăgoteăti (0.34 ha/inh.), Dobreşti (0.25 ha/inh.), Voineasa and Redea (0.19 ha/inh.), and the lowest ones in Craiova and Caracal (under 0.01 ha/inh.).

In general, more extensive use as pastures and hayfields are found in the north-central parts of the Leu-Rotunda Plain and the Caracal Plain, and less in the south of these relief units and in Dăbuleni Plain.

In 2002, the average value of the human pressure index on the environment through pastures and hayfields was still 0.07 ha/inh.

The total area occupied by these increased from 20,383 ha to 21,068 ha, of which 20,818 ha were pastures and 250 ha were hayfields.

Some of these lands have undergone a conversion of their use, coming from former plots of land planted with vines and orchards, which have been grubbed by the new private owners, who have been appropriated after the disbadment of the agricultural cooperatives.

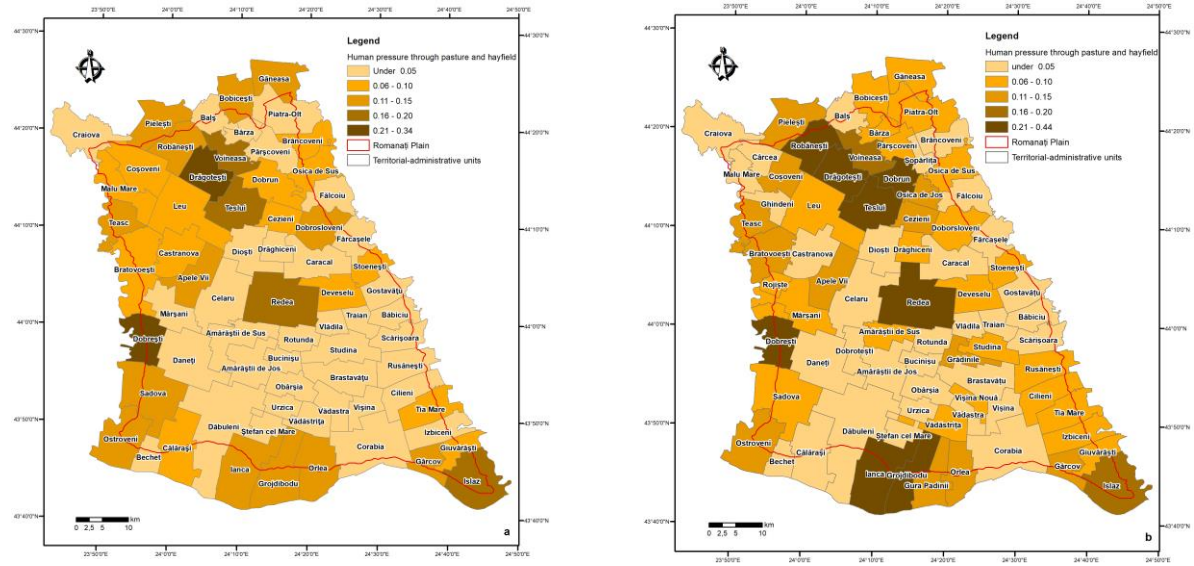

Figure 10: Human pressure through pastures and hayfields in Romanați Plain (a-1992; b-2017)

In 2017, the average value of the human pressure index on the environment through pastures and hayfields increased to 0.08 ha/inh.

The total surface occupied by these continued to increase to 21,124 ha, of which 20,945 ha are pastures and only 179 ha are hayfields.

The extension of pastures and hayfields has continued in the southern part of the Caracal Plain, and northern part of Leu-Rotunda Plain, in particular through the conversion of the poorly fertile agricultural land and degraded land.

The highest values of this index were recorded in the communes of Drăgoteşti (0.44 ha/inh.), Grojdibodu (0.43 ha/inh.), Dobreşti (0.31 ha/inh.), Redea (0.26 ha/inh.), Ianca 0.23 ha/ nh.), and the lowest in Obârșia, Bucinişu, Vişina, and Amărăştii de Jos (less than 0.01 ha/inh.).

Conclusions

The Romanati Plain is a relief unit inhabited since the Paleolithic and whose population is mainly engaged in the agricultural sector, the middle and large settlements concentrating about 80% of the total population.

Beside the 6 cities (Craiova, Caracal, Balș, Piatra-Olt, Corabia, Dăbuleni), most of the settlements are rural settlements, with an agricultural profile (grain, vine, fruit, technical crops, livestock breeding). Thus, the impact of human activities over the years has made its presence felt by modifying almost totally the original natural vegetation and replacing it with farmland, vineyards and orchards, pastures and hayfields.

Regarding the anthropic environmental pressure, the data analyzed for the 3 reference years show, in addition to the demographic decrease, a change in the way land is used. The surfaces occupied by vineyards and vineyard nurseries as well as those occupied by orchards and fruit tree nurseries have fallen vertiginously, instead of these are expanding the surfaces occupeid by pastures and hayfields, as well as agricultural land. A slight increase has also been recorded in the areas occupied by forests, in addition to the national afforestation programs, due to the various planting actions organized on a voluntary basis by various NGOs and private and public institutions, over the last 10 years.

Thus, even in the period after the fall of communism in Romania, human pressure on the natural environment of the Romanați Plain remained high. In this respect, communities and local decision-makers are expected to take measures to protect and improve the environment through a sustainable development approach.

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Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December** 2018), pp. **135-145** (11)
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Modelling intact forest landscapes habitats quality at global scales through the use of landscape ecology methods

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Abstract

Modelling intact forest landscapes (IFL) quality as habitats for various species represents a crucial aspect concerning wildlife conservation. Landscape ecology provides a rice pallet of metrics suitable for quantifying complex relationships between landscapes structure and function. Our research aims to conduct an ecological diagnosis of the 2013 non-altered IFL patches as optimal habitats for both edge and interior preferring species by taking into account their spatial adjacency to altered IFL patches by fire related and non-fire related causes between 2003 and 2013 through the use of the Edge Contrast Index Metric and the Core Area Index Metric. Our results evidence that none of the world geographical forest regions suffered potential ecological dysfunctions as habitats for either interior or edge dwelling species. However, the equatorial forest zones of Africa, America and Asia are characterized by alarming low levels of habitat quality which in the future can generate severe malfunctions.

Keywords: *Intact Forest Landscapes, Landscape Ecology, Landscape Function, Landscape Structure, Edge Contrast, Core Area.*

Rezumat. Modelarea calității habitatelor peisajelor forestiere intacte la scară globală folosind metode specifice ecologiei peisajelor

Modelarea calității habitatelor peisajelor forestiere intacte (IFL) pentru diferite specii reprezintă un aspect crucial în privința conservării biodiversității. Ecologia peisajelor permite aplicarea unei game variate de metrici utili în vederea cuantificării relațiilor complexe dintre structura și funcția acestora. Studiul de față are ca scop realizarea unui diagnostic ecologic al parcelelor IFL nealterate din anul 2013 în contextul eficienței funcției acestora de habitate pentru specii ce preferă atât zonele de margine, cât și cele interioare prin intermediul cunatificării influenței parcelelor vecine alterate în perioada 2003-2013 din cauze naturale sau antropice cu ajutorul Indexului Contrastului de Margine și Indexului Suprafeței Centrale. Rezultatele evidențiază faptul că regiunile forestiere globale nu prezintă potențiale disfuncționalități ecologice în contextul furnizării de habitate atât pentru specii interioare, cât și de margine. Totuși, regiunile ecuatoriale din Africa, America și Asia sunt caracterizate de prezența unei calități scăzute a habitatelor, situație ce pe viitor poate genera disfuncționalități severe.

Cuvinte-cheie: *Peisaje Forestiere Intacte, Ecologia Peisajelor, Funcția Peisajelor, Structura Peisajelor, Contrast de Margine, Suprafață Centrală.*

Introduction

Intact forest landscapes (IFL) are composed by a multitude of wild ecosystems which represent crucial habitats for a tremendous variety of species and support complex ecological functions and services vital for human wellbeing (Potapov et al. 2008). Because of these areas immense size and isolation, anthropic disturbances were maintained through history at insignificant levels, favouring their untamed wilderness (Potapov et al. 2008). However, many patches have already been disturbed by human induced fragmentation or alteration and these changes could also affect the ecological functionality of the neighbouring large intact ones. Consequently, between 2000 and 2010 primary forests have massively declined with a staggering annual rate of 0.4% (FAO 2010).

IFL are described as a complex of ecosystems encompassed by a geographical forest zone, characterized by the lack of identifiable anthropic disturbances and an area sufficiently extended and connected for supporting all indigenous wildlife (Potapov et al. 2008). The notion of IFL is not synonymous with primary forest (FAO 2010). Primary forests are included by IFLs together with other primeval rare or scarce vegetated ecosystems, such as grasslands, scrubs, alpine areas or even barren rocky areas (Potapov et al. 2017). IFLs are identifiable by several spatial characteristics, such as a patch surface exceeding 500 km^2, a width of at least 10 km and the lack of areas which in the last 30 to 70 years were highly disturbed by human activities or which contain anthropic infrastructures (Potapov et al. 2008).

The notion of IFL and the criteria of identification were developed by Potapov (2008). Other representative global scale researches focused on

identifying undisturbed natural landscapes dynamics under historical anthropic pressure must include several earlier studies based on mathematical models and high levels of subjective speculations (McCloskey & Spalding 1989; Bryant et al. 1997; Sanderson et al. 2002) and also recent assessments established by processing satellite imagery data through the latest available spatial methods (Hansen et al. 2013; Heino et al. 2015; Potapov et al. 2017).

Modelling IFL functionality as habitats for different species is crucial for understanding the spatial distribution of valuable ecological areas for supporting biodiversity located under the threat of various types of degradations, due to anthropic or natural causes. Landscape ecology methods represent an important tool that supports a robust and useful way of quantifying complex ecological aspects regarding IFL through the use of a wide range of landscape metrics. Despite being related with ecology (which studies from a systemically perspective the connections between the earths geospheres), landscape ecology is centred on a couple of distinct essential principles: the geographical extent of ecological processes, the accent on the relation between the natural environment and anthropic activities and the consideration of landscapes as fundamental study units (Botequilha et al. 2006).

There are a great variety of perspectives over the notion of landscape based on the observer's qualification and skills. Common ones include the visual elements of the landscape (González Bernáldez 1981) or the cultural perspective, which defines landscapes as a three dimension entity encompassing a material, social and emotional reality (Kosian 2008). Nevertheless, the most widely used remains the perception of landscapes as elements of the land surface, encompassing different natural elements such as mountains, rivers or woods (Wascher 2000). From an ecological perspective a landscape is considered a mixture of different land cover types capable of taking the form of several distinct structural elements such as patches, corridors and matrices (Forman & Godron 1986). A patch is considered a continuous nonlinear surface distinguishable from its neighbourhoods while a corridor represents a unitary linear surface that varies in composition from the rest of the landscape units. A matrix is defined as a continuous area that exceeds the rest of the landscape elements in spatial extension (Forman 1995).

Landscapes are evaluated through the use of landscape metrics at tree well established stages: patch, class and landscape. A class represents a multitude of identical type patches while the totality of classes composing the study area defines a landscape (Botequilha et al. 2006). Landscape metrics primary purpose is the understanding of the relations between landscape structure and function from an ecological relevant perspective (Csorba and Szabo 2012). These metrics were precisely developed for ecological modeling, being proper for quantifying spatial characteristics regarding landscape pattern or arrangement (Botequilha et al. 2006). Landscape metrics were initially computable just for raster data by several software such as Fragstats (McGarigal & Marks 1995) and Idrisi's Patter Module (Eastman 2003). Recent applications allow their calculation for various vector data, notable ones including vLATE (Lang and Tiede 2003), Patch Analyst (Rempel 2010) or Conefor Sensinode (Saura & Torné 2009).

Landscape structure is defined as the ratio between the repartition of energy, matter, life forms and the spatial characteristics of ecosystems. Landscape function indicates three wide aspects: benefits (such as resource supplying, shelter providing or system adjustment), movements (such as of energy, matter, animals or humans) and processes (such as the production of biological material, water filtering or habitat maintenance for various species) (Botequilha et al. 2006). Landscape structure and function relationships are extremely complex and therefore it is difficult to mathematically quantify them in a method that express reality in an ideal manner. Due to this fact, landscape structure indicates only potential landscape ecological or functional aspects and obviously not certain ones.

Landscape patches size and spatial structure influences to a certain level their ecological stability (Botequilha et al. 2006). For example, highly connected and expanded patches containing initial ecosystems indicate greater natural diversity and therefore higher probability of maintaining quality habitats than smaller isolated ones (Dramstad et al. 1996). In a similar manner, patches size and structure dynamics determines the landscape configuration and consequently the length of common edge with adjacent ones. In landscape ecology, the borderlines between landscape patches are named "edge" and influence to a large degree their ecological integrity (Botequilha et al. 2006). Nevertheless, the patches spatial arrangement within the landscape generates different physical characteristics which conversely cause variable ecological processes or flows. As an example, a grassland surrounded by arable land is influenced by longer periods of sun radiation which consequently generates higher values of temperature than one located in the adjacent of a forest (Forman & Godron 1986).

All over the world natural landscapes are facing unprecedented changes generated by the exponential growth of anthropic activities, being constantly transformed into agricultural and artificial landscapes (Kim & Weaver 1994). These changes are spatially manifested in the form of structural modifications such as loss or fragmentation and are usually

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December 2018**), pp. **135-145**
http://dx.doi.org/**10.5775/fg.2018.003.d**

perceived by natural ecosystems as disturbances being the prime vector for triggering severe ecological dysfunctions. They represent one of the greatest dangers for species habitats at both local and global scales (Sorrell 1998).

Our paper represents one of the first assessments of worldwide IFL's through the use of Landscape Ecology metrics. Based on the stated problems, the aims of the study are:

- to asses a comparative analyses of the potential ecological functionality of non-altered IFL patches as optimal habitats for edge preferring species based on their spatial adjacency to altered IFL patches (by fire and non-fire induced causes);
- to use the same ecological oriented approach by evaluating the patches function as efficient habitats for interior requiring organisms.

Method

The first step of our assessment is represented by the delimitation of the study area. For a more comprehensive perspective, the study was conducted at a global scale. All the IFL patches are located within a forest zone (tree canopy density exceeding 20% in the year 2000) extended over ten geographical regions, therefore resulting in ten geographical forest regions: Africa, Australia and Oceania, temperate South America, tropical South America, temperate North America, boreal North America, temperate Eurasia, boreal Eurasia, West Hemisphere Pacific Islands and Southeast Asia (Potapov et al. 2008). For our study we used all of the ten geographical forest zones except the West Hemisphere Pacific Islands which was excluded based on the fact that it lack's IFL.

The first global IFL database is established on the data available for the year 2000, being prepared in 2005-2006 and updated in 2012. The second global IFL database is centred on the 2013 year data and was performed in 2014-2015. The two databases are based on a common methodology, making in this way possible taking track of the IFL patch losses between 2000 and 2013 and consequently on the ones which remain untouched, spatial information which forms the third database and also the one used for our study, available for free use at www.intactforests.org in the format of shape file vector data (Greenpeace 2017) (figure 1).

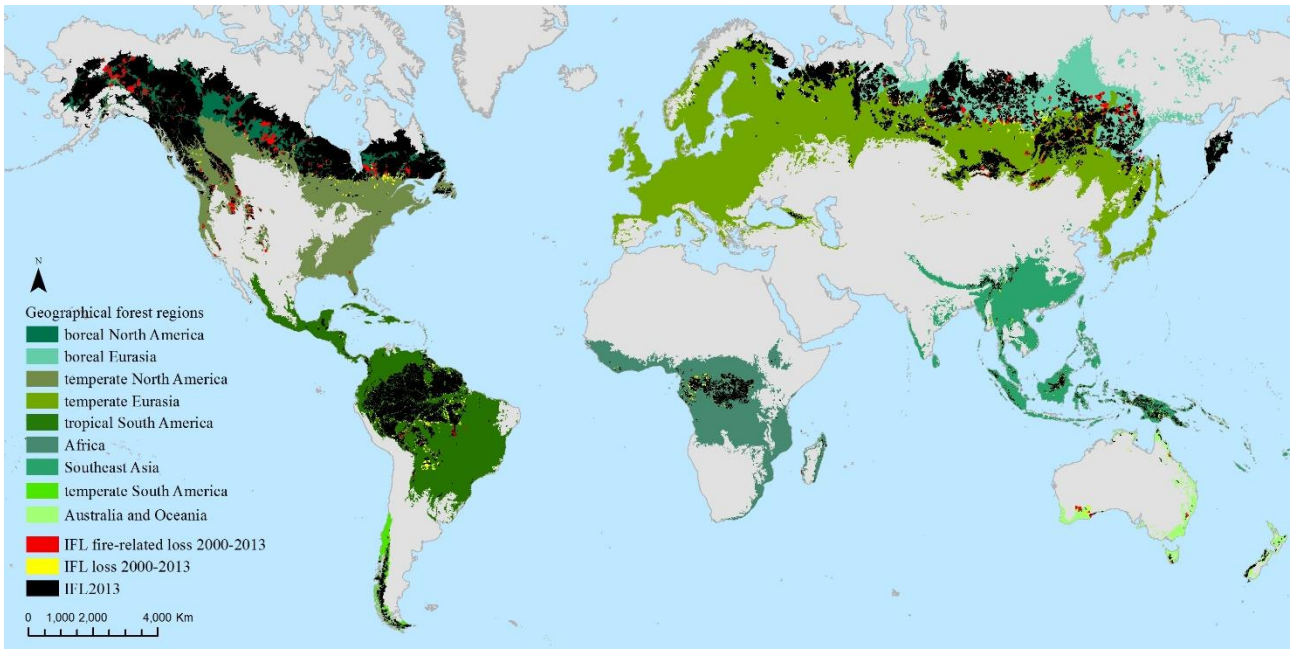


Fig. 1: Map of the study area, with all of the nine geographical forest regions used for the analysis and the IFL dynamics between 2000 and 2012.

An IFL patch loss represents the spatial segregation and therefore functional alteration of an initial IFL patch. Potapov (2017) determined two types of loses, such as forest cutting or replacement by artificial areas (which were considered non-fire generated and are based on anthropic actions) and burned areas distributed in the proximity of intensively administrated infrastructures (which were considered to be induced by natural fires and therefore the assignation of their genesis to anthropic intervention is questionable).

The second step in modelling IFL habitat quality is represented by the third database organization into two new distinct ones which shall be used for our

assessment. The first contains the intact IFL in 2013 and the non-fire induced IFL losses between 2000 and 2013. The second encompasses the same intact IFL from 2013 and the fire determined IFL losses between 2000 and 2013. Both databases were converted from vector to raster data, with a cell size of 2 km^2, being proper for large scales models.

The third and final step is represented by the computation of the Edge Contrast Index metric and the Core Area Index metric at a patch and class level through the use of Fragstats software for the non-altered IFL patches from the two new databases (McGarigal et al. 2002).

From an ecological perspective, contrast can be described as the weightiness of dissimilarity between neighbouring patches regarding several ecological functions that are significant to a certain species (McGarigal and Marks 1995). In our case, contrast is expressed as the expected level of disparity between non-altered and altered (by non-fire or fire induced causes) IFL patches concerning the non-altered patches ecological function as habitats for edge preferring species. The degree of contrast characterizing the boundary of an altered and a non-altered IFL patch determines several ecological edge effects, being particularly useful for modelling edge species habitat requirements (Forman and Godron 1986). Therefore, a non-altered IFL patch specie's potential of accessing the resources in the neighbouring altered ones could be embedded by the fact that those patches are affected by human intervention and consequently the resources are weaker. This aspect negatively affects the species possibility of accessing complementary resources (Dunning et al. 1992).

Contrast metrics need the allocation of a matrix of values ranging between 0 and 1 and representing the magnitude of contrast defining common borders (or edges) between altered and non-altered IFL patches. Yet, despite the fact that in this case there is not a solid theoretical support for allocating the selected values, it is still more effective to apply values according to the expert opinion knowledge level of the ecological process under study (McGarigal & Marks 1995). Hence, for our study the employed values were 0 for the adjacencies between patches of the same type or between a patch of any type and the landscape background (suggesting a minimum contrast situation) and 1 for the case of an altered IFL patch adjacent to a non-altered one (indicating a maximum contrast state).

The Edge Contrast Index (abbreviated ECON) quantifies the level of contrast between a patch and its bordering neighbour, equalling the ratio between the sum of the patch of interest perimeter section lengths amplified with their allocated contrast values and the patches total perimeter length, amplified with 100 (McGarigal & Marks 1995; Botequilha et al. 2006). It can be computed at patch or class level through the area weighted mean method:

$$ECON = \frac{\sum_{k-1}^{m}(p_{ijk} * d_{ik})}{p_{ij}}(100) \quad (1)$$

$$ECON_{AM} = \sum_{j=1}^{n}\left(\left[\frac{\sum_{k=1}^{m'}(p_{ik} * d_{ik})}{p_{ij}}\right]\left[\frac{a_{ij}}{\sum_{j=1}^{n}}\right]\right)(100)$$

$$CON_{AM} = \sum_{j=1}^{n}\left(\left[\frac{\sum_{k=1}^{m'}(p_{ik} * d_{ik})}{p_{ij}}\right]\left[\frac{a_{ij}}{\sum_{j=1}^{n}}\right]\right)(100)$$

$$ECON = \frac{\sum_{k-1}^{m}(p_{ijk} * d_{ik})}{p_{ij}}(100) \quad (2)$$

Where:

ECON = Edge Contrast Index

$ECON_{AM}$ = Area Weighted Mean Edge Contrast Index

p_{ijk}= lenght (m) of edge of patch ij adjacent to patch type (class) k.

d_{ik}= dissimilarity (edge contrast weight) between patch type i and k.

p_{ij}= lenght (m) of perimeter of patch ij.

Each section composing the non-altered IFL patch perimeter is weighted by the designated contrast value for the shared boundary with an altered IFL patch or background. Hence, for a non-altered IFL patch ECON equals 0 if the patch is entirely bordered by background or by another non-altered patch, suggesting that the patch has no contrast with its neighbourhood. Conversely, ECON equals 100 if the entire non-altered IFL patch is totally surrounded by an altered one.

In landscape ecology, the notion of ”core area” describes the internal area of a patch delimited by an allocated buffer width and similar with the degree of contrast discussed above, it’s ecological relevance it is influenced by the process of edge effect (McGarigal & Marks 1995). Edge effects represent the product of complex interactions between diverse biotic and abiotic components that determine various ecological functions and services in the proximity of patch boundaries compared to patch internal areas (McGarigal & Marks 1995). Therefore, the spatial adjacencies between different patch types favour distinct ecological processes between the edge and the core area regarding the patch of interest and consequently different habitat characteristics, being especially relevant for forest interior preferring organisms (Hansen and di Castri 1992). For example, the boundary area of a non-altered IFL patch

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December 2018**), pp. **135-145**
http://dx.doi.org/**10.5775/fg.2018.003.d**

adjacent to an altered one might be more exposed to human intervention, aspect which could affect various core area species (given the case of particularly sensitive organisms to human activities). Also, the same edge could generate a barrier which affects the non-altered patch species movements.

Core area metrics also require the conduction of a matrix encompassing the deducted edge depth distances for the adjacencies between altered and non-altered IFL patches. In many situations such as in our case there is a lack of a theoretical basis for specifying any certain edge depth influence and so it must be determined with a high level of subjectivity (McGarigal & Marks 1995). Based on this aspect, for our models we defined an edge depth of 10 km, equalling the minimum width of an IFL patch (Potapov et al. 2012), and representing the influence of an altered patch over a non-altered one. Nevertheless, the effectiveness of the core area metric is crucially influenced by the raster data cell size, patch area and edge depth values applied (McGarigal & Marks 1995). For our study, based on the fact that the landscape resolution is 2 km^2 and the minimum patch dimensions are 500 x 500 km, the 10 km edge influence is suitable for a global scale modelling.

The Core Area Index (abbreviated CAI) is a relative index which computes the percentage of a patch that represents core area, equalling the ration between the patch core area and the total patch area, and amplifying the result with 100. As in the case of the ECON, the CAI is computable at a patch and area weighted mean class level:

$$ECON = \frac{\sum_{k-1}^{m}(p_{ijk} * d_{ik})}{p_{ij}}(100)$$

$$CAI = \frac{a_{ij}{}^{c}}{a_{ij}}(100) \quad (3)$$

$$CAI_{AM} = \sum_{j=1}^{n}\left(\left[\frac{a_{ij}{}^{c}}{a_{ij}}\right]\left[\frac{a_{ij}}{\sum_{j=1}^{n}}\right]\right)(100)$$

$$ECON_{AM} = \sum_{j=1}^{n}\left(\left[\frac{\sum_{k=1}^{m'}(p_{ik} * d_{ik})}{p_{ij}}\right]\left[\frac{a_{ij}}{\sum_{j=1}^{n}}\right]\right)(100)$$

$$CON_{AM} = \sum_{j=1}^{n}\left(\left[\frac{\sum_{k=1}^{m'}(p_{ik} * d_{ik})}{p_{ij}}\right]\left[\frac{a_{ij}}{\sum_{j=1}^{n}}\right]\right)(100)$$

$$ECON = \frac{\sum_{k-1}^{m}(p_{ijk} * d_{ik})}{p_{ij}}(100) \quad (4)$$

Where:

CAI= Core Area Index

CAI_{AM}= Area Weighted Mean Core Area Index

$a_{ij}{}^{c}$= core area (m^2) of patch ij based on specified edge depts (m).

a_{ij}= area (m^2) of parch ij.

If a specific patch doesn't possess any core area, CAI equals 0. Conversely, if the patch possesses only core area, then CAI equals 100 (McGarigal and Marks 1995).

Discussion

Initially, the patch level ECON values for the first two maps (which have a possible range of 0 from 100 and are expressed as percent's) were classified into five equal intervals, representing very low (0- 20 %), low (20- 40 %), medium (40- 60 %), high (60-80 %) and very high (80- 100 %) values. Since the last three intervals (medium, high and very high) are spatially represented by small and scarce IFL patches, we merged them into one single interval, which compresses ECON values between 40 to 100 %. Similarly, the patch level CAI values for the first three intervals (representing medium, low and very low values) of the second two maps were also merged into one single interval (comprising values between 0 to 60 %).

The first map quantifies the ECON values for non-altered IFL patches based on their spatial adjacencies with altered ones by human or non-fire related causes (figure 2). Very low ECON values (between 0 and 20 %) are scored by the largest majority of IFL patches. Low ECON values (between 200 and 40 %) are indicated by patches found in eastern Canada, western R. D. Congo, western Brazil, Indonesia, south-east Siberia and north-west Russia. On the other hand, medium and high ECON values (between 40 and 100%) were obtained by remote IFL patches located in tropical South America, temperate North America, Eurasia, Africa, tropical Asia, Australia and especially boreal Eurasia.

Conversely, the second map computes the patch level ECON values for non-altered IFL patches taking into account their common borders with altered ones by natural fires (figure 3). Very low ECON values (between 0 and 20%) characterize almost all the IFL patches composing the nine forest regions of the globe, except several remote ones positioned in central and eastern Alaska or Canada, which returned low values (between 20 and 40%). Also, medium and high ECON values (between 40 and 100%) are modelled by scarce IFL patches located mainly in central-eastern Alaska, USA, central Brazil and eastern Siberia.

The third map shapes the CAI values for non-altered IFL patches regarding their common edge with altered ones by anthropic induced causes (figure

4). Very low, low and medium CAI values (between 0 and 60%) are signed by numerous patches located in North America, South America, Africa, Southeast Asia and Eurasia. High CAI values (between 60 and 80 %) are encompassed by IFL patches situated in the largest part of the Brazilian plateau, Congo river basin, Borneo, Sumatra, eastern Siberia and north-western Russia. Finally, very high CAI values (between 80 and 100 %) were registered by the largest majority of IFL patches.

Finally, the fourth map encompasses the patch level CAI values for non-altered IFL patches concerning their spatial adjacencies with patches altered by fires (figure 5). In this case very low, low and medium CAI values (between 0 and 60%) are registered by scarce IFL patches located in eastern Alaska, north-eastern Montana, central Brazil and eastern Siberia. The rest of the patches returned high and very high CAI values (between 60% and 100%).

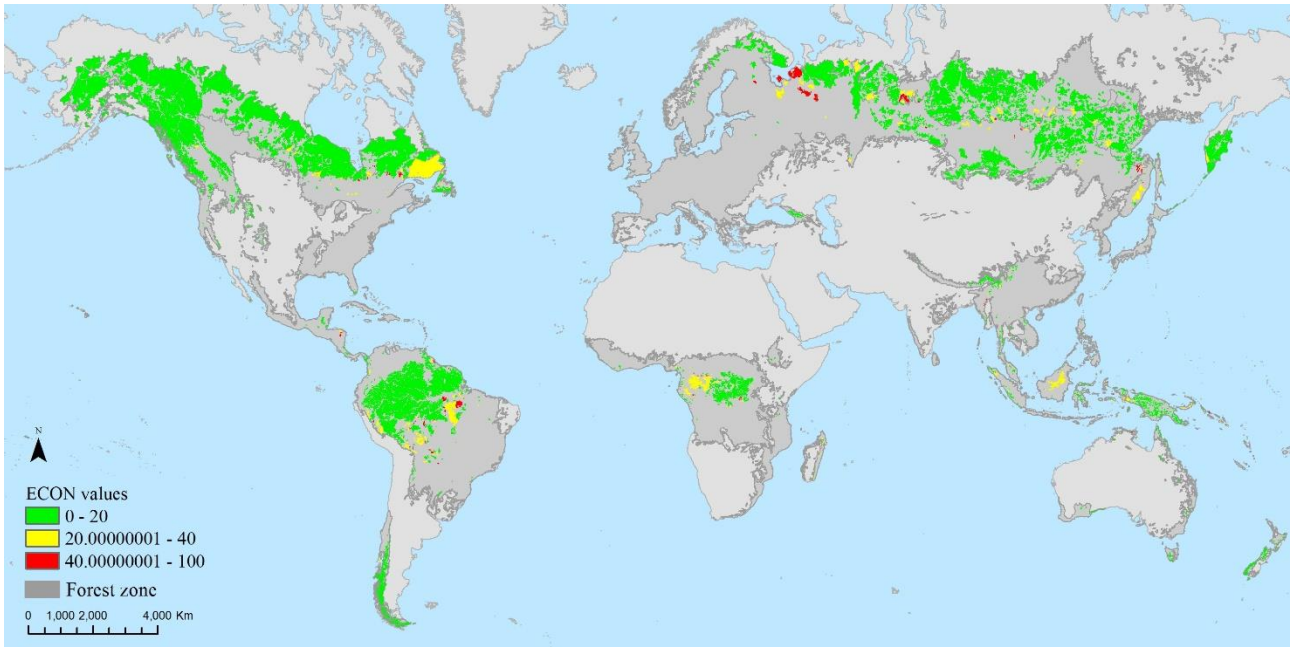
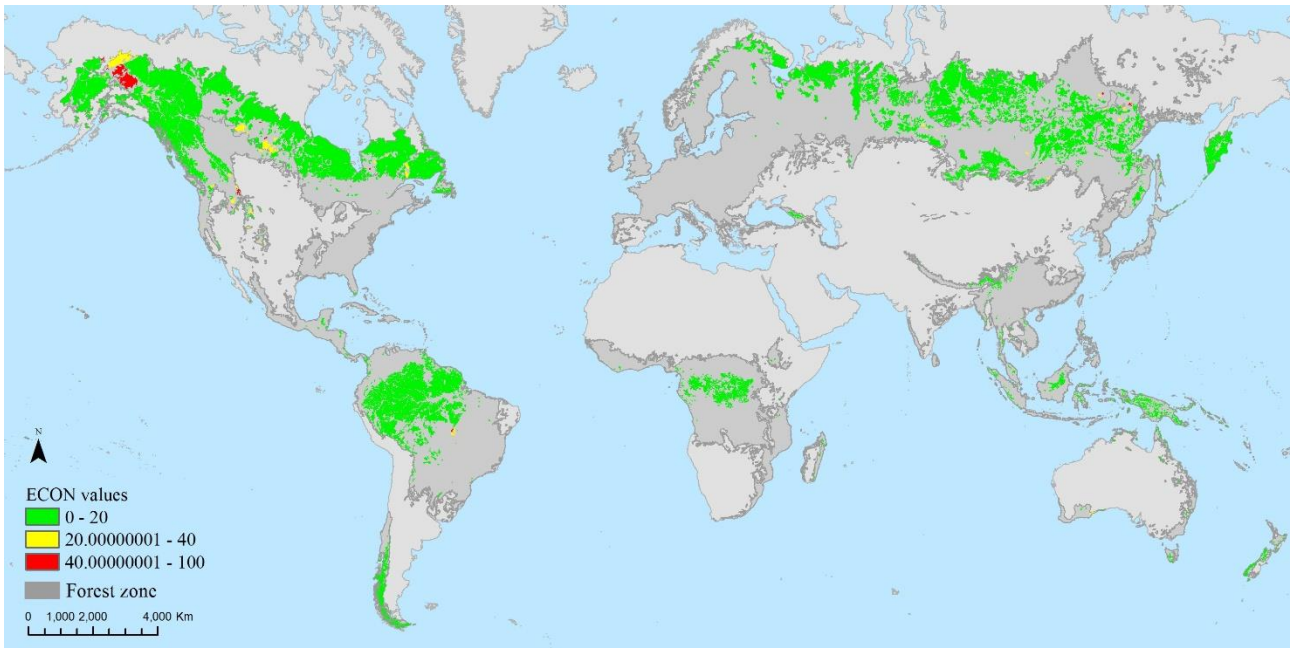


Fig. 2: Patch level ECON values for non-altered IFL patches based on their spatial adjencies with altered ones by non-fire related causes, such as forest clearing induced by human needs for artificial space or agriculture.



Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVII**, Issue **2** (**December 2018**), pp. **135-145**
http://dx.doi.org/**10.5775/fg.2018.003.d**

Fig. 3: Patch level ECON values for non-altered IFL patches based on their spatial adjencies with altered ones by fire related causes

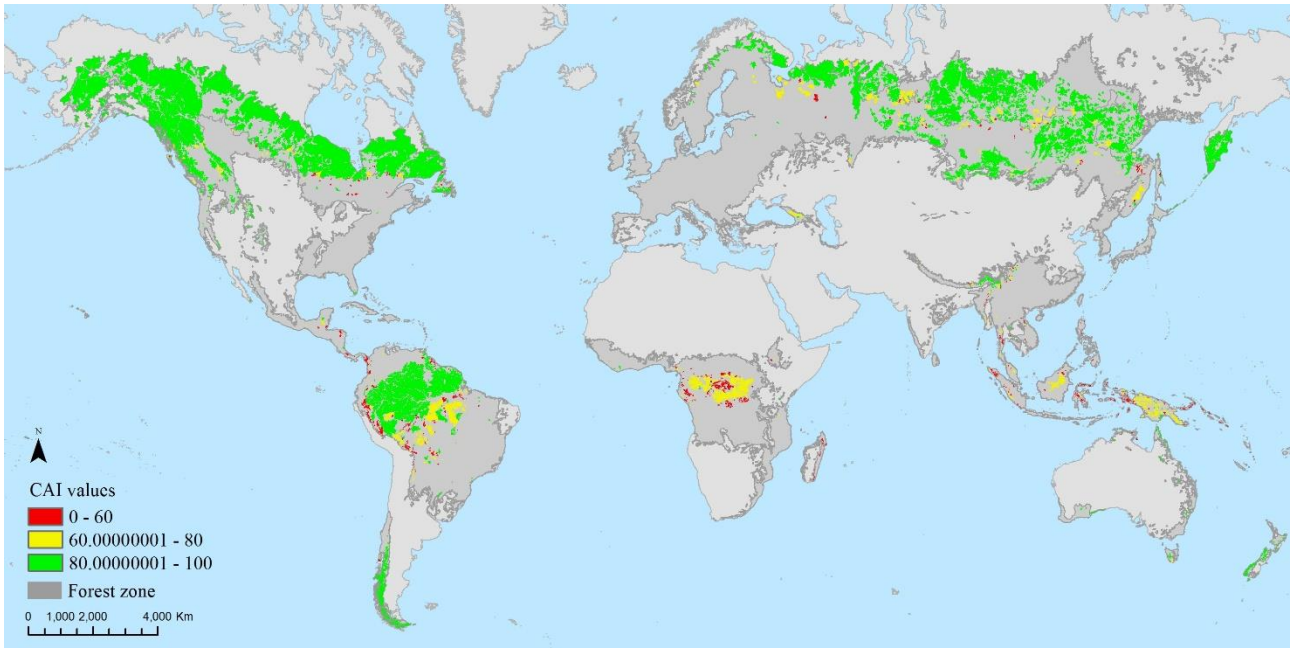


Fig. 4: Patch level CAI values for non-altered IFL patches based on their spatial adjencies with altered ones by non-fire anthropic related causes

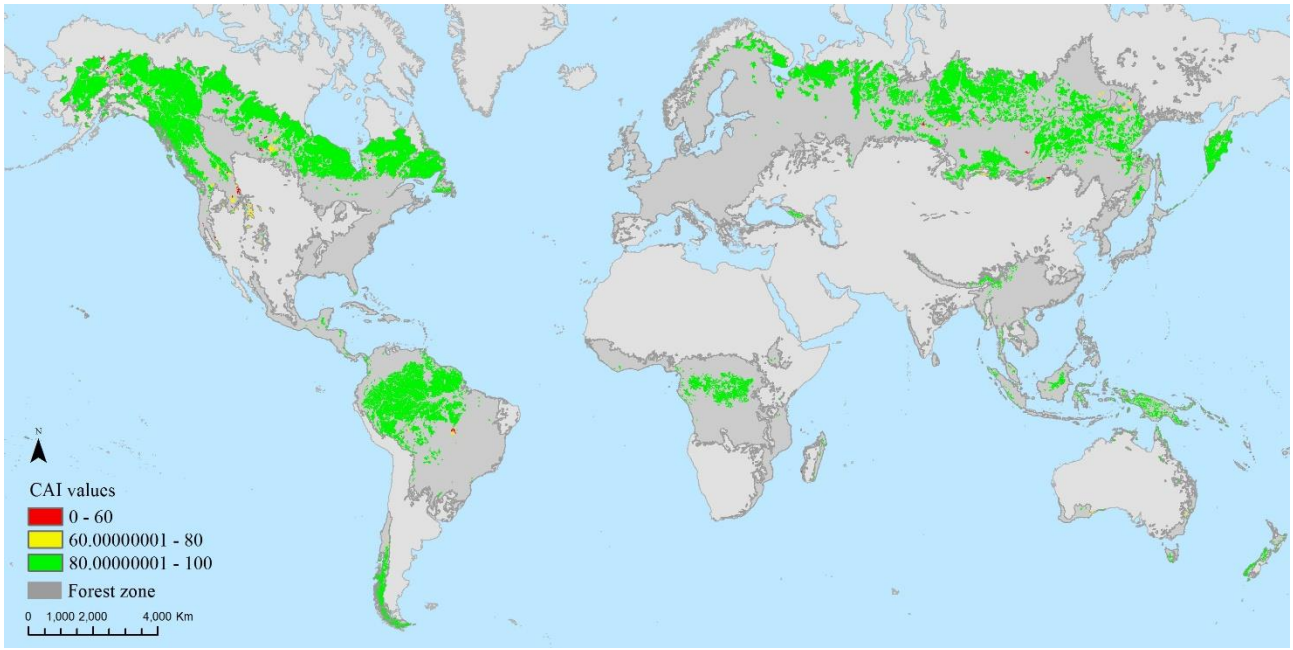


Fig. 5: Patch level CAI values for non-altered IFL patches based on their spatial adjencies with altered ones by fire related causes

For a general perspective, both patch metrics were summed at the class level using the area-weighted mean statistical method, for all of the nine geographical world forest regions. We preferred the patch area weighted mean technique because it offers a more landscape-targeted outlook if compared with the area mean which offers just a patch-oriented viewpoint (McGarigal & Marks 1995). We consider it more relevant for either interior or edge requiring species, based on the fact that the ecological

influence of a certain patch over the species it is usually determined by its size. Despite this aspect, if the patch size exceeds the minimum habitat required area of the species in question, it doesn't necessarily guarantee that the patch possesses a healthy ecological functioning. Such information offers just a quantitative viewpoint and not a qualitative one (Csorba and Szabo 2012).

From a landscape ecological perspective, potential ecological dysfunctions could be generated by the amount of common border between altered and non-altered IFL patches. Higher ECON values (> 50 %) suggest a potential malfunction of the IFL patches function as habitat for edge species, based on the fact that the edge shared with a degraded IFL by fire or anthropic causes exceeds half of the perimeter of the non-altered IFL patch (McGarigal & Marks 1995). These aspects could be translated in a high level of vulnerability of the non-altered IFL habitat function to future fire or anthropic degradations. Applying the same logical explanation, lower ECON values (< 50%) suggest a lower level of vulnerability.

On the other hand, lower CAI values (< 50%) indicate a potential dysfunctionality of an non-altered IFL patch habitat quality for interior species, due to the fact that the common edge with a degraded IFL patch generates a buffer area with a size which exceeds half of the total area of the non-altered patch (the remaining less than half of the total area being consider the core area, which is the one typically preferred by such species) (McGarigal & Marks 1995). Consequently, higher CAI values (> 50 %) suggest that the core area exceeds half of the size of the non-altered IFL patch, generating a potential efficient ecological functionality. Therefore, the size, shape and spatial distribution of the intervened patches have the potential to induce severe ecological malfunctions to the non-altered ones, especially affecting their quality as habitats.

Computing the patch area weighted mean ECON values per geographical region based on non-fire or human affected patch adjacencies, our results highlighted the fact that all of the nine regions are characterized by high levels of potential habitat functionality (< 50%). The highest is reached by the temperate southern forests of Oceania and Chile and by the boreal ones of Siberia and Canada (< 3%), followed by the temperate areas of Eurasia and North America (5-10%) and lastly by the tropical regions of South America, Africa and Asia (10-20%). In a similar manner, the patch area weighted mean ECON values regarding adjacencies with fire affected patches also reveal an overall advanced level of habitat quality. The top is reached by the tropical forest of South America, Africa and Asia, and by the temperate southern ones of Chile (< 1%), followed by the temperate zones of Eurasia, North America, Oceania and by the boreal areas of Eurasia (1-5%) and finally by the Canadian taiga (5-10%). Summing the two values, we obtain the patch area weighted mean ECON values per geographical region concerning both types of intervened patch adjacencies. The values highlighted that the temperate southern forests of Oceania and Chile possess the best ecological healthiness (< 5%), followed by the boreal zones of Canada and Russia (5-10%), the temperate areas of North America, Eurasia and the tropical ones from Asia (10-15%) and ultimately by the equatorial regions of Africa and South America (15-20%) (figure 6).

Modelling the patch area weighted mean CAI values per region based on the shared amount of edge between intact patches and human affected ones, our results reflect the fact that all of the nine regions possess a notable level of ecological functionality (over 50 % core area). The only exceptions are represented by Africa and tropical Asia, which scored considerably lower values (between 60 and 65% core area). At the opposite pole, regions such as Oceania, Chile, Siberia and Canada registered considerably higher values (over 90% core area), followed by the temperate forests of Eurasia and North America and by the tropical ones of South America (between 80 and 90%). The patch area weighted mean CAI values centred on the amount of common border between non-altered and altered IFL patches by natural fires points out the highest overall level of habitat quality. Thereby, all the regions encompass core areas summing over 90% of the total patch surface, the largest being modelled for tropical Asia with 100% core area. At the opposite pole, the lowest values characterize temperate Eurasia with 94% core area. Finally, the overall patch area weighted mean ECON values computed at a geographical region level evidences that the temperate southern forests of Oceania and Chile and the boreal ones from North America and Eurasia possess the best habitat functionality (over 90% core area), followed by the temperate areas of Eurasia and the tropical regions of South and Central America (between 70 and 80% core area) and lastly by tropical Africa and Asia (just between 60 and 65% core area) (figure 7).

Various investigations highlighted that increasing population density and worldwide total forest reduction are strongly correlated (Mather 1998; Mather 2000). Furthermore, important areas of both protected forest (3%) and intact forests (1.5%) were lost over the past decade in different regions due to various human induced causes (Heino et al. 2015). Anthropic activities are the main reasons for global IFL reduction between 2000 and 2013 and include the expanse of agriculture and pastures (which are the mains vectors for the IFL losses in tropical America) or logging (which conducted to the largest IFL losses within temperate North America and Eurasia, Africa

and Southeast Asia) (Potapov et al. 2017). Also, mining and the expanse of transportation infrastructures are the primary supposed causes for the largest IFL reduction within the southern temperate forests of Chile or Oceania, while fire caused IFL losses are dominant in the boreal regions of Eurasia and North America (Hansen et al. 2015; Potapov et al. 2017). The four models provide evidence that there is an urgent need for a better motorization and conservation of the equatorial and northern temperate non-altered IFL patches, in order to reduce vulnerability to future degradation based on agricultural activities or illegal logging at both regional and national levels (Hunter & Schmiegelow 2010). At a national scale, Brazil stands out as a global model in terms of minimizing deforestation actions, through the use of Landsat data in identifying tendencies in forest reduction over the Amazonian Equatorial forests (Hansen et al. 2015; Instituto Nacional de Pesquisas Especias 2013). At a regional level, the United Nations conducted several initiatives, yet with no success (Hansen et al. 2015).

It is vitally important to maintain as much as possible the high ecological functionality of the immense wild areas located in the boreal forest of North America or Eurasia and in the remote southern temperate forests from Chile or Oceania, areas which probably in the future will remain the last bastions of wilderness. Here, it is recommended that large non-altered forest patches must represent a priority regarding conservation programs. Yet despite the stated aspects, even protected IFL are vulnerable to deforestation actions, especially due to the economic and social underdevelopment of the inhabitants from isolated forested areas (Vanonckelen & van Rompaey 2015). There are studies which prove that the protection of forested areas does not always guarantee a lower rate of forest loss (Heino et.al. 2015). From an overall perspective, our results reflect the fact that in the year 2013 none of the global geographical forest regions non-altered IFL patches is diagnosed as encompassing potential low habitat functionality for interior or edge preferring species, based on the length of shared edge with altered patches between 2000 and 2013. Yet, assessing a comparative analysis, the tropical regions and the northern temperate ones possess overwhelming higher levels of vulnerability than the boreal ones and especially than the southern temperate ones.

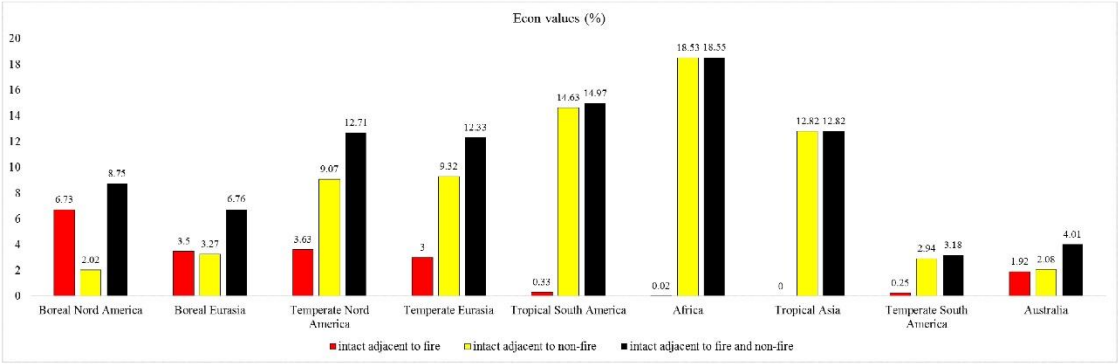


Fig. 6: Patch area weighted mean ECON values per geographical region.

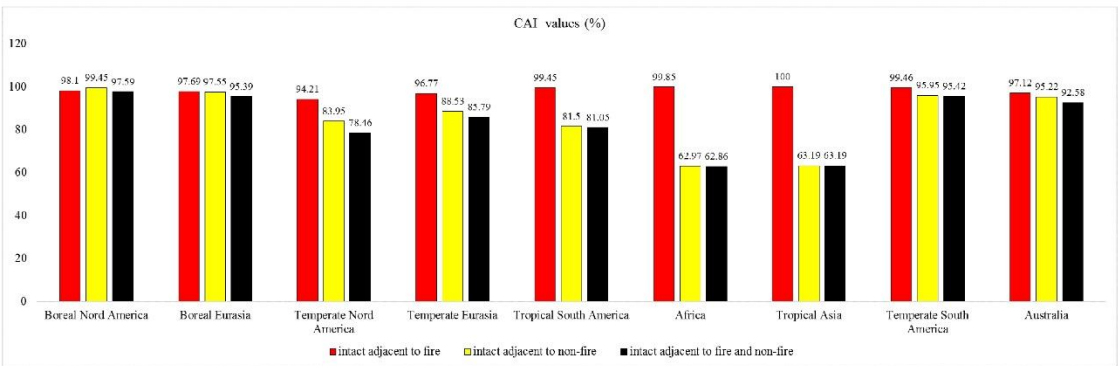


Fig. 7: Patch area weighted mean CAI values per geographical region.

Conclusion

IFL play a vital role in maintaining ecosystems biodiversity by offering favourable habitats for a wide range of species. Despite their isolation and immense size, between 2003 and 2013 numerous IFL patches have already been disturbed by human caused fragmentation or alteration, changes which could consequently affect the ecological integrity of the large neighbouring unaffected ones. The amount of shared edge between altered and non-altered IFL patches represents an essential piece of ecological information suitable for assessing the intact ones functionality as optimal habitats for either interior or edge preferring species. Landscape ecology methods represent an indispensable tool commonly used for modelling landscapes spatial and structural characteristics through the use of a wide range of metrics, measurable at both patch and class level, such as the ECON and the CAI indexes.

Our models highlighted that until 2013 none of the nine world geographical forest regions non-altered IFL patches suffered potential dysfunctions as habitats for both types of species when taking into account the amount of common border with altered IFL patches by fire or non-fire induced causes. The only exception is represented by the equatorial forests of America, Africa and Asia which are characterized by alarming potential future malfunctions.

We therefore strongly recommend attempting actions in two well evidenced directions:

(1) maintaining unaltered at all cost the immense boreal intact forests from North America, Eurasia and of the remote temperate ones from South America and Oceania by expanding the global protected areas network;

(2) implementing rigorous actions for reducing illegal forest exploitation at regional or national scale regarding the higher vulnerable equatorial and northern temperate forests.

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The connection between sustainable tourism and certification systems

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Abstract

The subject of certification and standards is vast, complex and at the same time topical, so the best is to begin by clarifying the terms. A "standard" by definition is a set of guidelines that helps organizations to develop, manage and control everything, from processes and products to services and systems. These guidelines meet specific requirements in areas such as efficiency, quality and safety.
On the other hand, the certification is the process that verifies whether an organization, product or tourist service meets the specific standards of providing a written guarantee (the commercial logo), the latter representing a good way to allow customers to identify products that deliver higher quality service levels. At the same time, it participates in increasing the confidence in ecotourism products both nationally and internationally, but also in promoting the concept and principles of ecotourism at local, regional and national level; it contributes to the sustainable achievement of destinations and to the growth of shared knowledge with regard to a certification system, resulting in the benefits brought by it.
In order to certify an organization, product or tourist service that meets certain standards, accredited third-party certification bodies must verify that the requirements are met through an audit process. Only after the successful completion of the audit process, an official certificate of an organization can be issued, and the admitted company agrees to maintain the systems according to the standard requirements of the continuous improvement.
But why do you need to submit to the certification process activity and to all its expenses? What are the benefits of a company or its customers? The third-party certification shows to current and potential customers that an organization is committed to quality and has taken enough time to build and maintain a culture in its processes to give customers the same thing, i.e. the quality of the travel product.

Keywords: *sustainable development, sustainable tourism, certification system, standards, accreditation, certification*

Rezumat. Conexiunea dintre turismul durabil și sistemele de certificare

Subiectul certificării și al standardelor este unul vast, complex și în același timp de actualitate, de aceea, cel mai bine este să se înceapă cu clarificarea termenilor. Un "standard", prin definiție, este un set de linii directoare care ajută organizațiile să dezvolte, să gestioneze și să controleze totul, de la procese și produse la servicii și sisteme. Aceste orientări satisfac cerințe specifice în domenii precum eficiența, calitatea și siguranța.
La rândul său, certificarea este procesul ce verifică dacă o organizație, un produs sau serviciu turistic îndeplinește standardele specifice acordării unei garanții scrise (logo-ul comercial), acesta reprezentând o bună modalitate de a le permite clienților să identifice produsele ce le asigură un nivel de calitate al serviciilor mai ridicat. Totodată aceasta participă la creșterea gradului de încredere în produsele ecoturistice atât pe plan național, cât și pe plan internațional, dar și la promovarea conceptului și a principiilor ecoturismului la nivel local, regional și național; la realizarea durabilă a destinațiilor și creșterea cunoștințelor în ceea ce privește un sistem de certificare, reprezentând beneficiile aduse de acesta.
Pentru a certifica o organizație, un produs sau serviciu turistic ce atinge anumite standarde, organismele terțe acreditate pentru certificare trebuie să verifice dacă cerințele sunt îndeplinite printr-un proces de audit. Numai după finalizarea procesului de audit cu succes se poate emite un certificat oficial al unei organizații, compania admisă fiind de acord să mențină sistemele în conformitate cu cerințele standardului în perfecționare continuă.
Dar de ce este necesar să vă supuneți activității și cheltuielilor procesului de certificare? Care sunt beneficiile unei companii sau al clienților acesteia? Certificarea acreditată de la terți demonstrează clienților actuali și potențiali că o organizație este dedicată calității și și-a acordat timpul necesar să construiască și să mențină o cultură în cadrul proceselor sale pentru a le oferi clienților același lucru, calitatea produsului turistic.

Cuvinte-cheie: *dezvoltare durabilă, turism durabil, sistem de certificare, standarde, acreditare, certificare*

Introduction

This paper aims to present the theoretical aspects of sustainable tourism and ecotourism certification, but also the link between the three functions on which a credible certification system is based.

The interesting topic which is in the spotlight of tourism specialists, the ecotourism certification was also addressed by authors such as Martha Honey (2002) in „Ecotourism and certification. Setting Standards in Practice" or X. Font și R.C. Buckley (2001) in „Tourism Ecolabelling. Certification and Promotion of Sustainable Management", which present the subject from different perspectives.

In other words, sustainable tourism is both a resource that meets the needs of tourists and local communities, as well as a way of protecting the environment with the help of actors who continue to actively engage in a responsible attitude towards the environment.

Sustainable tourism and ecotourism certification have been addressed in the scientific literature, either in several ways or from different perspectives, such as the complex approach of the author Mirela Mazilu (2011) in various works such as „Turism și dezvoltare

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http://dx.doi.org/**10.5775/fg.2018.032.d**

durabilă", where she defines sustainable tourism as a form of tourism that "allows the development of tourism and leisure activities in a country, region or tourist destination, taking into account the basic principles of sustainable development, showing respect for the environment, for people and for the local economy and culture of the inbound tourist region". By addressing the theme of ecotourism certification from conceptual clarifications, certification criteria, to their application to a particular destination, in works such as „Aspects Regarding The Romanian Certification In Ecotourism Destinations" (2017a) or „Certification standard for tourism in the Danube region" (2017b), Mazilu et al. state that "some systems strongly rely on a so-called third-party assessment, with an independent auditor who verifies the characteristics of the entity to be certified on the spot. Some systems choose an easier approach based on self-evaluation".

The certification is defined as a voluntary procedure that evaluates and provides a written guarantee that a facility, product, process or service meets specific standards. It provides a commercial logo to those who meet or exceed basic standards.

Certification is a way to ensure that an activity or product meets certain standards. Within the tourism industry, various organizations have developed certification programs that measure different aspects of tourism: (a) quality, for the entire tourism industry, (b) sustainability also for all sectors and (c) ecotourism, in natural ecosystems, protected or fragile ecosystems, which may include local communities that meet the definition above.

Tourism is a cultural, social and economic phenomenon that involves the movement of persons to countries or cities other than the place of residence to undertake personal or professional activities. These people are called tourists, visitors or excursionists depending on the length of their stay.

Tourism has an impact both on the natural and anthropogenic environment, as well as on the local population, tourists, but also on the economy. Due to these multiple impacts, the wide range and diversity of production factors needed to produce the goods and services acquired by visitors, and the broad spectrum of stakeholders involved or affected by tourism, a holistic approach is required to developing, managing and monitoring tourism (fig. 1).

Taking into account the limits of tourism development, according to the already known formula "too much tourism kills tourism", mass tourism causes the unpleasant negative effects such as:

- destruction of the environment, historical monuments, the rhythm of local life;
- damage to the natural, cultural and social environment of the overburdened tourist area, the ending of the "tourist colonization" of some regions;
- addiction on political conflicts;
- seasonal tour operator specializations, unprofitable phenomenon in the practice of tourism, which are changeable from year to year.

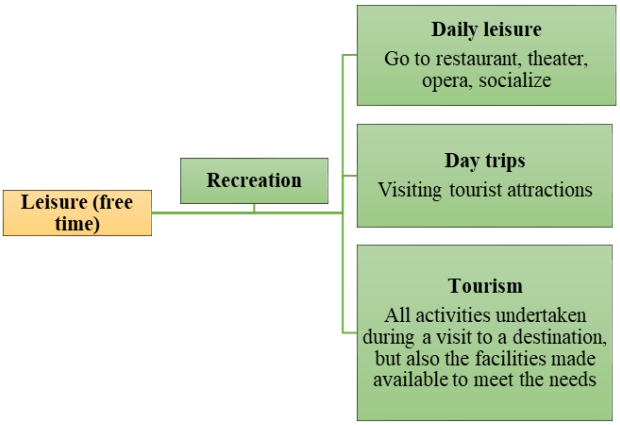

Fig. 1: The conceptual graph of the notion of tourism

Methodology

The study is based on an in-depth documentation of the content of specialized books and, in particular, the consultation of web pages, especially Google Trends. This method is widely used in the analysis of all tourism sectors, as the role of the Internet as a source of information is increasingly important. The number of tourists using it to collect information about possible destinations, their tourist potential, whether or not they have certification from certification systems and many other details is growing, and tourism service providers consider the Internet to be one of the most important marketing means.

The article aims to highlight the link between sustainable tourism and certification systems through conceptual clarification of terms, using comparative methods, inductive analysis, etc. Also the statistical method was combined with the mathematical processing to obtain concrete data related to the perception and image of sustainable tourism.

What do we mean by sustainable development?

The concept of sustainable development was stated by I.U.C.N. (International Union for the Conservation of Nature), as following:

"Sustainable development is a process that runs without producing, exhausting resources, ensuring development. Tourism resources must be capitalized at a rate identical to their renewal and abandonment when the resource is regenerated very slowly to

replace it with another, with greater regenerative power" (Mazilu, 2011, p. 18).

Theobald F. William defined the sustainable development of tourism as the action which implies "directing the management of all resources in such way in order to meet economic, social and aesthetic needs while preserving cultural integrity, ecological, essential processes, biological diversity and life support systems" (Gheorghilaș, 2014, p.62).

When talking about sustainable development, it usually means that we can carry out activities that meet the needs of the present, without compromising future generations, following three main aspects:

- From an **ecological** point of view - the activity minimizes damage to the environment (flora, fauna, water, soils, energy consumption, contamination, etc.) and tries to bring positive benefits to the environment by protecting and preserving it.
- From a **social and cultural** point of view - the activity does not harm and can revitalize the social structure or the culture of the community in which it is located.
- **Economically** speaking - activity does not just start and then quickly dies because of bad business practices; it continues to contribute to the economic well-being of the local community. A sustainable business should benefit its owners, employees and neighbours.

What is sustainable tourism?

The World Tourism Organization (UNWTO) has defined sustainable tourism as "tourism that takes full account of the present and future economic, social and environmental impacts that address the needs of visitors, industry, the environment and host communities."

Sustainable tourism development guidelines and management practices are applicable to all forms of tourism in all types of destinations, including mass tourism and various niche tourism segments. Sustainability principles address the environmental, economic and socio-cultural aspects of tourism development as well as an appropriate balance to be established between these three dimensions to ensure long-term sustainability (fig. 2).

So, sustainable tourism should make the best use of environmental resources which is a key element in tourism development, maintain essential ecological processes and contribute to the preservation of natural heritage and biodiversity. It should respect the socio-cultural authenticity of host communities, preserve the built and living cultural and traditional heritage, and contribute to intercultural understanding and tolerance. And it should ensure long-term, viable economic transactions that deliver economic benefits to all stakeholders and are distributed fairly, including stable jobs and social services for residents.

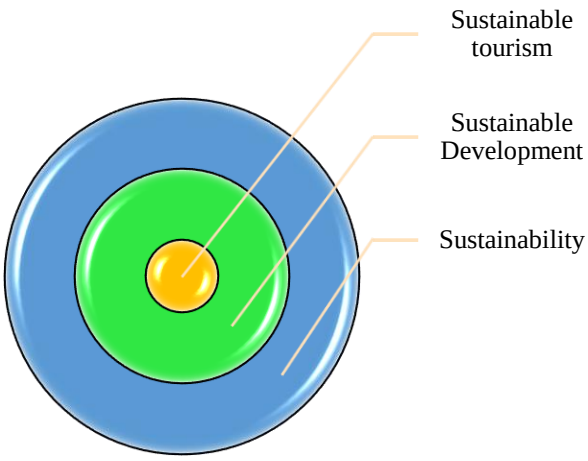

Fig. 2: The conceptual framework of the notion of sustainable tourism

The development of sustainable tourism requires the informed participation of all relevant stakeholders as well as strong political leadership to ensure broad participation and consensus building. Achieving sustainable tourism is a continuous process that requires constant monitoring of the impact, introducing the necessary preventive and/or corrective measures whenever necessary.

Sustainable tourism should also maintain a high level of tourist satisfaction and ensure a significant experience for tourists, increasing their awareness of sustainability issues and promoting sustainable tourism among them.

Sustainable tourism is not a distinct or special form of tourism. All forms of tourism should rather strive to be sustainable, including what is known as "mass tourism".

There are no successful techniques in sustainable tourism, but we can take into account some directions for action, such as:

- Develop a plan for sustainable tourism development;
- Promoting sustainable tourism;
- Better communication within sustainable development;
- Foster sustainable development as a tourist fructification agent;
- Initiating tourism in sustainable development for quality tourism.

The guarantee of success for such tourism implies:

- Stimulate private initiative in tourism and create a framework to support local tourism;
- To capitalize the touristic potential of the county by developing, diversifying and promoting the tourist supply;
- Sustainable development of tourism through: rational use of tourism resources and promotion of

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Volume **XVII**, Issue **2** (**December 2018**), pp. **146-151**
http://dx.doi.org/**10.5775/fg.2018.032.d**

conservation and environmental protection measures in accordance with the provisions of national environmental legislation;
- Maximizing tourist potential by integrating tourism with other regional industrial areas;
- Support for local institutions and operators to develop and modify resources according to community requirements;
- Development of the tourism industry through direct investment in the creation and construction of general and tourism infrastructure objectives;
- Reviving tourism through effective local initiatives;
- Stimulate local initiatives in tourism by creating mutual interests;
- Maximizing economic benefits for the population due to the development of tourism in order to achieve economic sustainability;
- Developing tourism through the qualitative increase of tourism services in order to attract new visitors;
- Developing poorly used tourism potential;
- Improving environmental conditions in tourist areas;
- Improving the image of tourist areas;
- Development and modernization of transport infrastructure;
- Showing off the natural, architectural and cultural heritage through specific actions;
- Promoting tourism for leisure and sports.

What is a Certification System?

A certification system describes the rules, procedures and management for certification. It sets out specific requirements for a product, process, system or body and uses a third party to ensure that the specified requirements have been demonstrated.

A credible certification system is based on three distinct functions: standards, certification, and accreditation (fig. 3).

A **standard** can be defined as a set of technical guidelines, instructions for designers, manufacturers and users. Standards promote safety, reliability, productivity and efficiency in almost all industries that rely on components or technical equipment. Standards can run from a few paragraphs to hundreds of pages and are written by experts with knowledge and expertise in a particular field that is in several committees.

Standards represent a way of communication for producers and users. They serve as a common language, defining quality and establishing safety criteria. Costs are lower if procedures are standardized; training is also simplified; interchangeability is another reason.

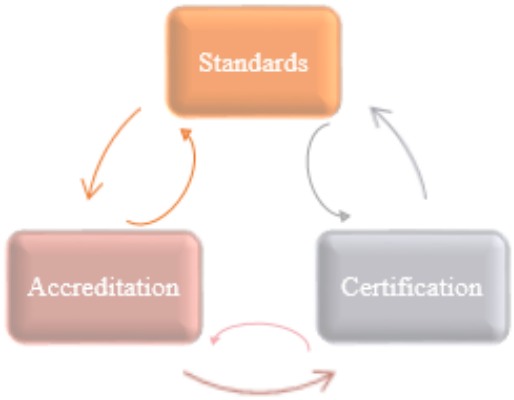

Fig. 3: The three functions on which a credible certification system is based

The standard setting is the process of defining certification requirements in collaboration with stakeholders and is coordinated by a standardization body.

One way to identify businesses that genuinely practice ecotourism or other forms of sustainable tourism is **certification**. This is a very good way to attest the fact that a product or tourist activity meets certain standards.

Certification is defined as a voluntary procedure that evaluates, audits, and provides a written guarantee that a facility, product, process or tourism service meets specific standards. Those who meet or exceed basic standards are offered a commercial logo. Certification is one of the tools that motivates tourism businesses to improve their economic, social and environmental performance while being rewarded, tangible or intangible for these achievements.

The certification highlights three main areas: certification of systems, products and staff. The goal of the certification is to demonstrate that the specified requirements are met. The requirements are usually based on international standards.

Certification can be a useful tool to add credibility by demonstrating that the product or service of these institutions responds to customer expectations. For certain industries, certification is a legal or contractual requirement.

Certification sets standards and contributes to the genuine distinction between ecotourism and sustainable tourism businesses. This helps protecting the integrity of these concepts.

Certification is not a goal itself. It is one of the tools to motivate companies and others to improve their environmental, social and economic performance while rewarding them to do so (fig. 4). These rewards are sometimes tangible and sometimes they are not.

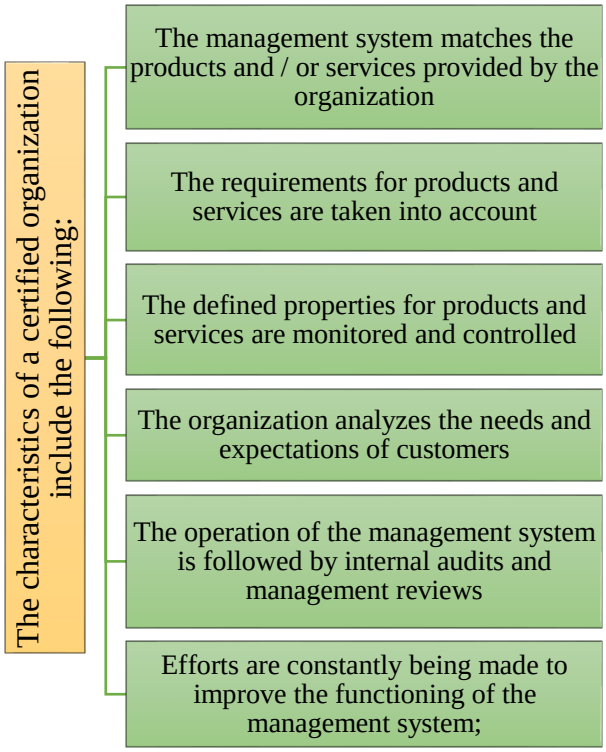

Fig. 4: The characteristics of a certified organization

According to the World Tourism Organization, the world currently has over 200 sustainable tourism and ecotourism certification programs whose competences include aspects related to the impact of tourism on the economic, socio-cultural and environmental level. Most programs evaluate accommodation, only a few programs certifying sectors and other aspects of the tourism industry.

From the point of view of the geographical distribution of tourism certification systems, we can see that Europe has half of the total number of sustainable tourism and ecotourism certification programs (fig. 5).

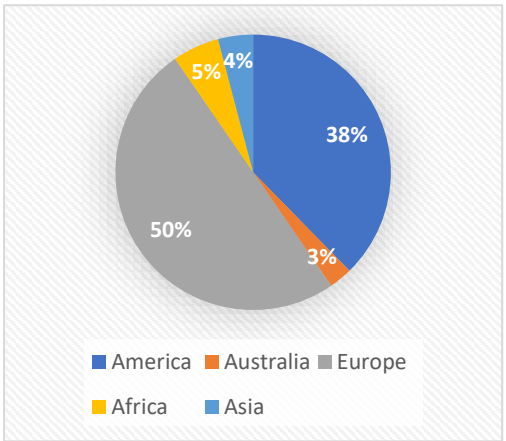

Fig. 5: Geographical distribution of tourism certification systems (2019)

Europe is the continent where the ecological certification of tourism services began for the first time with the Blue Flag Campaign for Beaches in Denmark in 1987 (currently around the world).

Between 1992 and 2002, over 60 ecotourism certification programs were developed, according to an ECOTRANS study requested by the World Tourism Organization (UNWTO) (2013).

Most of them were set up in Europe. Initially most of the systems rated only accommodation units, then they began to expand their area by certifying all sectors and aspects of tourism.

Accreditation - official recognition by an independent body, generally known as an accreditation body, that a certification body operates in accordance with international standards.

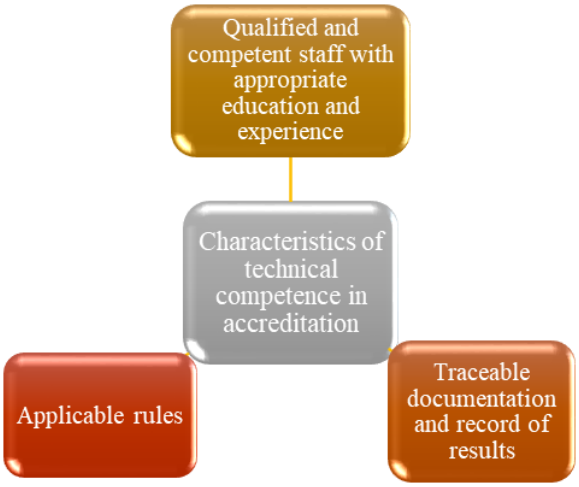

Fig. 6: Characteristics of technical competence in accreditation

Accreditation is the determination and demonstration of competence. The body requesting accreditation defines the area in which its competence is assessed. Accreditation is granted for the domain in which the applicant's competence is demonstrated. The purpose of the accreditation is to demonstrate the reliability of the results and / or the credibility of the certificates issued by the body. There are several requirements for accreditation standards, depending on the nature of the activities (fig. 6).

Accreditation is made to evaluate both the management system and the technical operations, while the purpose of certification is to verify how well the requirements of the management system are met. An organization that carries out certification may also be accredited; this demonstrates the competence of certification. However, certification itself does not demonstrate that an organization is capable of delivering reliable results or products, as certification standards do not include technical competence requirements.

Conclusion

Tourism is a volatile, complex and increasingly accessible industry. The tourism phenomenon is omnipresent all over the world, so its social, economic and environmental impacts are also global. These effects may be positive or negative. Sustainable tourism typically aims to have a minimal negative impact, minimize damage and optimize economic benefits. Ecotourism, a type of sustainable tourism, usually takes place in largely intact natural areas that tend to be environmentally sensitive and often socially sensitive (especially if local groups are involved), so the potential impact may be even greater. Ecotourism aims to expand the positive impact, through special attention to conservation, benefits for the host population and visitor education.

Some businesses and/or destinations really do meet these goals, others claim falsely and others do not care. Some would like to meet those goals, but they don't know exactly how to do it. One way to reward businesses that truly respect these goals is by granting credible recognition outside of them, certification being a tool to do so.

Certification leads to increased industry standards in terms of health, safety, environment, social stability, as well as reducing the cost of environmental protection, by protecting the environment and limiting the negative impact on it, protecting cultural and social values of local human values.

Finally, we can say that the current socio-economic environment requires orientation towards a sustainable, ecological business. Tourism companies are motivated to implement a quality certification system to obtain cost savings and global recognition of the quality of ecotourism services.

In this context, by implementing an ecotourism quality certification system, companies in the area could get a better image and a differentiation from competition, resulting in beneficial effects on the market by reducing costs and improving performance. Thus, certification systems can become a source of income through the loyalty of ecotourism users.

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Assessing the importance of the Jewish urban cultural heritage in Oradea, Bihor County, Romania

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Abstract

The current study aims to assess the importance of the Jewish cultural heritage in the city of Oradea, Bihor County, Romania, an emerging and highly dynamic tourist destination. This synagogue was revealed as the most representative building pertaining to the Jewish cultural heritage was revealed based on a survey applied to the central public authorities, tourists and the local population. As a result, the Sion Neologue Synagogue stood out as the most representative of the Jewish identity heritage in a proportion of 90%, while 96% of the respondents replied that it is the most important tourist site of the city altogether, especially after its rehabilitation works. Among the other listed buildings, the Sion Neologue Synagogue was selected by the interviewees based on its uniqueness and novelty features, trimmed up in an eclectic style, imbued with Art Nouveau ornamentations.

Keywords: *Sion Synagogue, Jewish heritage, Oradea*

Rezumat. Evaluarea importanței patrimoniului cultural evreiesc din Oradea, județul Bihor, Romania

Studiul actual are scopul de a evalua importanța patrimoniului cultural evreiesc din orașul Oradea, județul Bihor, o destinație turistică emergentă și foarte dinamică. Astfel, pe baza unui sondaj aplicat autorităților publice centrale, turiștilor și populației locale, aceasta sinagoga s-a evidențiat ca fiind cea mai importantă clădire a patrimoniului cultural evreiesc. Potrivit rezultatelor cercetarii, Sinagoga Neologa Sion a fost desemnată de respondenți ca fiind cea mai reprezentativă pentru patrimoniul de identitate evreiască în proporție de 90%, în timp ce 96% dintre respondenți au răspuns că aceasta este cel mai important obiectiv turistic al orașului, în special după lucrările de reabilitare. Printre celelalte clădiri enumerate, Sinagoga Neologă Sion a fost aleasă de respondenți datorită particularităților sale arhitecturale privind unicitatea dată de stilul eclectic, pigmentat cu elemente Art Nouveau.

Cuvinte-cheie: *Sinagoga Sion, patrimoniu evreiesc, Oradea*

Introduction

Cultural sites have a high impact on the quality of social life, economic choices and cultural production (Grodach et al., 2017), especially the culture that withstood the test of time, thus making its transition to heritage tourism (Gravari-Barbas, 2018; Barrere, 2016). Cultural heritage (Feeney, 2017) has managed to gap friendly the transition from the past to the present and trigger high interest for tourists, stakeholders, public authorities, local residents, etc. Given the interest which cultural heritage has triggered, many groups and communities call for its protection, sustainable management and governance (Joppe, 2017; Bertacchini & Segre, 2016) as some of the man-made resources are stronly affected and prone to constant degradation. On the backdrop of a globalized world, many cities are striving to protect their identity heritage (Throsby, 2016) through different means of policies and strategies, turning them into historical buildings, World Heritage Sites; networks involving many decision makers, the civic society and political actors (Cuccia & Rizzo, 2016).

On this backdrop residents of historical cities feel the urge to protect their monuments and such holds true in the case of Oradea which possesses a heritage whose beauty is represented by a prevailing Art Nouveau/Secession and eclectic style buildings erected at the turn of the 20th century, right before the first world war, at a time of great economic boom for Transylvanian cities. Modern ideas that arrived from Paris, Vienna, Bucharest or Budapest found a natural home in Oradea at that time and began shaping a taste for European culture in the local inhabitants, highly receptive to new European trends (Novicov, 2014). The Art Nouveau artistic and cultural emancipation during 1890-1910 converted the city of Oradea into a centre of Romanian art and culture with exceptional stucco and ironwork ornamentation on the buildings, thus creating an urban identity for the city (Huovinen et al., 2017). In Oradea, the Art Nouveau heritage is associated with an elitist society, namely the rich entrepreneurial or petite bourgeois Jewish burghers (Novicov, 2014). For this style, historical models were abandoned to make way for free, creative shapes inspired by nature (Howard, 1996).

The eclectic style prevalent in the case of the Sion Neologue Synagogue, the cultural site under scrutiny in the current paper, features many accents of the Art Nouveau style.

Art Nouveau and the eclectic styles refer to architecture and design, graphic and fine arts, theatre and dance, as well as individual items such as a vase, a tapestry, a poster or a bed, its vagueness of application rather identifies it to a period more than a style, encapsulating it between the fin-de-siecle and debut-de sicle, i.e. 1890-1910 (Howard, 1996). It was a period of prolific artistic output, as the year 1890 gave the world two innovations: cinema and Art Nouveau (Sembach, 2002).

Aiming to highlight and promote this heritage, in many parts of Europe less capitalized, a networking project was set up by an association of local governments and non-profit governmental institutions in 2000 during its first Plenary Meeting in Barcelona so as to allow its members to collaborate on the Art Nouveau sustainable management strategies. Currently, 77 cities have joined this network, among which two cities from the western part of Romania, Oradea and Timisoara as featured on the Art Nouveau European Route – Ruta Europea del Modernisme website. Distressing events play their role in tourism and a shift in the victimized ethnic group's behaviour, namely their effort to maintain their identity demanding greater respect in the parketplace (Padoshen & Hunt, 2011). The Jewish heritage represented by synagogues, palaces and private houses created an identity for the city of Oradea through the arabesques, floral and animal ornaments, feminine silhouettes and curved lines which feature a unique representation on each building, so that out of the 253 listed historical buildings of Oradea (according to the List of the Historial Monument Buildings of Oradea, 2004), it is uncommon to find two identical Art Nouveau or Eclectic style buildings. At present it is the historical buildings' uniqueness which gave rise to a dynamic urban tourism in Oradea counting 29,333 tourists in the peak season of August 2017 (INS, 2017a) and that inspired local tour guides to link past ethnicities and events to the contemporary Secession/Art Nouveau and eclectic heritage of Oradea

Local tour guides in Oradea strive to provide a successful interpretation rather than attract a high flow of tourists; it is meant to bring a degree of satisfaction and enlightment to the learning experience (Wight & Lennon, 2007; Tătar et al., 2018) for the visiting of the Sion Neologue synagogue.

Research methodology

The data required for this study were obtained during October 2017 - February 2018, using the sociological questionnaire survey method, the quantitative method of data collection and analysis (Chelcea, 2007; Becker et al., 2012; Babbie et al., 2010; Ilieş et al., 2016; Tătar et al., 2016). Three types of surveys were applied to the central public authorities, tourists and the local population. From a structural point of view, the questionnaires were composed of 5 items referring to the degree of knowledge concerning the defining elements of the Jewish identity heritage in Oradea; considerations as to the extent to which the Sion Neologue Synagogue in Oradea represents an important heritage element for the city, namely a tourist attraction; considerations on the importance of rehabilitation of the Sion Neologue Synagogue of Oradea for the development and promotion of local tourism; knowing the distinctive elements by which the Sion Neologue synagogue of Oradea stands out in local and regional tourism; personal considerations about the respondents' expectations regarding the involvement of the public authorities, tourists and locals for the Jewish heritage tourist capitalization. Furthermore, socio-demographic data, i.e. gender, age, residence and ethnicity were also captured in the questionnaire.

Results and debates

Information on the monitoring of respondents' awareness of the Jewish heritage role in the development and promotion of tourism in Oradea was obtained by surveying 281 people, representatives of central public authorities (6 persons), the local population (133 persons) and tourists (144 persons). In the outline of the socio-demographic profile of the respondents, the following analytical aspects were addressed: gender, age, residence and ethnicity. This study included 139 males and 142 females aged between 17 and 78 years. From the analysis of the respondents by age groups it was found that the largest share is held by the young people group aged 17-34 years, 49% (138 persons), followed by the group of adults aged 35 - 49 years, 32% (91 persons) and the elderly of over 50 years, 19% (52 persons). As for the respondents' residence environment, 234 were from the urban area, with the remaining 47 from the rural area.

The Defining Elements of the Jewish Identity Heritage in Oradea

The history of Oradea city is closely linked to a wide ethnical composition (Dincă et al., 2012), but mainly to that of a Jewish community.

The Jews were recorded in Oradea since 1489 (i.e. Judeo Josa de Varad as he appears in documents) and later on in 1722 in Oradea 22 Jews were allowed in the city in exchange for a tolerance tax of 50 florini (Mozes, 1997). Across time the economic differences widened and along them the taxpaying burden. They held different jobs such as traders of fibre, silk, butchers, tailors, shoe-makers, masons, but the range of their business was only limited by law to trade, only later on their rights were extended and even doctors were allowed to practice in 1850. In 1873, among the Jews of Oradea there was a rupture between the reformist Hungarian Jews and the Orthodox Jews, attached to their traditions. By that time, in 1900, in Oradea lived 12,000 Israelis, accounting for 26,3% of the entire population. The Jewish education was set up in 1786 and continued until 1869. In the records of Oradea, out of 208 students who attended the Law Academy, only seven were Jews, but the Jewish intellectuals' number increased constantly due to their thirst for knowledge and permission to enrol in high education, so that in the first decade of the 20th century 29 Jewish teaching staff members were recorded (Mozes, 1997), along with 49 doctors, 6 pharmacists, 58 lawyers, 10 owners of printing houses, 8 journalists, etc. Franz Joseph who bore respect for the Jewish community and firmly intervened against anti-Semitism, stated that he counted on them for the Empire modernization. This liberalist approach yielded emancipation for the city and its high-class elitist citizens (Bodo, 2016). Unfortunately, this prosperity was abruptly stopped in the life of the Jews along with the fascist occupation and their deportation to Birkenau and Auswitz concentration camps. So, we can speak about a Jewless Oradea on the 3rd of June 1944 when the last Jewish transport took place, all were deported except for 16 Jewish families which were exempted by the anti-Jewish laws. Nonetheless by 31st December their number increased slightly to 140 Jews (Mozes, 1997).

These distressing events played their part in the identity of the city and left a strong impact in the memory of its inhabitants. The built heritage that the Jews left behind gained recognition for the current tourists. These buildings speak of Jews' history and their cultural legacy needs to be further on disseminated and talked about, as it happens currently in the city of Oradea, as many have become tourist attractions.

Most Art Nouveau buildings in Oradea were the property of the rich bourgeoisie of Jewish origin. But unfortunately, out of 17,880 Jews that could be counted at the flourishing economic and artistic boom of Oradea in 1920 (Varga, 2010), barely 140 Jews could be counted at the last census in 2011 (according the Population and Residence Census of the National Institute of Romania, 2011), their footprint leaving a high impact in the city's cultural landscape.

The city of Oradea boosts a prolific cultural production from the fin-de-siècle and debut-de siècle Art Nouveau period with 253 recorded historical monument buildings (according to the List of the Historical Monument Buildings of Oradea, 2004). Besides an architectural production, the city cultural output was highly intensive with more than 24 existing printing houses at around the year 1900, a trendy lifestyle that attracted tourists who could be accommodated and fed within more than 123 touristic units. Following this development trend, in 1903 the city was electrified with public lightning and the first functional tram lines in 1906 so that urbanistic ally the city gains its status of a reputed western city during 1985-1915 (Borcea, 2003).

Within the current local literature referring to the architecture of Oradea, it is stated that the Eclectic and Art Nouveau/Secession styles shaped the definitive image of the city (Zoltan, 2003). Today it stands out as a dynamic city which combines both tradition and modernity.

On this background, the Jewish identity heritage is an essential landmark for the history of Oradea and also a resource with tourist valences. Among the defining elements regarding the Jewish heritage of Oradea city, with relatively easy possibilities for promoting and capitalizing on tourism there are: synagogues (Sion Neologue Synagogue dating from 1878; the Orthodox Synagogue – 1890; Poale Cedek Synagogue – 1910; Sas Chevra Synagogue – 1908, Synagogue Viznitz - 1915), Jewish palaces (Black Eagle Palace dating from 1905, Ullmann Palace - 1913, Moskovits Palace -1910-1911, Miksa Moskovits Palace 1904-1905, Stern Palace 1904-1905, Sonnenfeld Palace 1911-1912) and other notable Jewish buildings (House Darvas 1909- 1910, The School for the Constabulary 1911-1913, Salamon Goldstein Building 1910, Adorjan I House 1900, Adorjan II House 1904-1905, Hotel Parc - 1915).

The knowledge of the defining elements regarding the Jewish identity heritage in Oradea, Bihor County was an essential aspect on which this study was focused. Thus at the first question: Do you know which are the defining elements in the Jewish identity heritage in Oradea? 178 respondents or 63% answered positively.

The most reputed Jewish identity heritage sites chosen by the respondents were: The Sion Neologue Synagogue (67% representatives of the local public authorities, 72% representatives of the local population, 47% tourists), the Orthodox Synagogue (67% representatives of the local public authorities, 57% representatives of the local population, 6% tourists), Ullmann Palace (17% representative of local public authorities, 1% tourists), Fuchsl Palace (21% representatives of local population), Black Eagle

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Palace (100% representatives of local public authorities), Moscovits Palace (17% representative of local public authorities) and Darvas Moscovits House (17% representative of local public authorities).

Therefore, the interwees chose the Sion Neologue Synagogue as the most representative Jewish identity cultural heritage of Oradea.

The Sion Neologue Synagogue in Oradea, an Identity Heritage Site and an Important Tourist Attraction for the City

Respondents (representatives of local public authorities, local population and tourists) were asked to assess to what extent the Neologue Synagogue in Oradea represents an important cultural heritage element for the city. Although only 63% of the respondents were aware of the defining elements regarding the Jewish identity heritage in Oradea; to the second question of the survey: To what extent do you consider the Sion Neologue Synagogue in Oradea: 2.1. Is an important heritage element for the city? 2.2. Is an important tourist attraction for the city? it yielded a greatly positive response, 90% considering it as an important heritage element for the city, and 96% of them an important tourist attraction for the city, respectively (Fig. 1, 2).

The Sion Neologue syanagogue stands out as the most representative tourist attraction of the city in the tourists' and the local population's opinion in the context of a dynamic tourist flow, the tourists recorded as being interested in the urban cultural heritage (museums, memorial houses and public art collections) reaching half (i.e. 100,017) of the resident population in the year 2016.

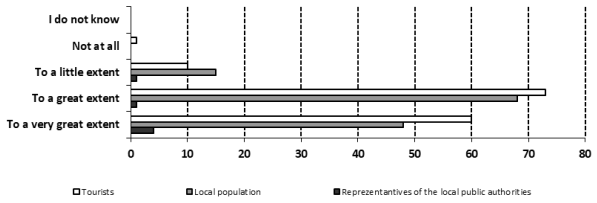

Fig. 1: Assessing the importance of the Sion Neologue Synagogue in Oradea as a heritage site for the city

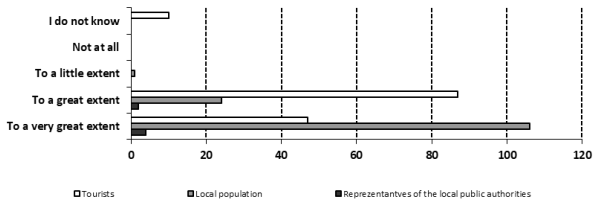

Fig. 2: Assessing the importance of the Sion Neologue Synagogue in Oradea as an attraction for the city

The Importance of Rehabilitation of the Sion Neologue Synagogue in Oradea in the development and Promotion of Local Tourism

Regarding the importance of rehabilitation of the Sion Neologue Synagogue in Oradea, in the development and promotion of local tourism, respondents were asked to evaluate its utility on a scale from 1 to 10, where 1 = Not at all, and 10 = To a great extent. The answers obtained for each of the three samples, in part, indicate high values regarding the importance of having restored the synagogue (Fig. 3).

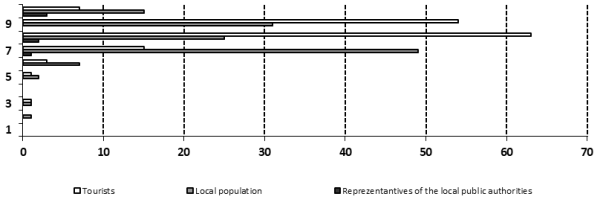

Fig. 3: Considerations on the importance of the newly restored Sion Neologue Synagogue in the development and promotion of local tourism

Among many city tours mentioned on the city's official promotion webpage (i.e. oradea.travel) the Sion Neologue Synagogue is intensely featured within the themed tours Religious sites tour as well as on the interactive map, on the main page at the monuments and heritage with the tourist circuit and on the ecclesiastical architecture sections. Local tour guides within the synagogue are striving on a sustainable interpretation of the site. The Sion Neologue Synagogue, built in 1878, is listed as a historical monument within the official list provided by the Ministry of Culture - The National Institute of Historical Monuments, classed in the II category of architectural monuments and representative for the local heritage (B). Due to the small number of Jews left in Oradea, the synagogue could not serve its initial religious purpose anymore and was handed over to the local community which restored it within the project The Promotion of Religious Jewish Tourism within Oradea-Debrecen and entered the tourist circuit as a museum in 2015. Besides its daily visitation availability (except for Mondays) it is a venue for concerts, exhibitions and other cultural and religious events.

In order to protect its historical buildings, Romania adopted in 2001 the law concerning the protection of historical monuments, i.e. law no. 422 which foresees a set of scientific, judicial, administrative, financial and technical measures meant to identify, research, store, classify, reserve, protect, maintain, reinforce, restore and capitalize the monument/building. The

article 6 of the Law Order 422/2001 stipulates that all the afore mentioned measures are incumbent, according to each case, to the owners or entitled persons having real and legal rights over them. Related further laws were issued according to the arising necessities, such as the Law no. 153/2001 referring to the enhancement measures for the environmental architectural quality of buildings; the law no. 10/1995 of the quality in constructions and the fiscal Code, which stipulates both incentive as punitive measures. Nonetheless even these proved to have shortcomings for the urban necessities of Oradea, so the City Hall (Chief Architect Department) commissioned a study which delivered, also electronically, individual files of the surveyed buildings, stating all degradation elements and the limits of possible interventions. This entire legal framework made possible the right inventory, classification, restoration and protection of the cultural Jewish heritage of Oradea city.

Distinctive Elements of the Sion Neologue Synagogue in Oradea in Local and Regional Tourism

For this approach the respondents had to choose from a set of provided choices such as: oldness; uniqueness; novelty; others; the ones that they considered important. The results revealed that respondents were in favour of the elements of novelty and uniqueness (Fig. 4).

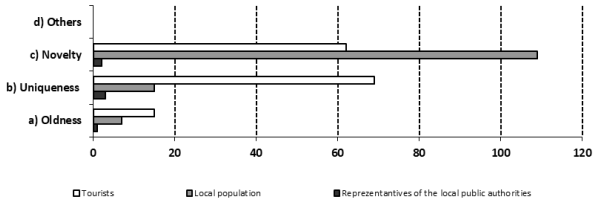

Fig. 4: Considerations regarding the distinctive elements by which the Sion Neologue synagogue in Oradea stands out in local and regional tourism

Both regionally and locally, tourism is an important economic activity (Herman et al., 2017) with deep implications in the preservation, valorisation and promotion of identity elements, specific to the place and human communities (Herman & Wendt, 2011; Herman & Gherman, 2016; Herman & Benchis, 2017). Nonetheless, against the backdrop of globalization, many of these identity elements, defining a human community that developed over time in a social, economic and political context are threatened with extinction, because the conditions that have competed for the appearance and affirmation of the place's identity have diluted, sometimes to extinction (Ilieş et al., 2009, 2010, 2014, 2016) as in the case of many Romanian wooden churches and water mills from the surrounding villages of Oradea. In this context, tourism plays a particularly important role, meant to capitalize on those identity attributes that are related to old age and uniqueness. The age of cultural sites, combined with elements of uniqueness and novelty have often led to the declaration of a considerable part of the Jewish heritage in the category of historical monuments, thus stimulating and facilitating the tourist's interest (Herman, 2012; Tatar & Herman, 2013). In the meantime, the more prestige the site acquires, the higher the housing and real estate value become (Poria et al., 2013). This issue makes it debatable if increasing tourism numbers is desirable as many tourist sites suffer of an over-tourism phenomenon (Seraphin et al., 2018; Tourtellot, 2018; Higgins Desbiolles, 2017) which entails a whole process which finally marginalizes the local community out from the entire tourism entrepreneurship. As a rising touristic city, Oradea's tourists (i.e. 190,022, according to The National Institute of Statistics, 2016b) almost reached the resident population's number (i.e. 222,229 inhabitants according to the County Statistical Institute, 2016) in the year 2016, among which more than half of recorded visitors (i.e. 100,017 -e National Institute of Statistics, 2016c) target the cultural heritage of the city by visiting museums, memorial houses and public art collections.

The Sion Neologue Synagogue stands as an imposing building with a square shape topped by a dome and high windows. The outward ornamentations are inspired from the Moorish art. The most representative part of the synagogue is the main facade. The access is provided by three semi-circular-arched doors on the Western side for men, and two rectangular doors on the synagogue's lateral sides for women, the latter being actually the entrance in the current museum (Zoltan, 2003). One of its uniqueness elements refer to its valuable organ with its 856 pipes. The novelty avant-la-lettre feature is related to the term neologue, from its name Sion Neologue Synagogue which refers to the fact that the sermons were preached in Hungarian, a whole set of new more liberal rules, meant to remove the outdated habits were set at the Congress from Pesta on the 14th of December 1868, whereas the same Orthodox Jewish community, more conservative did not approve of the new rules and continued the same old practices in Hebrew. So, in Oradea we can speak of two split approaches towards Judaism, the neologists of the Neologue Synagogue Sion and the conservative of the Orthodox synagogue (Bodo, 2016).

The dome that topped the synagogue was finished in May the 26th 1878 and the inauguration took place on September the 24th, 1878. Due to its intense degradation over the years, it was rehabilitated it its

initial outlook in 2015 and since then it has entered the tourist circuit.

Assessing stakeholders' Involvement in the Tourism Capitalization of the Jewish Heritage

Personal considerations of the respondents' expectations regarding the involvement of public authorities, tourists or locals in terms of the tourism capitalisation of Jewish heritage was a benchmark for this study. From the analysis of the provided answers, only 14% of the respondents answered positively, the remaining 86% had no expectations. A relatively similar situation emerges from the broken analysis of the respondents (representatives of the local population and tourists), except for the local public authorities whose response rate was of only 50%. The qualitative analysis of the respondents' answers (14%) points to some ambiguity, uncertainty and ignorance regarding the involvement of the stakeholders in the tourism capitalization of the Jewish heritage in Oradea. However, some expectations that have been clearly highlighted by the surveyed respondents refer to the continuation of the rehabilitation and tourism promotion of all historical buildings in Oradea by the mayoralty in partnership with the local population, involving citizens who hold real estate with historical value; the opening of a Holocaust museum; the involvement of NGOs and travel agencies operating within the city's territory for the Jewish heritage tourist promotion.

Conclusion

The role of the Jewish heritage represented by the Sion Neologue Synagogue is influenced by a set of results. Although the city of Oradea is identically defined by the Jewish heritage, this aspect is rather little known by the interviewees. The most prominent Jewish heritage elements were: The Sion Neologue Synagogue, The Orthodox Synagogue, Ullmann Palace, Fuchsl Palace, Black Eagle Palace, Moscovits Palace and Darvas House. 90% of the respondents considered that the Sion Neologue Synagogue in Oradea represents an important heritage element for the city, while 96% of them considered that it is an important tourist attraction for the city (Fig. 1, 2) altogether. The rehabilitation is justified by distinctive features of uniqueness and novelty (Fig. 4). From the analysis of the answers referring to the stakeholders' involvement for tourist capitalization of the Jewish heritage, it was found that only 14% of the respondents replied positively, with the remaining 86% having no expectations.

According to the survey it came out that the Sion Neologue syanagogue stands out among the other Jewish cultural heritage buildings of Oradea as the most representative for the tourists and the local population in the context of Oradea's highly dynamic tourist flow landscape, the tourists recorded as being interested in the urban cultural heritage (museums, memorial houses and public art collections) in the year 2016 reached half (i.e. 100,017) of the resident population.

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Sustainable Educational Tourism Potential of Djerdap National Park

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Abstract

Starting from the new education paradigm, which relies on constructivist and contextual approach, this paper will specify the tourism potential of the Djerdap National Park, which should develop young people's skills for sustainable development. The main objective of this paper is to use the holistic approach, the analysis of tourism resources, their educational potential and types of educational tourism in the Djerdap National Park to emphasize the insufficiently utilized educational potential. This could help children and young people acquire knowledge, skills and develop their personality by promoting learning through experience, direct contact with the things they are learning about, research and project approach.
The results of this study indicate the need to create educational programs for all ages, to improve accommodation capacities as well as educational materials, to better educate the guides on how to conduct ambient learning, project and research activities for all age groups. Emphasizing the importance of educational tourism, which could help education for sustainable development, the paper underlines the need for support from state level with promotion, activities, projects and sharing best practices.

Keywords: *Djerdap National Park, educational tourism, education for sustainable development, students' competencies*

Rezumat. Potențialul turismului educațional durabil al Parcului Național Djerdap

Pornind de la noua paradigmă educațională care se bazează pe abordarea constructivistă și contextuală, această lucrare va specifica potențialul turistic al Parcului Național Djerdap, care ar trebui să dezvolte abilitățile tinerilor pentru dezvoltarea durabilă. Obiectivul principal al acestei lucrări este de a folosi abordarea holistică, analiza resurselor turistice, potențialul lor educațional și tipurile de turism educațional în Parcul Național Djerdap pentru a sublinia potențialul educațional insuficient utilizat. Acesta ar putea ajuta copiii și tinerii să dobândească cunoștințe, să-și dezvolte personalitatea prin promovarea învățării prin experiență, contact direct cu lucrurile pe care le învață, cercetarea și abordarea proiectului.
Rezultatele acestui studiu indică necesitatea de a crea programe educaționale pentru toate vârstele, de a îmbunătăți capacitățile de cazare, precum și materialele educaționale, de a educa mai bine ghizii privind desfășurarea activităților de învățare în mediul ambiant, cercetarea și proiectare activităților pentru toate grupele de vârstă. Confirmând importanța turismului educational, care ar putea ajuta educația pentru dezvoltarea durabilă, lucrarea subliniază necesitatea sprijinului la nivel de stat pentru promovare și implementare de activități, proiecte și schimb de bune practici.

Cuvinte-cheie: *Parcul Național Djerdap, turismul educațional, educația pentru dezvoltarea durabilă, competențele studenților*

Tell me and I'll forget; show me and I'll remember
Chinese proverb

Introduction

Within the globalized society there is a need to improve the quality of education and adapt it to suit the needs of the modern labour market, technological development and multicultural society. The focus on competence approach in education, improvements in education, reorganization of the existing programs and their modification to be in line with the concept of sustainability and lifelong education are significant changes society and individuals are faced with. Key competencies for lifelong learning and sustainable development are specified in the new *Law on the Foundations of the Education System in the Republic of Serbia* (2017). According to this document, the key competencies are knowledge, skills and attitudes that each individual needs for personal satisfaction and development, social inclusion, active civic engagement and employment in a knowledge-based society. These competencies are not simply automated activities; they carry within them conscious and meta-cognitive components, which imply thinking about one's own competencies and ways to improve them (Frey, 2004, according to: Palekčić, 2008; Ćatić, 2012).

The concept of education for sustainable development promotes the acquisition of procedural, contextual and functional knowledge, values and attitudes, as well as a willingness to engage and act in accordance with one's own principles. The concept of sustainability also implies the adoption of "competences that help students observe phenomena, analyse them, make decisions creatively, be active, make judgments and act responsibly towards themselves, others and the environment" (Cvjeticanin et al., 2010, 176). This change is focused on the essential understanding and functionalization of knowledge (Duggan & Gott, 2002), through the co-construction of knowledge and experience, towards the constructivist (Milutinović, 2012) and contextual (Kelley & Kellam, 2009;

Verbitsky & Kalashnikov, 2012) approach to education and teaching.

In order to improve the quality of education, where the importance of learning for life and preparing students for life and various social roles is emphasized, the connection between teaching material and real-life scenarios is a necessity (Anđelković and Stanisavljević Petrović, 2013). Connecting learning material to real-life situations is an important aspect of changes within the education process. It is believed that in this way students develop a more positive attitude and understanding of science (Fensham, 2009; Kessels, Taconis, 2012; Bennett, Lubben, Hogarth, 2007) and they also learn to consider educational materials from different angles, which will make them more prepared and more capable to use it in real life (Nentwig et.al., 2005; Tytler, 2007). Therefore, the role of informal learning contexts (nature, museum, gallery, national park, and laboratory) is becoming more and more important both in formal and informal education (Anđelković, 2018).

Formal and informal outdoor education

Outdoor education is defined as an interdisciplinary research and educational field characterized by the following elements:

- the learning environment is relocated from a classroom to a natural, cultural and social environment outside the school;
- the interaction between sensory experience and learning from books is emphasized;
- the pedagogical benefits and importance of the location are underlined (National Centre for Environmental and Outdoor Education, 2004).

Direct physical contact with natural and cultural phenomena enhances authenticity in learning and is one of the most important determinants of outdoor education (Szczepanski et al., 2006). When we look at outdoor education in this way, we can see that it is a way of learning (offering alternatives to indoor education), an object of learning (where the landscape and its people become the curriculum) and a process of learning (drawing on experiential approaches to learning) (Szczepanski, 2009: 88). Outdoor education is often referred to as synonymous with adventure education where the focus is mostly on physical activities in nature - kayaking, hiking, camping, orienteering, nature-based learning, in order to acquire life skills.

In addition to physical activities, which are indeed very important for outdoor education, it also includes various types of formal and informal education that take place in the outdoor environment, such as, teaching, projects, research, camps, which are organized by formal and informal organizations and institutions, non-governmental organizations, sport teams (recreational courses), tourist activities, centres for ecological activities, school clubs. The main characteristic of outdoor education is direct experience (cognitive, emotional, social and practical) with the objects of learning.

Unlike the usual, conventional and traditional school environment, the outdoor environment offers a wide array of natural and social places which, due to their authentic and specific potentials, become outdoor classrooms: in nature (field, forest, lake, plain, orchard, zoo), historic sites (fortresses, archaeological sites, museums, exhibitions, old buildings, houses, ethno villages), cultural and educational institutions (galleries, exhibitions, theatres, health care institutions, homes, craft workshops, etc.), social environments (village, city, suburbs, streets, squares) (Andjelkovic, 2008). In a direct way, in an environment rich in stimuli, among animals and plants, tools, machines, laboratory apparatus, museum exhibits, students actively think by observing, comparing, listening, classifying, discussing, connecting, experimenting.

"Through various educational activities in different environments, students acquire and expand their knowledge from different fields, develop specific skills necessary for certain subjects, for example, they develop the ability to perform simple experiments, develop specific types of behaviour such as environmental protection and preservation, and certain attitudes - love for nature, experimental and scientific spirit, interest in plants and animals, interest in science and research" (Andjelkovic, Stanisavljevic Petrovic, 2013:118).

In addition to activities in schools (through ambient learning, research and project learning outdoors and extracurricular activities), there are more and more organizations in our environment promoting educational activities outside the formal education system, in the open, outdoors, such as scouts, mountaineering clubs, environmental clubs, different camps (educational, tradition and culture oriented, sport camps, recreation camps, health and environmental camps), recreation centres with special programs (canoeing, rafting, skiing, education, healthy lifestyle, environmental camps) which educate children and young people.

Moreover, in the last few decades, concern about the sustainability of natural resources and concern about environmental issues have intensified. There is a large number of organizations, governmental and non-governmental, which are interested in the preservation of the environment and sustainable development. Therefore, the environment is studied from different perspectives, multidisciplinary, and in accordance with the set goals and preferred outcomes. In this regard, educational tourism as a type of outdoor education is becoming increasingly

important and it is also a powerful tool for the education for sustainable development.

Education for sustainable development through educational tourism

The definition of youth tourism used by WYSETC (World Youth Student & Education Travel Confederation) reads: "*Youth travel includes all independent trips for periods of less than one year by people aged 16-29 which are motivated, in part or in full, by a desire to experience other cultures, build life experience and/or benefit from formal and informal learning opportunities outside one's usual environment*" (Moisă, 2010: 575). Educational tourism, as a subset of youth tourism, has developed from the growing need to acquire knowledge, gain experience and values through an experiential, active approach outside formal institutions such as schools, institutes, universities, and to build one's own potentials and gain experience. The term educational tourism refers to any "program in which participants travel to a location as a group with the primary purpose of engaging in a learning experience directly related to the location" (Rodger, 1998, p. 28). It is comprised of several sub-types including ecotourism, heritage tourism, rural/farm tourism, and student exchanges between educational institutions (Ankomah & Larson, 2000; Ritchie, 2003) defines educational tourism as a tourist activity where education and learning are primary part of their journey. In educational tourism, emphasis is not only on getting to know natural and cultural heritage and to acquire knowledge, but also on the application of knowledge acquired through formal and informal education in an authentic environment through direct contact with objects of learning. In this regard, educational tourism is a learning tool, which is based on experience and values (Bhuiyan et al., 2010; Pitman et al., 2010, 2011; Quezada, 2004; Lam et al 2011). The benefits of educational tourism for tourism industry are numerous, including increased number of visitors, cultural, educational, national attractions, tourist destinations, profit growth from tourist accommodation and services, and improved intercultural interaction among tourists themselves, but also between the local population and tourists (Jiyun & Jeonglyeol, 2014; Butcher, 2008).

Educational tourism (primarily children's and youth tourism) which includes heterogeneous groups from three to 30 years of age is not present enough in Serbia. Since 2013, educational tourism in Serbia has developed within the joint United Nations Program "Sustainable Tourism for Rural Development". This regional project for the development of children's and youth tourism in the region aims to connect four countries (Serbia, Croatia, Italy and Slovenia) in the field of children's and youth educational tourism, and to help in the exchange of knowledge and practices among partners, and among service providers selected by partners. Another goal is to collect publication data to be used to create a guide and information resource in these four countries. Educational tourism is important because it helps children and young people to acquire functional knowledge, develop creativity and establish contacts.

When talking about the importance of educational tourism for formal and informal education, National Parks play a special role as examples of holistic and interdisciplinary tourism and educational resource. National parks have multivalent and numerous benefits. "It is not only the result of their number and size, but also their importance for science, culture, education, schooling, recreation, tourism and the protection of natural ecosystems" (Stanković, 2003: 43). The value of Djerdap National Park goes beyond the boundaries of local and regional, since it is of immense natural, cultural, historical, traffic, energy, ecological and educational importance.

Natural, cultural and social potentials of Djerdap National Park for educational tourism

Djerdap National Park represents the unity between the specific natural and cultural heritage, which is a true example of sustainable development of a region. The "Iron Gate" of the Danube connects two important cultural and economic regions - the Lower and Middle Danube regions, and these have been seen as important natural and strategic regions since the prehistoric age. The area was declared as a National Park in 1974, and it covers an area of about 65 000 ha. It includes parts of the municipalities of Golubac, Kladovo and Majdanpek. It extends for around 100 km along the right bank of the Danube, from Golubac to Karatas, and it is 2 to 8 km wide. The main features of Djerdap National Park are: numerous geomorphological shapes, an abundance of cultural and historical monuments, great diversity of fauna and flora. Djerdap National Park is characterized by a high level of preservation of natural resources due to a low population density, the absence of large industrial plants and insufficiently developed transport infrastructure (Lukic, 2005).

Flora in North-eastern Serbia contains a large number of endemic and relict species. According to the Rulebook on declaration and protection of protected and strictly protected species of plants, animals and fungi (OG RS. No. 5/10 and 47/11), 43 species living in Djerdap National Park have a strictly protected status, while 124 have a protected status. The fact that 1013 species and subspecies belonging to the flora of Djerdap National Park make up more than a quarter of the total Serbia flora points to the

importance of this area not only for exploring the flora of Serbia, but also due to the fact it is considered an area of international significance for plant preservation, the so-called IPA area, due to a great diversity of plant life of different origins. The specific animal habitat (the Danube with its tributaries, forest habitats, gorge meadows and canyons) allow for a diversity of animal species. This area has been declared an area of exceptional importance for the preservation of the entire mammal fauna in Serbia. This provides great opportunities to explore the animal world, in a holistic manner, which also provides a better quality of learning. Mammal species with a strictly protected status that inhabit the Park are otters, marbled polecat, lynx, all bat species, etc. Djerdap National Park area is on the list of the Important Birds Area (IBA).

In the geological sense, the eastern zone of the fold mountains in Serbia is very complex. They were built from rocks of different origins and ages. The earliest rocks which can be found in this zone are Silurian (Paleozoic) slates (shale, sandstone) and limestone. On top of them are thick layers of sandstone and conglomerate from the Devonian period. During the Carboniferous, there was rapid sedimentation and the formation of conglomerates and clay with oil shale in shallow lagoons. Beds of Permian red sandstone cover a wide area of Eastern Serbia from the Danube in the north, to Suva planina and Ruj in the south. During the Mesozoic power, thick layers of Triassic, Jurassic and Cretaceous limestones and dolomites were created. Specific karst formationscan be found in this area.Moreover, Cenozoic, Paleogene and Neogene conglomerates, sandstones and clay can be found in the basins in Eastern Serbia. Geoheritage of Djerdap is very rich and diverse, however, we would like to specifically mention Greben (The Ridge) which is 119 m high, as an important source and resource for geological exploration and observation, since it is the best example of the geological history of the Danube Ocean, which was located between Getikum in the west and Mezikum in the east. By using experiential learning, which involves various thinking and practical activities that engage the students in the field, and also by using research techniques and methods, the students get familiar with the terrain and learn about it; they are able to see the sequence of layers, take pictures and videos of them, make reports, work diaries. This allows for a better-quality learning which enables students to acquire functional and procedural knowledge. Moreover, the emotional experience is also present during the process of learning, and students are more motivated for further work and research (Lukić, Anđelkovic & Deđanski, 2016). Since Greben (The Ridge) is one of the topics in Geography classes, field trips, visits and tours can be used to spot the sequence of layers from different geological periods and understand the way they were formed, but also to understand its connection with other natural, social, economic and environmental factors in that specific environment.

For educational purposes, that is, in order to get a better picture of the size and position of Djerdap National Park from "a bird's eye view", viewpoints are seen as very good locations to do the research and get a better picture of the connection between different natural and cultural aspects that together create a unity of life. When studying a certain topic in different school subjects, students do not see the whole picture and cannot see the connection between the phenomena and processes. That is why knowledge becomes fragmented and useless, which is one of the disadvantages of our education system. In order to overcome these shortcomings in teaching, interdisciplinary approach and content integration are increasingly emphasized, where the concept of learning outside the classroom becomes even more important. Djerdap National Park is a good example and we can freely say a good educational tool to see the clear and whole picture of the site studied. This is why viewpoints play a significant role in education. For example, Djerdap National Park has a viewpoint called Veliki Štrbac, which is the Miroč mountain peak 768 m high; together with Mali Štrbac peak which is 626 m high, these two peaks overlook the Danube at the location where it is the narrowest and the deepest (Đerdapski kazan). Ploče is a limestone plateau with three viewpoints at a height of 355m, below the Veliki Štrbac. Mali Štrbac offers a view of the coast of Romania, where the largest rock sculpture in Europe called *Decebalus, the last king of Dacia* is located, as well as Mrakonija monastery located at the entrance to the bay bearing the same name. These locations provide exceptional educational opportunities for students to understand the importance and significance of different cultures, traditions and religions existing at the same location, and to recognize how they all depend on nature.

Paths leading to the viewpoints (the most famous footpath is over Ploče plateau) offer a variety of educational challenges (measure the distance walked and walking speed, getting to know plants, orientation in nature, collect material and samples for future research, take pictures, record and later process the recordings using IK technology, make educational films, illustrations, guidebooks. All these can be the product of such field projects and research. Another educational resource is Kovilovo viewpoint (358 m high) which is the habitat of moonshine yarrow (*Achilea clypeolata*), an endemic species. Moreover, this viewpoint offers a view of the Donji Milanovac basin, from Greben to Golubinje, over 25 km long (including Lepenski Vir, Greben, submerged Poreč island, Donji Milanovac, Glavica, Golubinje and Romania). Noticing the changes in the

Danube flow speed, the riverbank terrain and the natural features, which can be seen from various viewpoints, are all valuable sources that allow us to notice the diversity of the Danube flow that can be seen by direct observation. Marked hiking trails with educational and information panels that contain information about the flora, fauna, climate, geological composition of the terrain can greatly assist students in collecting data and get a clear picture of the site they visited. By spending time at natural, historical and cultural sites, students build habits of proper behaviour towards environmental and cultural heritage. Being able to identify and recognize the signs and markers along footpaths is very important for students to gain experience and knowledge how to find direction in nature, and acquire skills that every person needs.

The cultural heritage is conditioned by the natural conditions and factors, which constitute the natural heritage of Djerdap National Park (plants, animals and geoheritage). The construction of the dam and the creation of artificial (man-made) lake have accelerated archaeological research on the banks of the Danube, in the Djerdap Gorge. The archaeological map of the Djerdap area contains 16 prehistoric, 33 Roman and Byzantium, and 8 medieval sites of historical importance (Lukić, 2005). We will mention some of them here. The *Spatial Plan for Special Purpose Area of Djerdap National Park* (2013) lists 4 cultural monuments of exceptional importance, 8 immovable cultural heritage sites, 11 registered sites, six identified sites, 13 registered submerged immovable cultural heritage sites, two registered submerged assets and one registered submerged immovable cultural heritage site. National architectural heritage is of particular importance for educational tourism, especially with regard to formal education (for example: houses in villages, hamlets and salaš-farm, furniture and furnishing; additional buildings such as stables; commerce objects such as watermills; agricultural tools and means of transport).

Archeological site Lepenski Vir is of particular educational value for understanding the life of the ancient inhabitants of this region and seeing hownature and culture were connected in lives of those ancient people. The culture of Lepenski Vir is characterised by the tradition of hunting and gathering communities who lived in the Old Stone Age, and who inhabited Transylvania and the South Carpathians at the end of the Ice Age. Activities of people who lived at that time (making tools), and the first art or hints of it (engraving), as well as its greatest achievement (monumental sculpture) are mostly associated with boulder stone. There were three main phases in the development of this culture: the founding phase (from 7000 to 6500 BC), the rise phase (from 6500 to 6000 BC) and the disintegration phase (from 6000 to 5500 BC) (Srejović, Babović 1983, Lukić, 2005). Educational films, exhibits and the site itself enable us to get to know the remains of sacred architecture, stone sculptures, jewellery, remains of residential architecture, etc. Visit to the archaeological site and educational activities presented in it allow for the development and application of an integrated and interdisciplinary approach in teaching which is the foundation for the education for sustainable development. Writing essays, reports, newspaper articles about this archaeological site, creating a tourist guide in a foreign language, drawing and painting using ancient techniques, sculpting, making maps and charts, participating in competitions and quizzes, making educational films about the visit are some of the activities that can be practiced at this and other sites within Djerdap National Park. Socializing, sharing experiences and working on some tasks help visitors develop teamwork and communication skills. These trips and visits often become an opportunity to develop intercultural dialogue and to learn about other cultures, religions and customs of different groups of visitors who may even be engaged in the same projects and programs.

Some of the monuments of great educational value are: Tabula Traiana, Trajan's Bridge, Fetislam fortress, The Diana Fortress - one of the largest and best-preserved Roman military fortresses on the Moesia Superior *limes* (border) which is the first stone fortress built in a square shape. In addition to the defensive walls, gates and main communication lines, several more objects that were characteristic of the Roman military camps were discovered inside the fortress: the headquarters of the fortress called *principia*, parts of military barracks, granaries (*horrea*). Besides the communication line which connected the headquarters with the south gate, alarge building with a very well-preserved underfloor heating system was discovered (Lukic, 2005).

Golubac Fortress is located at the entrance to the Djerdap gorge. Golubac fortress has nine towers made of stone. Golubac was built for the battle with cold weapons, while the cannon openings can only be found on the tower which was built additionally. This tower was built by the Turks. The fortress is protected and most of it is conserved since it is one of the best preserved and most picturesque medieval fortresses in our country (Lukic, 2005). In recent years, a visitor centre was built next to the fortress and it allows visitors to learn about the artefacts discovered at the site, and about the events related to the fortress through the exhibitions and films. Visitors also have the opportunity to participate in different workshops, lectures, film and photograph shootings related to the fortress itself and to enjoy concerts, literary evenings, art exhibitions, etc.

In addition to natural, cultural and historical potential, Djerdap National Park is also characterised

by the specific life and customs of its population, which adds value to this location. Getting acquainted with the way of life, religion, tradition, spiritual values of these people are just some of the educational potentials that a creative teacher in cooperation with partners from Djerdap National Park can use for teaching purposes. *Bačija* is a type of settlement found in Djerdap region. *Bačija* is a seasonal (summer) sheep farm where several families bring their sheep in, take care of them together, take them grazing on pastures outside the village, and eventually all these families use sheep milk together. This "alpine type" of *bačija* can be found in north-eastern Serbia and in south-eastern Serbia, Macedonia and among Serbian population on the Romanian side of Djerdap (Lukic, 2005).

Customs are numerous and diverse and they are very important for the people living in this region. However, many customs have disappeared due to the effects of the modern life style and the increasing openness of this region to its near and far environment. The beliefs of the people living in the Djerdap region are very interesting, since they are identical in both the Vlachs and Serbs living on opposite banks of the Danube. These people primarily believe in mythical beings but they also worship the nature deities: animals, plants and natural phenomena. The latter is the addition to the once important foundation the existence of this population was based on (Lukic, 2005). National costumes found in this area are not specific to this region only. Actually, such national costumes can also be found in the north-eastern Serbia and they are worn by the people on the Romanian bank of the Danube. Besides some specific details found only on the costumes of the Djerdap population, which are the result of the composition of the population and economic conditions, there are also certain features common to the costumes worn in all these different regions, especially the details, the ornaments and colours. This speaks in favour of the similarity in the ethno-psychological characteristic of this population, and of the interaction among the people living in the Djerdap area.

The entire territory of the Djerdap National Park encompasses in total 31 geoheritage sites, 14 nature reserves and 18 cultural and historic heritage sites.

In Golubac, close to the Danube shore, the dock was renovated, as well as a marina for small boats, concrete walkway was built as well as "Golubacki grad" hotel. The Danube and Djerdap Lake as the most important tourist attractions of the Golubac municipality are not sufficiently exploited. *Donji Milanovac* is located downstream from Lepenski Vir. It is the tourist centre for Djerdap with the "Lepenski Vir" hotel and National park office building. The hotel complex has many shops, restaurants, summer terraces, as well as a swimming pool, sport halls and outdoor sports court. Captain Miša's konak (Serbian: Kapetan Mišino zdanje) is located on the Danube bank, as well as a promenade, marinas for boatmen and a passenger port, as well as a home appliance factory. Kladovo has two hotels: "Djerdap" and "Aquastar Danube", several restaurants, a promenade along the Danube, a Cultural Centre and the Stara Čaršija whose main functions are trade and tourism. Djerdap has 7 accommodation facilities. The total number of rooms is 880, with 2145 beds - 1962 permanent and 183 additional (Lukić , Petrović & Denda, 2018). The facilities at the Djerdap National Park that are used for educational tourism purposes are: Kovilovo, Ploče, Veliki Štrbac, Mali Štrbac, Greben, Gradašnica, and Zlatno jezero. Moreover, in order to provide services and information for tourists, there is a visitor centre that offers pamphlets and brochures with pictures and text, as well as stuffed wild animals, fish, Lepenski Virsculptures replicas, cultural monuments miniatures, aboard with geological information, tactile exhibition, videos, and maps that show us the natural and cultural heritage of the National Park. All these things, especially when seen for the first time, have an immense value for education, because such an experience motivates and creates an interest in people to get to know and explore the site even further. In this regard, it is necessary to add more educational material that would be written considering visitors' age; moreover, it should include interesting facts that would be compelling to a particular group of students. It is also necessary to add electronic presentations.

In order to be able to use education resources and material outside school, tourist guides and employees in nature centres and museums have to undergo special training. Beside a good knowledge of the localities themselves, these employees need to know the age of visitors, their education level, and curriculum for the given class. They also need to have pedagogical, didactic and methodological knowledge in order to be able to carry out teaching activities outside the classroom, as well as to be creative when organizing workshops, programs and projects that would allow different age groups to fully understand the locality and understand the connection between nature and society, all in accordance with their abilities and educational needs.

Types of educational tourism in the Djerdap National Park

Given its significant natural, cultural and historical potentials, Djerdap is an excellent educational resource, which can be the goal, place and means of formal and informal education. In recent years, under the influence of economic, social and educational changes, educational tourism has been increasingly discussed as a still underdeveloped branch of tourism,

which has great potential regarding the development and sustainability of the National park itself and the whole region.

Educational activities are being carried out in Djerdap National Park for quite some time now, which benefits the development of educational tourism in this region. The cooperation between Djerdap National Park and schools who conduct their teaching and extracurricular activities at the Park is particularly important. The European Day of Parks was celebrated this year (2018) under the slogan "Cultural heritage in our nature", where a workshop on cultural heritage, folk music, beliefs and customs of Djerdap area was organized for younger primary school students. Students were also given the opportunity to try to make traditional handicrafts.

Moreover, the celebration of Nature Conservation Day in Djerdap National Park has already become a tradition – lectures and workshops are organized, teaching materials that introduce students with natural and cultural heritage of the Djerdap area (such as colouring books for younger primary school students). Collection of poems and alphabet book prepared by the Park employees are another proof that they recognize the importance of educational tourism, which has only started to develop in our country. During the World Water Day observance (March 22nd), the National Park organized exhibitions of artwork by students where the theme was "Nature for Water" and a literary evening called "The Danube in My Eyes".

Many schools from this area use the resources of Djerdap National Park to organize teaching and extracurricular activities, one of which being the International Day of Forests, which was celebrated in the Djerdap National Park thanks to the collaboration between the Park educators and teachers. A workshop was organized and its aim was to help students understand why it is important to protect and preserve forest ecosystems.

Many school projects were organized as well, some of which were: "Djerdap National Park Treasure Hunt", which promotes natural and cultural heritage of Djerdap. In collaboration with the Institute of Lowland Forestry and Environment, a lecture on the butterfly fauna was organized. The lecture was given to the students of "Vuk Karadžić" primary school from Donji Milanovac, and its goal was to introduce children with useful, but also potentially harmful insects of this region. Students were also able to watch a film about butterflies and the entomological exhibition at the Visitors Centre.

Table 1 Types of educational tourism in Djerdap National Park

Formal education	Informal education
Regular lessons (ambient learning - (preschools, schools, universities)	Workshops (art, science, education,sports, psychology)
Thematic Days	Research
Integrated day	Programs organized by educational institutions and cultural institutions
Projects	Conferences, study tours
Fieldwork (universities, schools)	Sports and recreation programs
School clubs and organizations	Projects by NGOs, local communities; educational projects
Extracurricular activities	Environment and Humanitarian Actions
Field trips	Scouts
Visits	Educational programs
Excursions	Conferences, summits
Nature school	Competitions
Research camps	
Summer and winter holidays	
Visiting scholars (from universities and schools)	

Educational activities that promote direct contact with the objects of learning, as well as a research and project approaches to learning are powerful tools in acquiring environmental knowledge and developing ecological skills in children and young people. Educating children can help them to develop

environmental awareness, a sense of respect for natural and cultural heritage, and to recognize the importance of their preservation.

The Park also organizes many educational programs and presentations, but we would like to specifically mention the project "Protected areas for nature and people", organized by the first "WWF Nature Academy". This project was started in October 2015 and will last until October 2019, and was designed to improve communication with the local community and involve it in the management of protected areas, to develop educational programs and tourist programs that will increase number of tourists and improve the development of protected areas. This project builds a partnership between students and employees (teambuilding), and allows students to learn about Djerdap National Park while working on projects and research. In order to help children and teachers to better understand the importance of preserving the environment, the Academy's program has covered many topics, including protected areas, their importance for people and nature, the "ecological footprint" (the effect that people have on the environment), as well as the ways how people can actively participate in the preservation of nature.

The project "EKO PULS - Djerdap National Park" is a pilot project aimed at developing a network of environmental education centres in Serbia by organizing environmental education programs which would promote natural richness in Djerdap National Park and emphasize the importance of environmental preservation. This project is even more important due to the fact that the local communities also got a significant share in the project implementation (Kladovo, Majdanpek, Golubac municipalities) in order to improve tourist programs and help the development of rural areas in the Lower Danube region. In addition to numerous educational activities, this project plans to develop and design recognizable tourist routes, with central information centres, souvenir shops and centres for promotion of healthy lifestyles. This project is of importance not only for this region but for the whole country as well, as it serves as an example of good practice and the basis for the development of a network of environmental education centres in Serbia which would promote environmental preservation and the development of rural areas.

Certain international projects were organized in the Djerdap National Park as well, some of which are: Bio REGIO Carpathians, which gathered partners from international organizations, scientific institutions and protected areas from six different countries in order to protect and develop the Carpathian Mountains region; Danube parks step 2.0 – improve river morphology, ecotourism and preservation of the most important Danube species; "Changing Face of Tourism Space in Lower Danube" project – which will fund the purchase of catamarans, canoes and canoeing equipment, bicycles. The project also involves training of tourist entertainers and local residents; UNDP/GEF project "Ensuring Financial Sustainability of the Protected Area System of Serbia" - which supports the development of ecotourism and sustainable tourism in Djerdap National Park by improving the capacities, products, visibility of the destination using new technologies, by renovating and promoting the educational hiking trail, and the interactive tactile exhibition at the Djerdap Visitor Centre. The plan is to train staff on ecotourism, while a handbook and a smart phone application were also designed (*Support for the development of ecotourism and sustainable tourism in Djerdap National Park, 2018*).

In collaboration with the "Djerdap National Park", "Vuk Karadzic" primary school in Donji Milanovac, formed a student club called Young Guardians of the Preserved Area. These young nature protectors presented their plan of activities to protect nature and promote natural and cultural heritage of the Djerdap National Park. This plan of activities includes workshops, panel discussions, field activities that will help raise environmental awareness and emphasize the importance of preserving the environment.

The traditional small conference called *Culture, education, creativity*, which takes place in Majdanpek and involves cultural organizations, educational organizations, different associations and individuals, is a good example of the exchange and discussion about tourist attractions and the presentation and promotion of Djerdap National Park activities. The aim of this conference, which should become a traditional event, is to provide more space in all types of media for the Djerdap National Park as an important educational, cultural and tourist destination.

When talking about the educational programs offered by the Djerdap National Park, we should mention the activities of the Youth Sports Camp "Djerdap", who organize sports activities as well as various cultural and educational programs for children, youth and adults. The Camp also organizes children and youth sports schools, sports camps and sports teams' preparations, sports competitions, workers' sports games, creative workshops, art colonies, ecological schools and environmental programs, recreational activities and schools in nature. The Camp has met all organizational and financial prerequisites for the implementation of various projects related to the above-mentioned activities. It also provides nautical, hunting and fishing tourism services and complete logistics. In addition to the main accommodation facilities, the Camp also provides 8 eight-bed bungalows, extremely functional and above all stylishly furnished. They were built follow the style of the old Vlach

houses, so their architecture fits into the cultural heritage of this region. Youth Sports Camp "Djerdap" has seven pavilions that are specially adapted to accommodate of young sports teams. Each entrance contains rooms and socializing areas that are ideal for theoretical instruction. These rooms are equipped with school benches, school boards and TVs.

The camp "My super school break" organized children's stay in nature during the summer holiday, in the immediate vicinity of one of the most famous archaeological sites - Lepenski Vir. The camp was designed to engage children in extra-curricular activities in nature, to develop their creativity, resourcefulness, team spirit and competitive spirit, and to help them acquire work habits. Children spend their free time creatively and safely, in facilities that are adapted to their needs and they are under the constant supervision of professionals with rich professional experience in working with children. During their stay in "Lepenski Vir" hotel in Donji Milanovac, children will be able to use the indoor swimming pool located within the hotel, while all the necessary sports facilities are close to the hotel. Children are also provided with a complete infrastructure required for all planned activities, and with indoor and outdoor classrooms.

The plan is to reconstruct the area called Rajkove livade in Majdanpek municipality and use it for children and youth tourism, nature schools, sports teams' preparations, accommodation of visitors, group visits, skiers in winter or for conditional training of athletes. This area includes an abandoned settlement that was used for Youth work actions in the past, and is located not far from Rajko's Cave. A slightly stip field southeast from Rajkove livade is intended to be used as a camping area for scouts.

Conclusion

Today, tourism faces many challenges, including the need to create a new position in the market, to improve quality, to provide destination differentiation, to modernize accommodation supra-structure and infrastructure, and to diversify the existing offers. Under the influence of the sustainable development concept and fluctuations in economic activity, there has also been a change in tourist demand and a tourist population due to a growth of youth and educational tourism, with the emphasis on educational holidays and active recreation.

The growing level of environmental awareness has brought an increasing interest in programs and projects, which take place in national parks through various types of educational activities, such as adventure education where the focus is mostly on physical activities in nature - kayaking, hiking, camping, orienteering, nature-based learning, in order to acquire life skills. In addition to physical activities, which are indeed very much present, educational tourism also includes various types of formal education (teaching and extracurricular activities) and informal education that take place in the outdoor environment, such as project and research camps organized by formal and informal organizations and institutions, non-governmental organizations, also including courses and tourist activities which involve direct experience (cognitive, emotional, social and practical).

Although the importance and potential of Djerdap National for the growth of educational tourism has been recognized, there are still many problems impeding its implementation, such as: limited financial resources, technical and material support, lack of qualified staff that will be trained and educated to design and conduct different educational programs in accordance with the educational needs of visitors and their age, as well as the lack of public awareness about the importance of this type of tourism. We have ahead of us a period of analysis and further work that should improve the quality and diversity of educational tourism in Djerdap National Park.

By emphasizing the pedagogical and educational potentials of Djerdap National Park which should be used for the purposes of educational tourism, we wanted to draw attention to the insufficient use of these resources for educational purposes; if these were used more, that would improve and develop research-based and contextual learning of visitors, diversify visitors' activities by engaging them in their own thinking and practical activities, in rebuilding their own knowledge, skills and attitudes in order to eventually be able to manage the learning process and become active participants in the creation of a sustainable society.

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Post-communist Romanian migration patterns: dynamics and territorial perspectives

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Abstract

The paper addresses a problem of great importance for Romania, that of the international migration that is in a continuous process of exacerbation after the collapse of the communist regime, but with important spatial differences. The analysis of the situation has led to the need for a series of spatial representations to highlight the typology and structure of migratory flows across the country in the post-communist period, as well as changes in direction or intensity.
In almost three decades, more than 550,000 people emigrated from Romania, while almost 240,000 were temporarily abroad in 2017, according to official statistics, but in fact, their number is much higher. The international migration of Romanians has particular characteristics, with four distinct periods, characterized by demographic characteristics and specific territorial distribution. On the whole, a mutation of emigrant areas from the west and center of the country is noticeable after the fall of communism to the eastern and southern regions in recent years, with predominant involvement of young adults.

Keywords: *emigration, temporary migration, regional disparities, post-communist period*

Rezumat. Tipare postcomuniste ale migrației în România: dinamică și perspective teritoriale

Lucrarea abordează o problemă de mare importanță pentru România, aceea a migrației internaționale, aflate într-un proces continuu de exacerbare după prăbușirea regimului comunist, dar cu diferențieri spațiale importante. Acest demers a impus necesitatea unei serii de reprezentări spațiale menite să evidențieze tipologia și structura fluxurilor migratorii la nivelul întregii țări în perioada postcomunistă, dar și schimbările de direcție sau de intensitate ale acestora.
În aproape trei decenii, din România au emigrat peste 550.000 persoane, alte aproape 240.000 persoane fiind plecate temporar în străinătate în 2017, conform datelor statistice oficiale, în realitate numărul acestora fiind mult mai mare. Migrația internațională a românilor prezintă caracteristici aparte, putând fi individualizate patru perioade distincte, caracterizate prin caracteristici demografice si distributie teritorială specifică. În ansamblu, se constată o glisare a zonelor emițătoare de emigranți dinspre vestul și centrul țării imediat după căderea comunismului către zona estică și sudică în ultimii ani, cu antrenarea predominantă a adultilor tineri.

Cuvinte-cheie: *emigrare, migrație temporară, disparități regionale, perioada postcomunistă*

Introduction

Stories about migrants, whether legal or illegal ones, originating from peaceful or conflict ridden regions, abound in media worldwide, as human mobility is an established part of mankind history. International migration is a complex phenomenon that touches all states, with multiple social, economic, security consequences involved and affects our daily lives more than ever before, in an increasingly interconnected world (IOM, 2018, p. 15).

In the context of the long-term crisis situations of migrants and the tense political situations generated by it at the level of economically developed European states, caught between pro-immigrationists and anti-immigrationists, migration remains one of the most fervent challenges for the European construction. The already known patterns address conceptual, procedural and economic migration issues throughout the 20th century, not anticipating the fluidity of the phenomenon imposed by new economic theories and multifactorial implications of migration in the context of free post-Fordist mobility.

There are two perspectives that dominate in defining the concept and way of analysing the phenomenon of contemporary migration: the first, predominant, is sociological, investigating the mechanisms and implications of migration at different scales.

The second perspective - geographical - involves spatial references to the size and regional differences caused by migration. A predominant east-west shift during the period of post-communist transition is articulated in research studies with significant intra-regional peculiarities in Central and Eastern Europe. An increased intensity and continuity of population movements, accompanied by increasing diversity of the form of these movements and their geographical directions, as well as a greater complexity of factors underlying migration come into reflection in the previous years (Black et al., 2010; Favell, 2008a, b; Burrell and Hörschelmann, 2014). The question regarding the Central and Eastern European countries remains if they are acting as a buffer zone between the European Union and the countries on their eastern and southern borders or if they constitute a real migration pole (OECD, 2001).

Beyond the classical theories on migration, which provide insights into the context, processes and

categories of mobility, as with any territorial mobility, migration is a spatial phenomenon, involving the movement of people from one place to another, referring to the change of ordinary residence, assuming this not only a new physical structure, but also a sense of the renewed community. Thus, the term is associated in the literature with crossing a certain type of socially significant frontier (Lindley, 2014, p. 7). Increased mobility could be an inevitable and necessary part of the transition to a post-modern social order, but the phenomenon continues to be associated at European level with the spectrum of the socio-political crisis. Migrants are still seen as "poorly integrated in the national culture, emblematic for their anomalous existence, a real challenge for the cohesion of national policies, a "reserve" of the labour force that helps fill the gaps in the labour market, recruited or discharged in response to fluctuations in the economic cycle and contributing to maintaining low wages (Lindley, 2014). Thus, migration is regarded as a symptom of non-uniform global development, which tends to serve the interests of capital (Black et al., 2010; Lindley, 2014; Burrell and Hörschelmann, 2014; Favell, 2008).

Literature review

During the last decades, as more and more countries become part of this process, ever more researchers have focused on international migration from the demographic (Coleman, 2008), economic (Potot, 2010; Black et al., 2010; Atoyan et al., 2016), sociological, cultural-anthropological (Cvajner, 2012) or psychological point of view (Boneva et al., 1997), the 21st century migration experience being quite different from that of previous generations, present day migrants being seen as 'agents of change' and 'enablers for development in countries of origin, transit and destination' (ILO, 2017).

Following the fast advances in transportation and communication technology, present migratory movements are no longer concentrated in a few corridors and no longer follow historical links, being widely assumed that the volume and diversity of people mobility has been increasing. Still, an extensive study conducted by Czaika and de Haas (2014), using three different measures capturing three different reference points for global emigration spread and global immigration spread, concluded that 'the world has not become necessarily more migratory, but the migration has become more 'skewed' on a global scale' and that migration has globalized from a destination country perspective, but hardly from an origin country perspective, the global migration map becoming only more skewed.

Great number of research has piled up analysing the globalization of migration, defined as the widening, deepening and speeding up of worldwide interconnectedness (Czaika and Haas, 2014), as all countries engage in migration systems growing in size and complexity, producing an increasing diversity of flows (Salt, 1992; Cast and Miller, 2009). Czaika and Haas (2014) aggregated the central concepts of intensity, diversity and distance into one composite measure of migration globalization, thus defining and conceptualizing migration globalization as functionally related processes of emigration dispersion and immigration diversification (p. 9). Analysing the unprecedented degree of immigrant diversity in Britain (considering that 'diversity is endemic to Britain – p. 1026) and other immigrant receiving societies, Vertovec (2007) coined the notion of super-diversity, referring to the increasing number of new, small and scattered, multiple-origin, transnationally connected, socio-economically differentiated and legally stratified immigrants. Globalized migration is more feminized, as there are more and more independent migrating women instead of dependent family migrants (Ramirez et al., 2005).

As early as the 1960s, researchers started to analyse chain migration and the role played by personal networks (family members and friends) (kinship – Tilly and Brown, 1967) for explaining the origin and dynamics of migratory flows, as these networks play an important role in assisting the short-term adaptation of internal and international migrants (Tilly and Brown, 1967), while also exerting a powerful influence over the selection of who migrates and when (Gurak and Caces, 1992)

Faucet (1989) identifies family and personal networks as one of the four major categories of linkages in a migration system, along with state to state relations, mass culture connections and migrant agency activities, arguing that there are tangible (monetary remittances, gifts and written communication among network members), regulatory (which may dictate the priorities for sponsorship of new immigrants by former immigrants) as well as relational linkages, involving the socio-economic status of migrants.

Referring to the migration decisions that are made by individuals or groups, Boyd (1989) points to the fact that at this microlevel, the decision to emigrate is influenced by the existence and participation in social networks, which connect people across space and provide resources in the form of information and assistance. Migrant networks, interacting with both destination and origin societies, facilitate the formation of ethnic communities in the destination society (Gurak and Caces, 1992)

Migration networks, as a form of social capital (Marcu, 2011), play a vital role in supporting and protecting their members' sense of self-worth, even when unable to provide access to significant material resources (Cvajner, 2012). Salt and Almeida (2006) point that Romanians have been circulating within

informal transnational networks which they use to exploit 'work niches' opened to illegal workers. Studying the circular migration pattern of Romanians in Spain, Elrich and Ciobanu (2009) conclude that migration networks are powerful mechanisms that countervail laws and regulations, very effective in nurturing migrants' adoption of permissive migration policies and cause migrants to stick to certain migration strategies.

Social networks, i.e. social interactions through which migrants obtain information and material resources that facilitate their movement and the process of adaption to conditions in the destination country (Elrich and Ciobanu, 2009) are usually seen as more important for women, who rely more strongly on relatives and friends for help, information, protection and guidance at their destination (Docquier et al., 2009).

Studies on human trafficking, although not per se on issue of migration but rather one of economic survival strategies on the part of both traffickers and those being trafficked (Baldwin-Edwards, 2006), as a result of the existence and enforcement of legal barriers regarding migration worldwide, have also began to pile, focusing on either the economic perspective, i.e. trafficking as business (Salt and Stein, 1997; Mahmoud and Trebesch, 2010; IOM, 2006; Baldwin-Edwards, 2006), or on the legal aspect, focusing on trafficking and human smuggling as criminal activity (Salt, 2000). A survey conducted by I.O.M. (2006) to evaluate human trafficking prevalence in Eastern Europe pointed that potential victims of labour exploitation come from a wider social group, including both men and women and young and middle age persons as well. Mahmoud and Trebesch (2010), using datasets from 5 Eastern European countries (including Romania), since the Eastern bloc has been a major origin region of forced labour migration and human trafficking soon after the fall of communism, emphasized that the risk of human trafficking is highest in areas with high rates of out-migration and that the restrictive immigration policies push would-be immigrant into illegality, thus increasing the phenomenon.

Worldwide, there have been identified several regional migration hubs, which receive a highly diverse immigrant population and which also act as places from where people flow all over the world (Czaika and Haas, 2014, p. 31). Europe is most definitely such a regional hub, shifting from a global source region of emigrants to a global migration magnet (Czaika and Haas, 2014). The nature and scale of migration in Europe over the last decades has changed significantly, the continent witnessing large waves of migration from both within and outside the European Union, several major types of migration being identified (E.C., 2011): i) labour immigration, permitted and even encouraged by some destination countries to fill in the gaps in the national labour market; ii) student migration, which despite temporary in nature, tends to become rather permanent for an increasing number of people; and iii) asylum seekers. Thus, the successive enlargement of EU has completed a geo-political shift in post 1989 Europe, due to its almost desperate structural need in terms of demography and labour force for increased intra-European population movements (Favell, 2008). Still, the diversity of migration experience across Europe, characterised by new forms and dynamics, is always in focus, as politically, much has changed in 10 years and the burning issues of today migrants are no longer those of 10 years ago (Salt and Almeida, 2006).

The East-West migration in Europe following the fall of communism has been unprecedented in terms of speed, scale and persistence compared to emigration experiences elsewhere, due to the big-bang nature of reintegration of former communist countries into the global economy (Atoyan et al., 2016). Romania is one of main ex-Communist European countries sending large flows of migrants to the countries in the Western and Southern Europe, the phenomenon being thoroughly documented for more than two decades by Romanian and European researchers as well (Sandu, 2005, 2007, 2009, 2010; IOM, 2006; Wiskow, 2006; Sandu and Alexandru 2009; Radu, 2003; Potot, 2010; Baldwin-Edwards 2006, 2008; Marcu, 2011; Galan et al., 2011; Martin and Radu, 2012; Suditu et al., 2013; Roman and Goschin, 2014; Goschin, 2018).

The present paper deals with the spatial articulation of migration in Romania rather than the social transformations associated with the regional particularities of the phenomenon, highlighting the areas with significant population loss caused by migration and the demographic crisis potential implied by the large-scale migration in the years following the 1989 revolution and integration into the European Union in 2007. It is an attempt to bring together a generous, challenging scale of analysis, the national one, with the interface of international migration.

Data and methodology

The statistical data provided by the National Institute of Statistics, the Tempo-online data series, as well as statistical results available online from the last three censuses (1992, 2002, 2011) were used to create a full database regarding migration in Romania, in the period comprised between 1990 and 2017. This first step was also the first major difficulty in structuring and achieving the purpose of the paper because generating detailed maps was hindered by the problem of lack of data at the level of the lower-ranking administrative-territorial units (at the beginning of the transition period) or localities that

have changed their administrative status especially after 2004 which made the available data unusable because to their lack of continuity.

In this respect, specific geographic information systems have been used to analyse the dynamics and territorial disparities at national level. Spatial and statistical data were processed using the ArcGIS 10.5 tools. In addition to the actual analysis based on spatial data available in vector format, a number of relevant indicators were used to analyse the spatial implications of international mobility types (temporary migration and permanent migration, in particular). Thus, the NUTS III units in Romania (counties) was used, allowing the analysis of the complete dynamics of the demographic indicators.

The cartographical materials obtained were a useful tool in deciphering the spatial trends of population mobility at national level, by highlighting the counties that had the most to lose from the overwhelming negative balance sheet of international migration.

Position and demographic profile of Romania in the spatial structure of the European Union

The effects of international mobility on the demographic evolution of the Romanian population gained importance in the post-communist period, being considered one of the main causes of demographic decline. While during the first years of transition the demographic decline based on migratory outflow was decisive, starting with 1994 it was mainly due to the natural deficit (Fig. 1). There was a negative natural increase starting with 1992 which increased during the following years, with obvious negative peaks in 1996, 2002, 2011 and 2014 onwards. Added to this, the negative migration balance amplifies the demographic decline until 2007 (-3.25‰ in 2006) when the extent of decline is mitigated by massive immigration (-1.28‰ in 2017). This contrasting evolution demonstrates the complexity of the factors and their territorial reflection in the post-communist period, but also the effects of a changing European construct on Romania: opening borders after a coercive communist regime in 1989, industrial restructuring and rising unemployment in the first decade, changing migration policies and eliminating visas in the Schengen area in 2002 and EU integration in 2007.

The extent of the migratory flow from Romania can be settled even more objectively if we analyse the foreign-born population residing within the EU-28 and EFTA in 2017 and its rising values as compared to the effects of its last accession wave (Fig. 2). Thus, the European continent becomes heterogeneous and multicultural if we look at the statistical overview which proves that in 2017, at least 5 out of every 100 people of working age born in an EU-28/EFTA country resided in an EU-28/EFTA country other than their country of birth and about 35 per cent of the total EU-28/EFTA foreign-born population were born in an EU-28/EFTA country, while the remaining 65 per cent were born elsewhere in the world (Eurostat). Both in 2008 and 2017, Romanian-born citizens residing in an EU-28/EFTA country remain most numerous as in 2017, Romanian-born population accounted for 18.4 per cent of the total intra-EU-28/EFTA foreign-born population, representing the largest foreign-born group originating in an EU-28/EFTA country residing outside their country of birth. According to Eurostat, the Romanian group recorded the biggest increase in share of natives residing within the EU-28/EFTA but outside their country of birth: about 1 in 13 Romanian-born people did not reside in Romania in 2007 and the per cent increased to about 1 in 5 Romanian-born people in 2017.

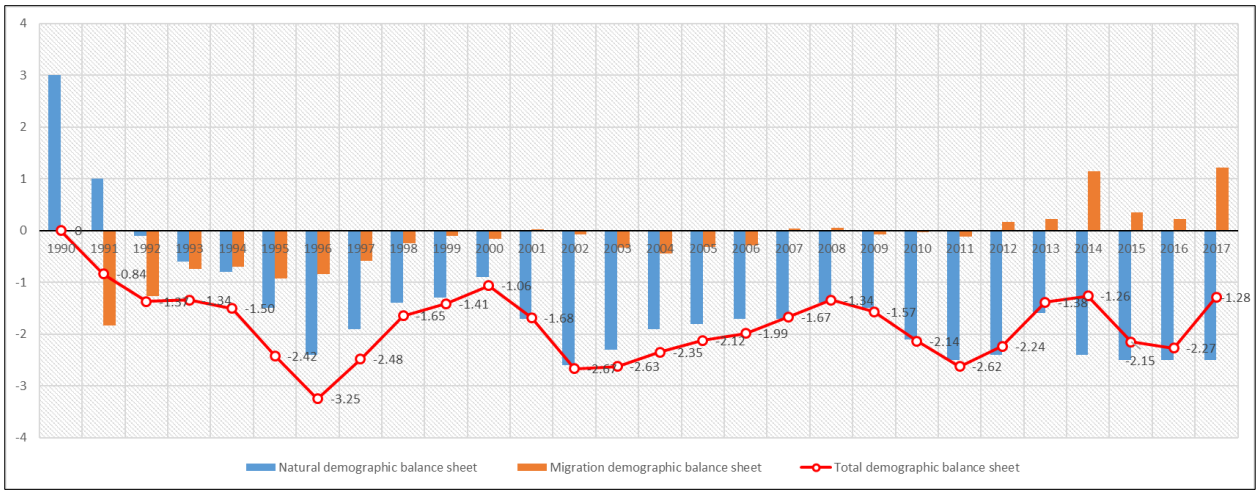

Figure 1: Total demographic balance sheet of Romania between 1990-2017 (Data source: INS, 2018)

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVIII**, Issue **2** (**December 2018**), pp. **171-186**
http://dx.doi.org/**10.5775/fg.2018.083.d**

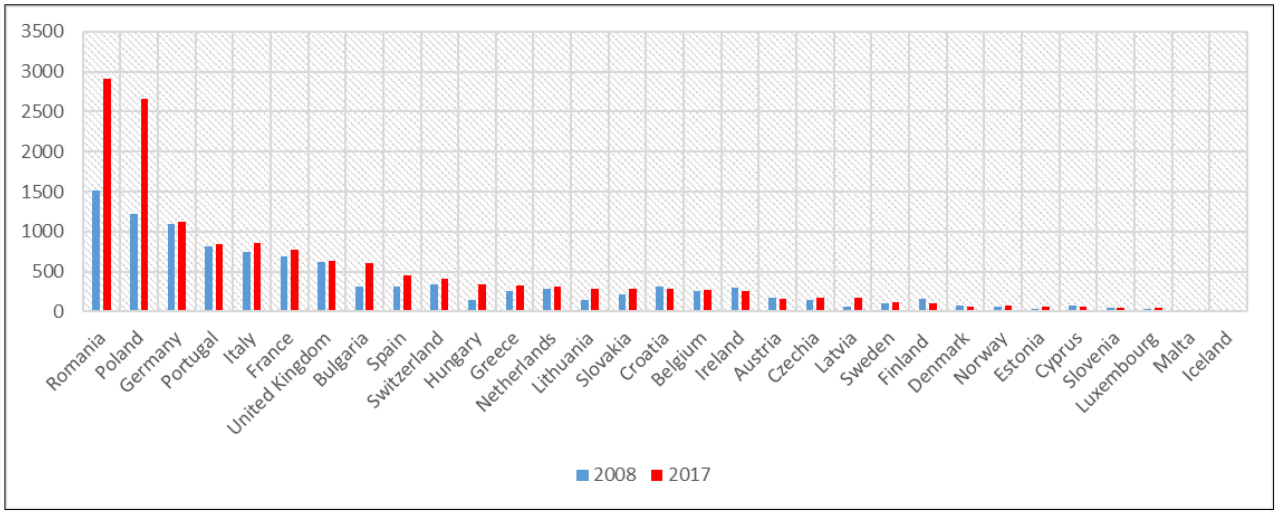

Figure 2: EU/EFTA born population of working age who usually resides in another EU/EFTA country (thousands) (Data source: EUROSTAT, 2018)

Intensity and migration pattern in the post-communist period

Although Romania was predominantly a country of emigration for more than one hundred years, with a rather impressive record regarding the number of persons involved (Horvath, 2007), the intensity and migration pattern in the post-communist period is detrimental as a worrying phenomenon for Romania given its significant contribution to the demographic decline. Still, Romanians are a nation without a tradition of international migration (Sandu, 2007, Marcu, 2001), during most of the 20th century being mainly ethnic minorities representatives that fled the country.

The fall of communism and disappearance of many restrictions regarding people mobility within and outside the country triggered significant structural changes in the migration flows. On the one hand, permanent emigration was a large scale phenomenon for the ethnic minorities living in Romania in the beginning of the 1990s, and to a much lower extend for 'pioneer migrants' who could find solutions for working and living in a completely different society. On the other hand, in and out-migration also experienced a peak in the first years of the 1990s, as all the major towns in Romania registered extremely high in-migration rates, sometimes exceeding 100‰. In fact, there were no massive movements from smaller towns or villages to the larger towns, but rather a de facto situation that finally became official – before 1990, the large towns in Romania were closed for migration, people not being allowed to move officially to these towns, even if they had a job there and were practically living in the town. Towards the late 1990s, with the crumpling of the Romanian economy, increasing unemployment rate and living costs in the urban area, many of the unemployed adults decided to move back to the rural area of origin, from where they had left during the communist industrialization period, or try their luck abroad, with a rather frequent clandestine character.

For Romania, there can be distinguished three different types of migration: permanent emigration, trafficking (affecting to a certain extent all the countries in the Balkans and Eastern Europe) and temporary/incomplete/circular migration, typical of voluntary population movements from the CEE region since 1989, having a clandestine character and involving semi-skilled and unskilled people, Romania and Bulgaria being a major source country (Baldwing-Edwards, 2006).

Romanians' emigration was generally directed towards European countries, where significant migration networks were created during the last two decades, being characterised by temporary labour that is expressed as intense circular migration (Marcu, 2011).

The emigration flows can be divided into four distinct periods (Sandu, 2006, 2007; Horvath, 2007):

- **1990-1996**, considered an 'exploration phase' (Sandu, 2007), a particular type of emigration dominated migratory flows as many Germans, Hungarians and Jews decided to leave the country. This particular form, which did not repeat in the following years, can be considered a "waiting" migration and it is directly connected with ethnic minorities, characteristic for other countries of Central and South-Eastern Europe (Kurkó, 2010; Horvath, 2007). These minorities moved to countries they had historical connections with (Germany, Hungary, Israel, USA). Ethnicity was a major discriminating factor (Sandu, 2007), since in 1990, out of the approximately 97,000 emigrants, 60,000 were German ethnics, and another 11,000 were Hungarian ethnics. Until 1996, the Germans were the second

largest ethnic group leaving Romania, followed by Hungarians. Although there were mainly young adults that left the country, the share of the older persons (60 years old and over) is considerably higher (there are no statistical data available for the first two years, 1990 and 1991 when the largest contingents of people left the country, but for the 1992-1996 interval, it is two times higher compared to the current period (8% and 3.6% respectively).

- **1997-2001** was characterized by a long, chaotic process of transition to a market economy, that generated fewer jobs available on the Romanian labour market, determining an important number of Romanians affected by industrial restructuring to emigrate mainly in the Western European countries. Young people (less than 15 years) held a particularly large share (27%) compared to the other periods, while the adults registered the lowest proportion (only 65%). Hungarians were more numerous than Germans, being ranked second after Romanians, Transylvania and the western regions providing the majority of emigrants, while the southern and eastern regions were quite unfamiliar to this phenomenon. Regarding the temporary migration, since Romanians were allowed to stay for only 3 months as tourists, there emerged circular migration patterns, Romanian migrants being highly flexible in adapting their migrations strategies to the new legislative situation (Elrich and Ciobanu, 2009). It included a great amount of clandestine activities.
- **2002-2006** is marked by the removal of visa requirements for Romanian citizens within the countries included in the Schengen space, which lead ever more Romanians to leave the country for working abroad, eventually staying there for good. It is during this period that Italy and, to a lesser extent, Spain became major destinations for Romanian emigrants, together with Germany, USA and Canada. Beginning with 2002, the number and share of German, Hungarian and Jews ethnics leaving the country decrease considerably. Consequently, apart from Transylvania and the western regions, Moldova in the east became an important source of migrants.
- **2007-2017**, due to joining the European Union and free movement of people, brought a new momentum for the Romanian emigration abroad, all the counties registered increased flows; thus, some of the countries in the central and western part of the country, which were ranked first during the 1990s, as well as most of the counties in Moldova have the highest migration rates in the country. Italy and Spain are major destination countries, with significant number of Romanians temporarily absent indicated by 2011 census (in Italy, Romanians form the most numerous ethnic minority, with almost 170,000 persons and over 71,000 persons in Spain), most migrants taking positions already tested by the network they are affiliated with and in locations where they already have friends who provide information, each experience enriching the stock of shared knowledge, orienting new migrants in the same direction (Potot, 2010).

The economic crisis from 2008-2009 and afterwards, due to restrictions and growing scepticism around immigration problems affecting the European continent, the number of permanent Romanian emigrants declined, but the temporary flows experienced an unprecedented explosion, working abroad turning into a mass phenomenon with major social, economic and psychological implications.

Surprisingly, an important aspect of recent migration refers to the number of immigrants in Romania, not at all quantitatively negligible after 2012. Their territorial concentration (counties in the North-Eastern region, but also Bucharest) clearly suggests important flows originating in the Republic of Moldova, respectively West-European businessmen or foreign-born students searching opportunities in Romania.

Permanent migration

According to the official statistical data provided by the National Institute of Statistics, there were around 550,000 Romanians that left the country for good since 1990, most of them originating from Transylvania (24%), Banat (20%) and Bucharest (18%), the top sending counties being Timiș (around 60,000 persons), Sibiu (51,000 persons), Brașov (34,000), Arad, Mureș and Cluj (more than 20,000 persons), while most counties in the southern part of the country had less than 3,000 permanent emigrants.

In the early 1990s, permanent emigration registered in Romania was more of a family reunification nature, but in time, its economic, cultural and educational motivations gained importance. The highest numbers of permanent emigrants were registered in the first years after the fall of communism, in 1990 the number peaking at 96,929 persons. For the 1990-1996 period, the total emigration rate for Romania was 11‰ – the highest for the entire analysed period, but the differences between regions were staggering – while some of the counties in Transylvania and Banat had emigration rates above 30‰ (reaching 85.7 in Sibiu and 57‰ in Timiș) (Fig. 3), more than half of the counties, located mainly in the southern and eastern part of the country registered emigration rates below 2.5‰, with many counties even below 1‰. It is during this first interval that approximately half (46%) of the total permanent emigrants left the country, most of them being German ethnics, and to a lesser extent Jews and Hungarians. Almost a quarter left Transylvania (Sibiu almost 40,000 persons and Brasov) and another quarter Banat (Timiș 40,000 people), Bucharest also registering important numbers (33,000).

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVIII**, Issue **2** (**December 2018**), pp. **171-186**
http://dx.doi.org/**10.5775/fg.2018.083.d**

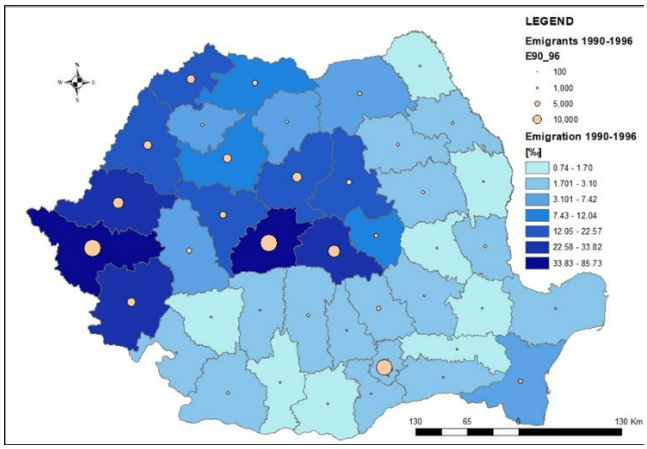

Figure 3: Permanent emigration during the first stage (1990-1996)

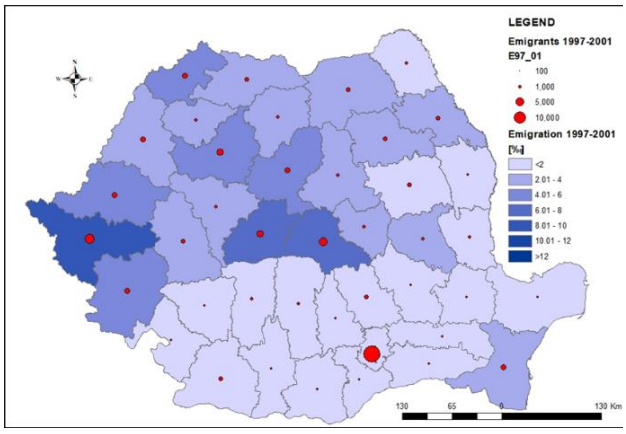

Figure 4: Permanent emigration during the second stage (1997-2001)

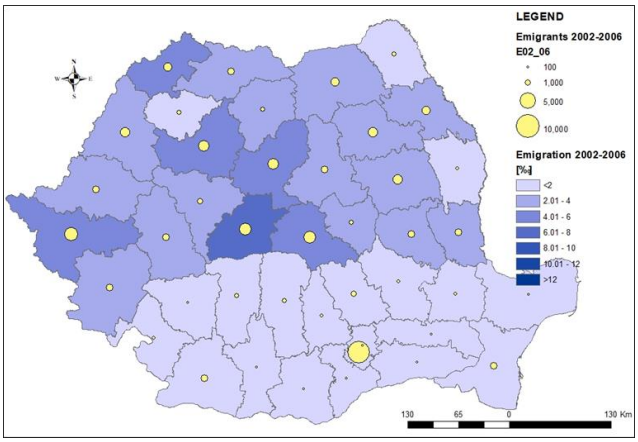

Figure 5: Permanent emigration during the third stage (2002-2006)

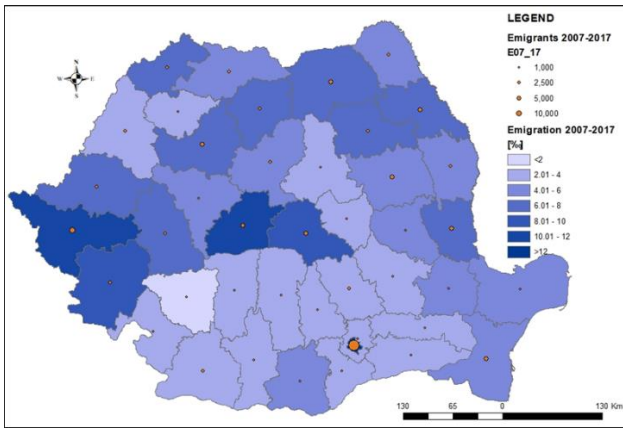

Figure 6: Permanent emigration during the fourth stage (2007-2017)

During the following two periods, 1997-2001 (Fig. 4) and 2002-2006 (Fig. 5), migration considerably decreased, with a total emigration rate of just 4.2‰ and 2.5‰, respectively, Sibiu and Timiș leading with the highest number of emigrants, although the phenomenon lost its momentum. It increased to a certain extent after Romania joined the European Union (Fig. 6), all the regions showing an increasing trend for the permanent migration, although at a different pace: highest for Bucharest and Moldova, a bit slower for Banat, Muntenia, Transylvania and the South-Eastern region, while the slowest is registered for Oltenia.

On the whole, from 1990 until 2017, there is a decreasing trend for permanent migration at national level, most of the regions showing the same trend, but for Moldova and Muntenia, where there is a slightly increasing trend.

It is important to note that unlike the temporary migration, most of the permanent migrants during the 1990-2017 period were women (54.6%), with quite significant differences from one period to another and, most importantly, from one region to another (Fig. 7). Thus, for the first period, 1990-1996, the male migrants held the highest share (47.8%) from the entire analysed time frame, but it should be mentioned that for only 9 out of the 41 counties the male migrants exceeded 40%, all of them located in the southern and eastern part of the country, while the counties with the highest emigration stocks, characterized by a heterogeneous ethnic structure, registered much lower shares of male migrants (for six counties it was less than 30%, dropping in Sibiu at just 22.8% male migrants).

Only during the second period, 1997-2001, there were counties where the male emigrants were more numerous than their female counterparts (but only for 12 out of the 41 counties), all of them located in Muntenia and Moldova, while those in Transylvania and the western part had also much lower shares. However, after 2007, it is exactly those regions that at the beginning of the analysed period were ranked first in terms of highest share of male migrants that are now ranked last (Botoșani, Gorj).

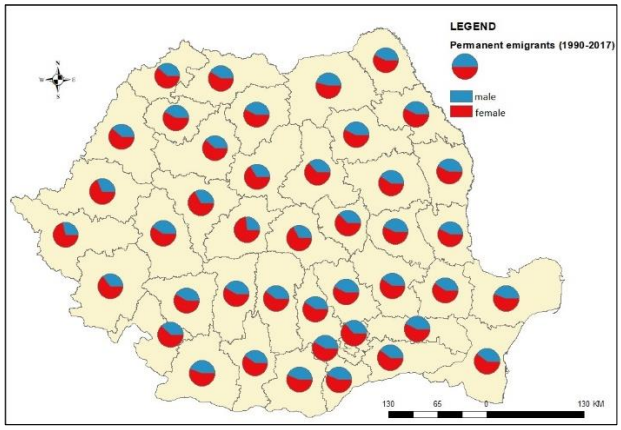

Figure 7: Gender structure of permanent emigrants (1990-2017)

The main destination countries (Table no. 1) for the Romanian emigrants were Germany (a third of the migrants, thus exceeding by far all the other countries), followed by the US (10%), Italy (9.3%) and Canada (8%). Still, there are some major differences from one period to another; thus, for the first period, 1990-1996, Germany was the main destination for more than half of the emigrants (50.6%), considering that German ethnics leaving Transylvania and Banat were the most numerous during the first two years, exceeding 60,000 persons, accounting for 62% of the emigrants until 1994. After 1996, although the share of emigrants heading for Germany decreased, it was still considerable (up to 16% during the last years). The US and Canada received almost 100,000 emigrants, most of them leaving the country between 1997 and 2007, while Italy and Spain became major destinations after 2002 (Table no. 1). Other countries receiving large number of Romanian emigrants are Hungary (mainly in the early 1990s), Austria, France and Israel. It should be noted that there are increasing differences between overseas and European destinations, as permanent migrants targeting overseas destination are on average much higher skilled (Radu, 2003). Thus, the phenomenon of brain drain has particularly important implications for productivity, considering the already low share of people with tertiary education (Atoyan et al., 2016), also inducing a decrease of the per capita endowment with human capital (Radu, 2003). Romania and Poland are by far the most affected countries in the Eastern Europe by the brain-drain phenomenon (Ionescu, 2014), Romania being ranked among the top 30 countries in the world in terms of skilled emigration stock (Docquier et al., 2009). Moreover, the reasons for migration are much more complex and diverse and do not concentrate only on the wage factor, better work conditions and possibility for an international career, as well as family reason being equally important (Nae, 2013; Roman and Goschin, 2014).

Table 1. Destination countries of permanent emigrants

Destination	1990-1996	1997-2001	2002-2006	2007-2017	1990-2017
Canada	13004	10903	7201	13201	44309
Austria	17114	3397	2112	9001	31624
France	9716	3957	1879	6669	22221
Germany	129166	15146	11256	26066	181634
Israel	3684	2155	547	8141	14527
Italy	9114	8626	12037	21547	51324
Spain	...	616	989	32147	33752
Hungary	29235	4885	5353	3799	42272
USA	20590	12714	9078	13031	55413
Other countries	23411	12350	6592	29897	73250
Total	**255034**	**74749**	**57044**	**163499**	**550326**

(Data source: INS, 2018)

In terms of age groups structure, a high percentage of emigrants aged 20-49 can be deduced, causing certain economic loss of most active age-groups. Throughout the entire analysed period, the emigrants aged 25 to 29 and 30 to 34 are the most numerous. The fact that these emigrants are young makes them ideal for Western countries, with more and more selective immigration policies in relation to their age and level of training.

In what concerns permanent immigration dynamics (Fig. 8), there are successive and quite large variations throughout the post-communist period: an obvious increase of immigration flows during 1998-2000, a further, even more prominent increase in the period 2006-2010, followed by a decrease until 2014 and then an explosive increase after 2015. Thus, three decadal periods were established for analysis, each of them including a convex ripple of immigration flows. Yet, although repetitive, the difference between these three periods is that succession of flows becomes more accentuated in a shorter period of time suggesting a complex variation of motivations and national economic, political, educational factors influencing Romania's external attractiveness.

Forum geografic. Studii și cercetări de geografie și protecția mediului
Volume **XVIII**, Issue **2** (**December 2018**), pp. **171-186**
http://dx.doi.org/**10.5775/fg.2018.083.d**

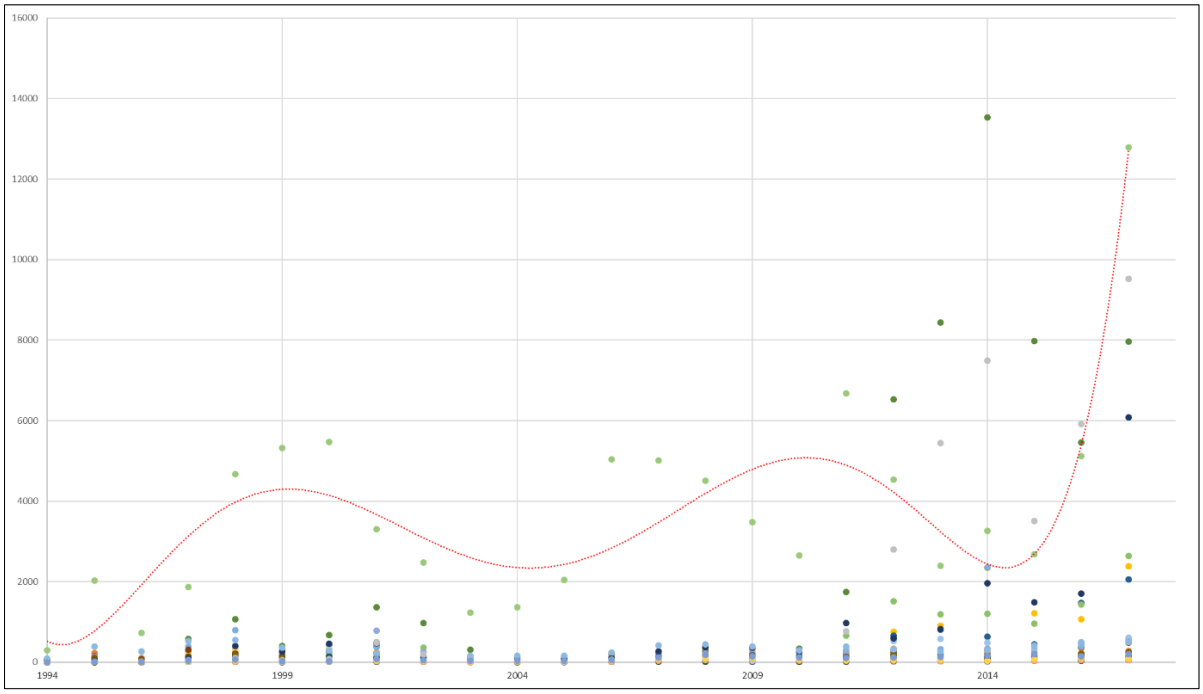

Figure 8: Variation of permanent immigrants number during 1994-2017 period

During the post-communist period, most permanent immigrants were young adults (20-24, 25-29 and 30-34 years old mostly), predominantly male and most of them coming from Germany at first, then Ukraine, Italy and the Republic of Moldova being the main sources of immigration.

Regarding the spatial differentiations of permanent immigration, most regions in Romania were characterized by extremely low rates in the first years of post-communism: Botoșani, Buzău, Giurgiu, Olt, Vaslui; only Caraș-Severin (0.16‰), Timiș, Bucharest (0.13‰) and Arad (0.11‰) registered some inflows, being border counties or as a result of greater political, economic and cultural openness (1994). At the end of the first decade, in 1998, Bucharest and counties in the West and Center Romania maintain high rates of emigration (Bucharest: 2.93‰, Timiș: 1.82‰, Sibiu: 1.64‰, Brașov: 1.45‰, Satu Mare: 1.23‰, Caraș-Severin: 1.2‰), while immigration concentrates in the same areas but also increase in the amount of flows, especially in Bucharest (2.16‰) and several well-developed counties (Fig. 9): Iași (1.28‰) and Cluj (1.1‰).

During the second analysed decade (Fig. 10), Timiș, Neamț, Iași and Bucharest register the highest rates of permanent immigration – over 3‰, while most southern counties maintain rather low rates (below 1‰). Overall, their poor social and economic development, the small number of larger, well-industrialized towns and the under-development of tourism all contributed to insignificant flows of permanent immigrants.

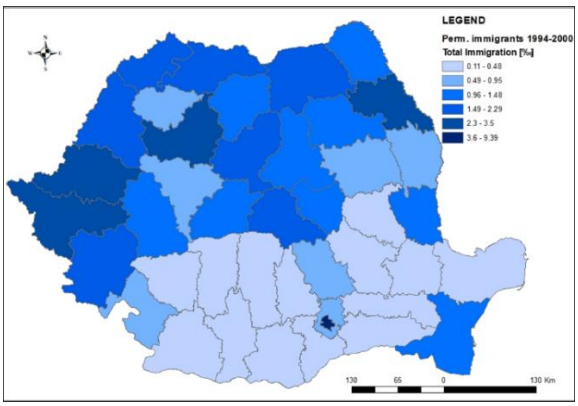

Figure 9: Permanent immigration during the first decade of the post-communist period (1994-2000)

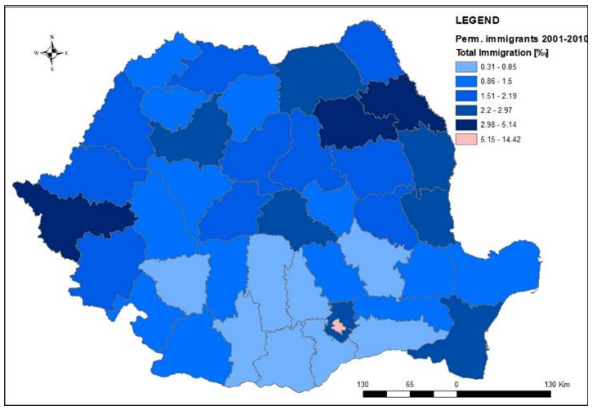

Figure 10: Permanent immigration during the second decade of the post-communist period (2001-2010)

A particular and surprisingly rising evolution is recorded in terms of the immigration rate after 2011 (Fig. 11) especially at the level of counties included in the North-East of Romania, due to the proximity of an EU country to the citizens of the Republic of Moldova and their historical and cultural affinities with Romanians. While counties such as Timiș, Brașov and Cluj, but also Bucharest and Ilfov register immigration rates comprised between 2.84-6.23‰ due to their economic development and ethnic heterogeneity, most counties in North-East Romania have a potential proximity attraction.

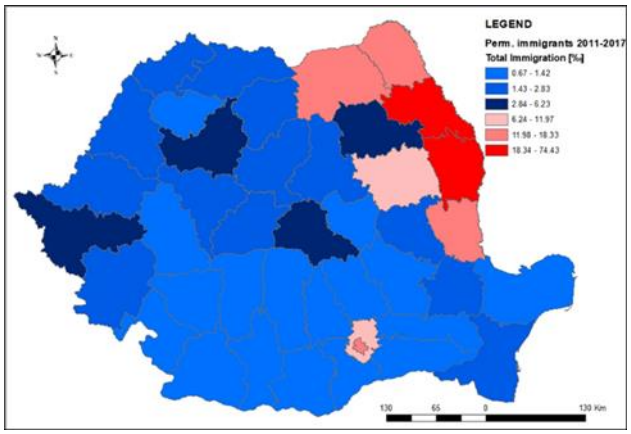

Figure 11: Permanent immigration during the third decade of the post-communist period (2011-2017)

Temporary migration

Temporary migration in the 1990s and early 2000s was both legal, following various bilateral labour recruiting agreements with Germany (1990, 1993) and later on with Hungary (2000), Spain (2002) and Portugal, as well as illegal, Romanians adapting their migration strategies and benefiting from the tourist visas within Schengen area, leaving the country as fake tourists, being illegally employed in the western countries (especially Italy).

The first official reliable statistical data referring to temporary migration were provided by the 2011 census, which revealed the true and frightening scale of temporary migration – there were some 685,000 persons that were temporary absent from home, more than half (58.7%) being abroad, and more than 900,000 persons that were absent from home for more than 12 months, out of which 728,000 were abroad. What is more, there was a significant under-registration of the absentees for more than 12 months, since at the time the census took place, more of these persons were abroad together with their entire family and there were no other family members in Romania to provide the necessary information about them (INS, 2012).

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At national level, most of them were predominantly young adults: almost half (46%) aged 20 to 35 and another quarter aged 35 to 44, with a fair share between men (50.2%) and women. Just like in the case of permanent migration and long-time absentees, most temporary migrants are a significant part of the active population, but besides 20-24, 25-29 and 30-34 age groups, there is a generous share of temporary migrants in higher age groups (over 35, even over 40) that demonstrate their previous difficulties to integrate on the national labour market, gaining satisfactory wages that could permanently keep them at home (Fig. 12).

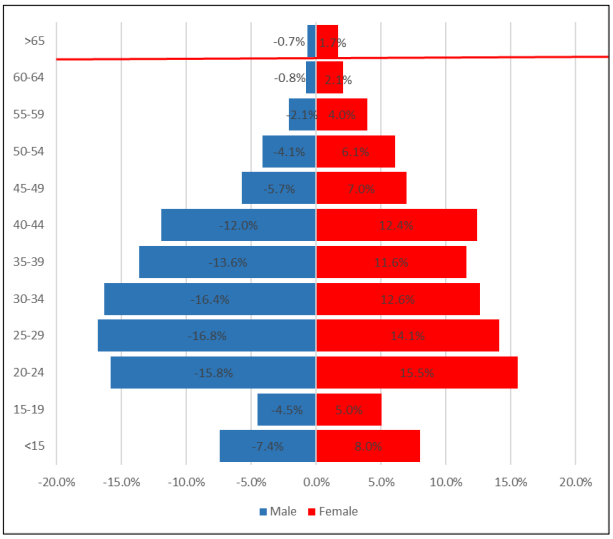

Figure 12: Population pyramid of temporarily absent persons (less than 12 months) at 2011 census

Originating mainly from urban areas (54%), and particularly from the eastern region of Moldova, where not only the highest contingents and shares are registered at county level, but also the communes with staggering proportions of population being abroad for more than one year. Neamt county includes 14 communes where more than 20% of the population was absent for a long time, with shares as high as 40% (Piatra Șoimeni 48%, Tămășeni 44%, Podoleni 36%), another 32 communes having shares between 10 and 20%. Similar situations are registered in Suceava (7 communes with more than 20% and another 35 between 10 and 20%), Vrancea and Galati, while in Ilfov, surrounding Bucharest, and the countries in Transylvania – Harghita, Covasna and Mures, where Hungarians form compact nuclei of ethnic minorities, the number of long time absentees is negligible (in Harghita, for instance, there are only 3 communes with higher shares, between 5 and 10% of the population).

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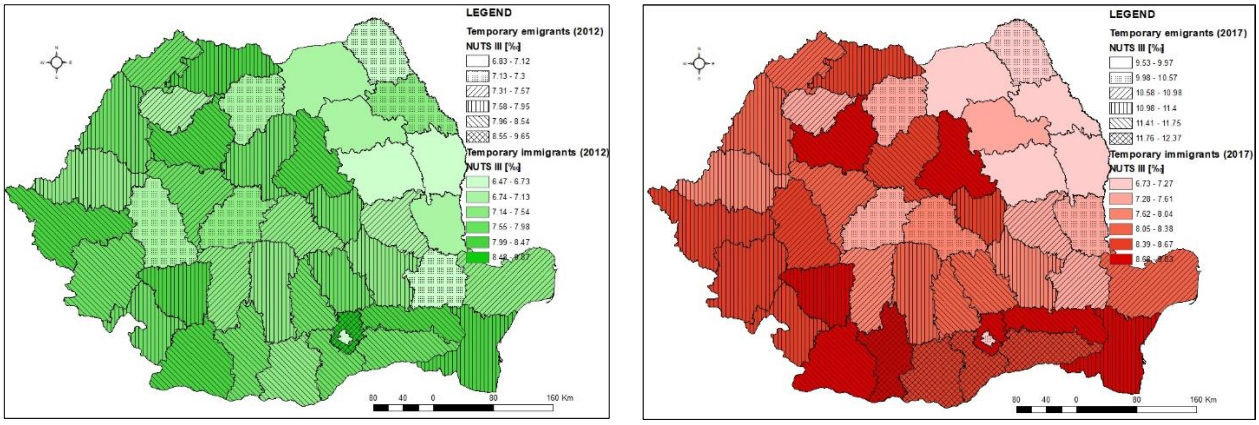

Figure 13: Temporary migration by counties in 2012 and 2017

In terms of temporary migration (less than a year), the 2011 national census primarily showed less organized territorial patterns than in the case of permanent migration, but also a significant increase during the years following EU integration, especially in economically less-developed regions and counties, situated in the Eastern, Southern and South-Eastern parts of Romania (Fig. 13). Maramures (with some 30,000 persons) and the counties of Moldova ranked first, with the highest numbers of temporary migrants (more than 20,000), while the countries in the southern part had much lower figures (Ilfov and Giurgiu around 1,000 persons).

At national level (Fig. 14), most temporary emigrants were male (53.5%) and coming from rural areas of Romania (65.2%), with a rather short period of stay (2-3 months). It should also be noted that the number of female migrants over 50 years old is more than double than that of the male migrants.

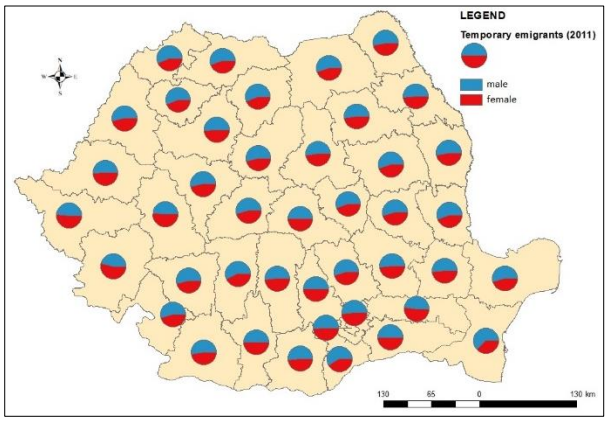

Figure 14: Gender structure of temporary emigrants (2011 census)

Out of the almost 30,000 children that were abroad during the 2011 census, 44.6% were in Italy, 21.6% in Spain and 9% in France, the numbers mirroring the main countries of destination of the parents. Still, the largest share of Romanian is found is Ireland, Portugal and France (over 12% of the total population), while Germany and the Czech Republic are ranked last (3% and 1.5%, respectively).

There is no doubt about the economic reasons as the main cause for leaving the country, 70% of the temporary migrants already having a job abroad or were looking for one, with a higher share among the rural (74%) and male (77%) population compared to the female one (63%), for whom family reasons held a significantly higher proportion (21%). While the economic reasons account for the vast majority of people originating from the eastern part (more than 75%), their share in the western and central part of the country is much lower (less than 65%), the proportion of persons for educational purpose increasing.

Regarding the education level of the temporary migrants, the average urban migrant has mainly completed upper secondary education (63% being ISCED level 3-45% general upper secondary education and 18% vocational education), those with tertiary education being quite numerous (13%), while the rural migrant has generally completed lower secondary education (ISCED level 2) (42%), although there is a significant high share of upper secondary education as well (especially vocational education). It is also worth mentioning the fact that generally, the share of highly educated migrants originating from the counties in the western and central part of Romania is double and even three times higher than the national average of 6% (Cluj 18%, Brasov 16), unlike the counties from the Eastern and Southern regions, where the numbers are well below the average (Giurgiu 2.6, Botoșani 2.9%).

Also, similar to permanent migration flows, the favourite destinations (Fig. 15) of temporary migrants were Italy (the first destination country for Romanians originating from 28 counties out of 41 and the second choice for another 11 counties) and Spain (first destination for 7 counties, and second choice for another 27), except for the residents of Harghita,

Covasna and Mureș counties on the one hand and Brașov, Sibiu and Timiș counties on the other hand, which also manifested a clear preference for Hungary, respectively Germany, which is also ranked the third destination for 15 counties, some of them with quite significant shares.

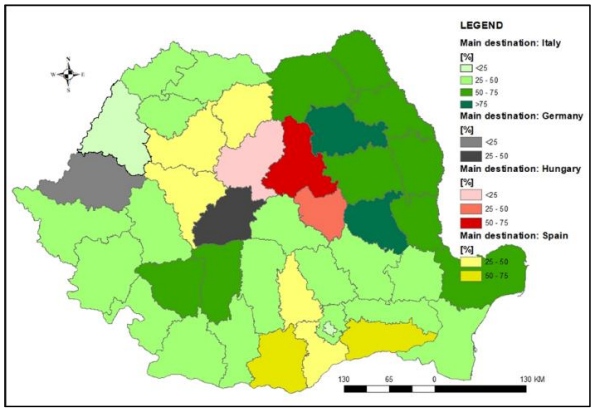

Figure 15: Main destinations of temporary emigrants (2011 census

In- and out-migration

The dynamics of in and out-migration at county level between 1992-2017 (Fig. 16) shows the intensity of the overall territorial mobility of Romanian counties, including both internal and external migration.

Out-migration during 1992-2017 was higher in the counties most affected by population loss: either in favour of other more developed regions of the country (as it it the case for most counties located in the south-west Oltenia), as a result of suburbanisation (from Bucharest to Ilfov county) or in favour of external flows part (Hunedoara and several counties in Moldova: Vaslui, Botoșani).

On the other hand, the highest in-migration flows reflect of the better economic dynamics and performance of some of the towns in Romania (located in Timiș and Cluj counties), the intensity of external flows recently specific to the North-Eastern border counties such as Iași and Vaslui, an obvious preferred destination for the citizens of the Republic of Moldova.

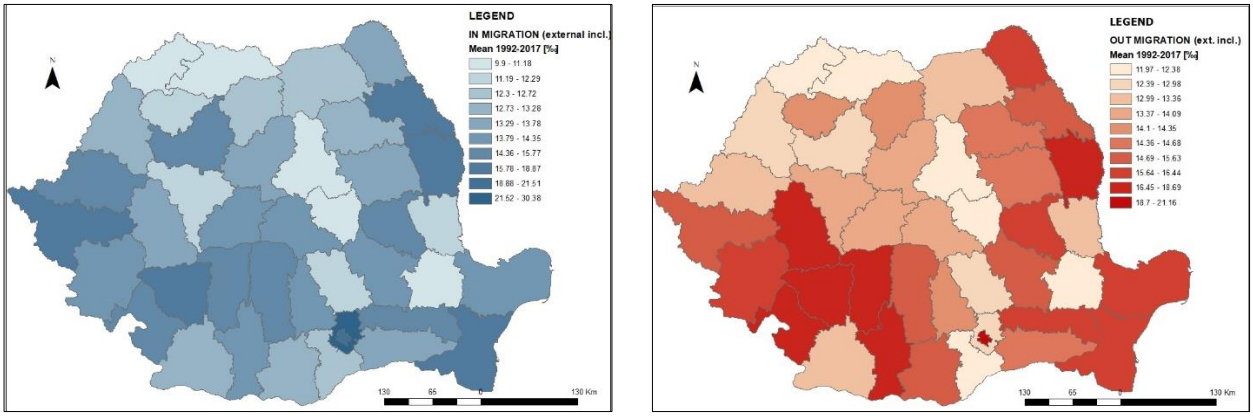

Figure 16: In- and out-migration (average 1992-2017)

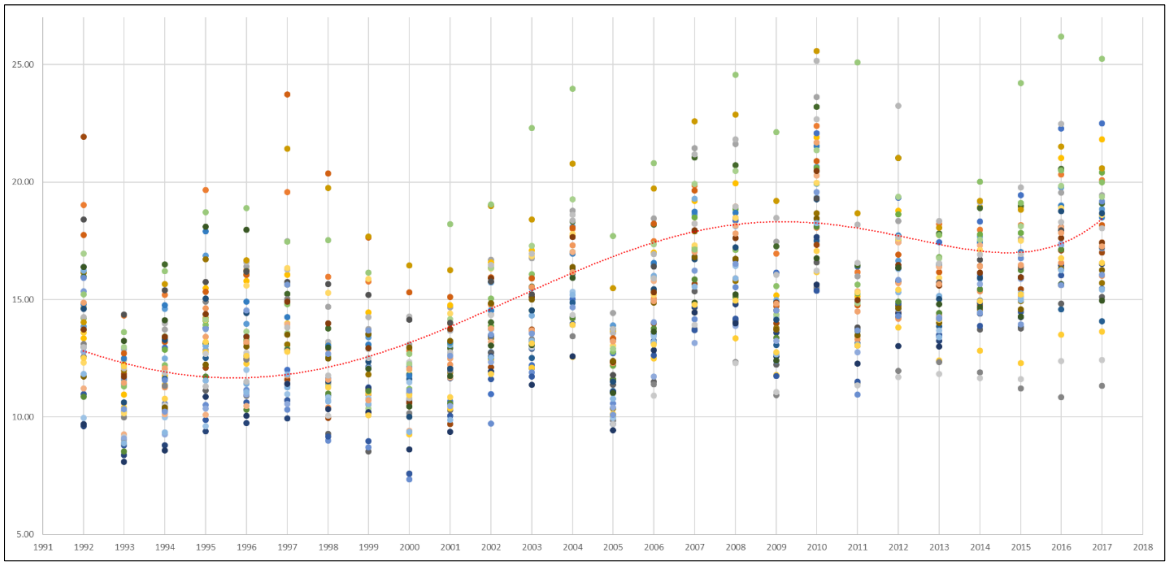

Figure 17: Dynamics of out-migration (including external migration) at the level of Romania's counties, between 1992-2017 (‰)

The temporal dynamics of out-migration (including external mobility) between 1992-2017 (Fig. 17) reveal some peaks in territorial mobility for most counties: 1992, 1997, 2004, 2010 and 2017. Regardless of the various motivations it was based, out-migration rates of over 20‰ are highly noticeable for Sibiu county, in 1992 and in the south-western and north-eastern parts of the country in 2010 and 2017-2018. The intensity of out-migration flows was reshaped during the post-communist period by permanent transformations of both internal and external legal conditionings and economic constraints, migration policies and mobility opportunities.

Conclusion

During almost three decades following the 1989 Revolution and changing political regime, Romania has clearly been a migrant sending area. Although the deficit of international migration has been counterbalanced by massive immigration from the Republic of Moldova starting with 2012, nonetheless, the phenomenon of emigration is not reversed or even attenuated.

Emigration peaked in the early 1990s, with the central and western part of the country providing most of the emigrants, while the southern part of the country is characterised by a much lower propensity for emigration. Most of the emigrants are women, of German, Hungarian and Jews origin during the first decade, while for the last 20 years Romanians accounted for more than 90% of the emigrants, targeting both European destinations (Germany, Italy, Hungary) as well as overseas countries (mainly USA and Canada). Three counties – Timis, Sibiu and Brasov rank first during the entire analysed period for permanent emigration, but also for international immigration (along with Cluj). Temporary migration is on the rise after Romania joined the European Union, most migrants being males, moving mainly to Italy, Spain, Germany and France.

Analyzing the phenomenon from a regional point of view, territorial disparities have been found to be increasing especially in the last 10 years: economic differences were amplified because previously less developed Romanian regions became more and more centrifugal as a result of both internal and external mobility, demographical loss in rural areas exacerbates more than in urban areas and population ageing protrudes at a national level.

The central and western part of the country (historical regions of Transylvania, Banat, Crisana and Maramures) are the main source region for emigrants, leaving for the most diverse destinations, in terms of both permanent and temporary migration. Still, Transylvania and Banat are also the first destination for immigrants and in-migration, due to a much more dynamic and competitive economy, and also due to the needs of the labour market.

The eastern part of the country, Moldova, is characterised by high out-migration and high temporary migration (the region with the highest number of officially recorded temporary migrants, more than 370,000 persons for the last 6 years), targeting mainly Italy (with values as high as 87% of temporary migrants from Vrancea country heading for Italy). After 2007, it is also the main immigration region, mainly for people coming from the Republic of Moldova.

The southern part of the country (Dobrogea, Muntenia, Oltenia) is the least dynamic region in terms of migration, but during the last 10 years, it shows an increasing trend for both permanent and temporal migration, being also a major source for out-migrations (especially Oltenia and Dobrogea) and the least attractive area for immigrants.

One of the key consequences of international migration is the unfavourable contribution to demographical decline, which totalized over 500,000 permanent emigrants during the post-communist period (at least in official statistics) and a migration deficit which places Romania among the European countries with the strongest propensity of the population to move abroad. This evolution of Romania's migration status also has negative effects on demographic structures and population components as most migrants are young, well-trained and economically-active persons, which evinces in both a quantitative and a qualitative downshift.

Although in the post-communist period Romania has progressively become an interesting destination for business or studies, a well-founded migration strategy should be a national priority for policy-making actors and responsible institutions due to the recent evolution of the phenomenon. Reducing territorial discrepancies, encouraging return migration, keeping a stable, constant, safe and trustful political and economic environment, paying more attention to integration of immigrants in Romania could be possible solutions.

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