SEDIMENT TRANSPORT ON THE DANUBE RIVER IN THE ROMANIAN BORDER AREA – CHARACTERISTICS

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Abstract. The beginnings of knowledge on the Danube River are lost in the historical past of Europe. The first information on the Danube is of a hydrographic nature, also referring to the elaboration of maps by the Austro-Hungarian Empire. A brief overview of the catchment area, with its orographic, geologic, climatic and hydrographic characteristics, reveals the conditions of water flow and sediment formation on the Danube. In 1838, the Austro-Hungarian authorities set up the first level gauge in the Romanian border sector (at Orşova) to measure water levels on the Danube. In the following years, water flow and sediment measurements began, further completed by the Romanian state after the 1877 War of Independence. Based on past measurements and on those gathered so far, enabled reconstituting the water level and sediment flow regime until 1840, presented in this paper. Special attention has been paid to coarse alluvial transport, dragged and in suspension. Analysing the interaction between water current and physical structure of the riverbed, yielded the empirical functions of hydro-morphological stability of the Danube riverbed and the empirical functions of dragged and suspended coarse sediment transport. The average specific discharge by sections of dragged coarse sediment and the average concentrations by sections of coarse sediment in suspension depend linearly on the average specific water discharge. Based on the empirical functions of coarse alluvial transport, which result from the processing of measurement data, led to determining the daily discharge of coarse sediment, dragged and in suspension, on the Romanian sector of the Danube between 1840 and 2012. Calculations yielded the multiannual average values and the maximum annual values of dragged and suspended coarse sediment discharge at the hydrometrical sections downstream of the Iron Gate. Here are the synthetic data: multiannual average values of dragged coarse sediment discharge vary between 14.6 kg/s at Gruia and 5.6 kg/s at Ceatal Ismail; maximum values of dragged coarse sediment discharge vary between 23.9 kg/s at Zimnicea and 47.9 kg/s at Grindu; multiannual average values of suspended coarse sediment discharge vary between 54.1 kg/s at Zimnicea and 130.1 kg/s at Ceatal Ismail; maximum values of coarse sediment discharge vary between 400 kg/s at Corabia and 2048 kg/s at Ceatal Ismail.

1. INTRODUCTION

A knowledge of the Danube River goes back to Europe's historical past. The first scientific information speak about hydrographic aspects and the elaboration of maps by the Astro-Hungarian Empire. Thus, in 1838, the first hydrometric rod was planted by the emperial authority at Orşova to measure the Danube water levels (13). As of 1857, the former European Commission of the Danube initiated measurements on water and alluvia discharge in the Danube Delta, completed by the Romanian State after the 1877 War of Independence.

On the basis of these past measurements and of others gathered up to-date, the water level and sediment discharge regime could be assessed (up to 1840), with highlight on dissolved and suspended coarse alluvia transport, an issue never tackled before (5).

Empirical functions were obtained by analysing the interaction between the water current and the channel physical structure. These functions were used to establish the hydromorphological stability of

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the Danube channel and of the dislodged and suspended sediment load. The results have shown that the mean specific discharge of coarse alluvia by sectors and the mean concentrations of coarse suspended sediment by sections are lineary dependent on mean sectional water discharge.

The empiric functions of coarse sediment transport, assessed by the processing of data-sets measurements, led to establishing the daily discharge of dislodged and suspended coarse sediments in the Romanian Danube sector over the 1840–2012 interval.

2. THE FORMATION OF WATER AND SEDIMENT DISCHARGE ON THE DANUBE RIVER

2.1. The Danube drainage basin

The Danube drains its waters from an 817,028 km^2 hydrographic basin which covers about 11% of Europe's surface-area. Depending on the course of the Danube channel, the basin shape is asymmetric, with 56% of its surface lying on the left bank and 44% on the right bank.

Out of the whole Danube basin area, 36% are covered with mountains: very tall (over 4,000 m in the Alps), and tall (1,000–2,000 m in the Carpathians, the Balkans and the Dinaric Alps); 64% represent medium-high and low areas (tablelands, hills and plains). Orographically speaking, the Danube basin contains three sub-basins: upper, middle and lower, average basin altitude is 475 m.

The geological structure of the Danube drainage basin consists of eruptive, sedimentary (limestone) and metamorphic rocks. The basin soil structure is formed of clays and loess combined with chernozems on which a vegetation of meadows, crops and various types of forest lands has developed.

In terms of physical-geographical conditions (position, relief and vegetation), a specific continental-temperate climate has developed in the course of time, its characteristic parametric values are given below:

- The annual mean air temperature stands between 8°C in the upper part of the basin and 12°C in its lower part; absolute air extremes of +37°C in summer and –36°C in winter. Values of +43° and of –33°C are recorded in the plain-area of the Lower Danube sector.
- A major climatic factor of the Danube basin, namely precipitation, is basically involved in the formation of water discharge and the River's water-regime. In view of the diversity of atmospheric circulation and of landform-types within the Basin area, precipitation are unevenly distributed. Thus, in the lowlands, the annual mean stands at some 400–600 mm, with 800–1,200 mm in the Carpathians and 1,800–2,500 and over in the Alps. Highest amounts fall in spring and summer, lowest ones in autumn and winter. The snow layer is usually 20–30 cm thick in the plains and tablelands, and about 1.5–2 m in the mountains. In harsh winters, the snow layer can be several metres thick (e.g. in the years 1953–1954 and 2012).
- Apart from precipitation, evaporation and evapo-transpiration register pretty high values, the latter ranging from 450 mm and 650 mm/year in the low areas of the upper part of the basin, down to 100 mmm/year with the decrease of altitude. A similar situation occurs in the middle part of the basin, where mean values reach 500 mm/year. In the lower part of the basin evapotranspiration increases up to a mean value of some 400 mm/year at the Danube mouth to the Black Sea.

2.2. The Danube Basin drainage network

The relief, geology, soil, vegetation and climate of the Danube drainage basin have shaped a relatively dense hydrographic network of valleys, brooks, rivers and lakes drained by its channel. The Danube-drained network of over 120 tributaries by the is unevenly distributed in the three sectors of this hydrographic basin.

In its upper part (131,338 km^2), the Danube tributaries (Iller, Lech, Altmuhl, Naab, Regen, Isar, Inn, Traun, Enns, Kamp and Morava Ceha) spring from the permafrost mountains. The main tributaries of the middle part (444,894 km^2) are Raab, Vah, Hron, Drava, Sava, Tisa, Veliko Morava, as well as smaller watercourses. The lower part (240,796 km^2) receives the Timok, Jiu, Iskar, Olt, Iantra, Vedea, Argeş, Ialomiţa, Siret, Pruth and several less important tributaries.

A common feature of the Danube tributaries is their rapid flow in the mountain area they spring from, with rates slowing down in the hillsides and plains where channels are lined with broad, high-water floodable meadows.

3. THE DANUBE CHANNEL

The Danube channel follows the route of an old drainage basin depression, formed at the beginning of the Quaternary and crossing Europe from West to East through the territories of twelve countries: Germany, Austria, Slovakia, Croatia, Hungary, Serbia, Romania, Bulgaria, the Republic of Moldova and Ukraine. The Danube springs from the South-Eastern slope of the Black Forest Mts (in Germany), the source of the rivers Brege (1,000 m alt.) and Brigah (1,1125 m alt.). The Danube channel, which covers some 2,875 km from source to mouth (at the Black Sea) is formed by the unification of the two streams (Brege, 48.5 km and Brigah, 42.6 km) in front of Donauessingen settlement (676 m alt.).

- **The Upper Danube sector**

The Danube channel (970 km long) covers a distance of some 970 km from its sources (km 2,875) to Devin (km 1,880); at the end of this course the drainage basin reaches 131,338 km^2 (in the Bratislava section at km 1,868.8). This Danube channel sector is typically mountainous, with a narrow, meandering valley deeply cut into the rocks, water flowing at great speed.

- **The Middle Danube sector**

This sector stretches out along some 959 km between Devin (km 1,880) and Turnu Severin harbour (km 931) the drainage basin finally having a 578,300 km^2. But for the Carpathian Mts. Defile (from Baziaş km 1,073 to Gura Văii km 942), this sector is typically lowland.

With a view to improving navigation and energy production, the Middle Danube sector was provided with a dam, locks and water-power plants located in the Carpathian Defile (the so-called Iron Gate Hydropower and Navigation System), built between 1964 and 1971. The influence of the newly-formed storage-lake stretches out up to Belgrade (km 1,172).

- **The Lower Danube sector**

The Lower Danube channel goes from downstream of Turnu Severin harbour (km 931) to the mouth of the Danube Delta (at Ceatal Ismail, km 79.64); the drainage basin area has 807,000 km^2. In this lowland sector, the channel is 300–1,300 m wide, over 1.5 m minimum depth, with up to 28 km-wide floodplains.

The overall Danube Floodplain area in the Romanian border sector covers 680,000 ha, out of which some 419,820 ha are dyked along 1,158 km to prevent overflows.

The water-table slope and the water current velocity are of 4.5 cm/km and 2.5 km/hr respectively, on average. Except for the upstream sector, where the Iron Gate 2 Energy and Navigation System was built (km 863) and a storage-lake formed between km 942.8 and km 863, the channel is not regulated. Numerous holms and secondary arms developed downstream.

The Danube and the Danube Delta, displaying over 1,300 km of channels, and a 1.30 km-long sea coast, lie within Romania’s natural borders.

The three hydrographic elements represent natural resources used by Romania and its riparian neighbour countries for navigation, energy, and as a source of water for agriculture, industry, urbanism and tourism.

- **The Danube Delta**

In-between the main arms and outside them, the Danube Delta area totals 4,200 km^2 (out of which 880 km2 lie on Ukrainian territory and 3,370 km^2 on Romanian territory) there are several water zones, among which Chilia-Sulina between the arms of Chilia, Tulcea and Sulina; Sulina-Sfântu Gheorghe between the arms of Sulina and Sfântu Gheorghe; Sfântu Gheorghe-Razelm, in the south, in-between the last two arms where one finds two zones: 1) the Razelm-Sinoe Complex and 2) the Ialpug-Catlabug-Chitai Lake Complex north of Chilia Arm on Ukrainian territory.

3.1. Characteristics of the Lower Danube water regime

3.1.1. Water discharge

- **Water flows. Trends.**

Data on water flows and levels (1840–2011) [7] are given in Table 1.

Water flow-time variation trends are illustrated in Fig. 1 graphs of water discharge multi-annual mean values at Orşova and Ceatal Ismail (1840–2013). The findings reveal that, after a lapse of some 75 years, values remained stable at ca 5,550 m^3/s at Orşova and ca 6,500 m^3/s at Ceatal Ismail.

In the Lower Danube, between Orşova and the river inflow to the Danube at Ceatal Ismail (km 80), the Danube tributaries contribute to a water-flow of some 890 m^3/s. Due to water drainage from the upstream, as well as from the Romanian sector, water levels at the Delta mouth average some 6,550 m^3/s, a daily maximum (2,187 m^3/s) and minimum (1,303 m^3/s having been registered on July 2, 1897 and on December 31, 1855, respectively.

The average water-flow at the mouths of the Danube arms to the Black Sea is 5,990 m^3/s. the difference of 560 m^3/s between the two values comes from water penetrations into the Delta, losses through evaporation and inflows to the Black Sea by other routes than the mouths of the Danube arms. Water flows tend to increase with time, annual maxima by ca 4.5 m3/s; average and minimum values by 4 m^3/s and 3.1 m^3/s, respectively.

Table 1

Characteristic multi-annual variables of the Danube water-flow (1840–2012)

No	Metering section	Position (km)	Maximum flow				Average flow	Minimum flow			
			Qmax m^3/s	Year	Month	Day		Qmin m^3/s	Year	Month	Day
1	Baziaş	1,072.4	15,800	2006	4	16	5,551	1,015	1901	1	13
2	Moldova Veche	1,048.7	15,880	2006	4	16	5,554	1,002	1858	2	23
3	Drencova	1,016.4	15,931	2006	4	16	5,554	1,003	1901	1	13
4	Şviniţa	995	15,877	2006	4	16	5,557	1,060	1985	10	6
5	Orşova	957.4	15,947	2006	4	16	5,574	1,060	1985	10	6
6	Drobeta-Turnu Severin	932	15,758	2006	4	16	5,585	1,103	1985	10	6
7	Gruia	856.5	15,758	2006	4	16	5,592	1,103	1985	10	6
8	Calafat	786.9	15,916	2006	4	16	5,636	1,009	1858	2	3
9	Bechet	678.7	16,169	2006	4	16	5,724	1,019	1864	2	23
10	Corabia	624.2	16,185	2006	4	16	5,731	1,022	1864	1	13
11	Turnu Măgurele	596.3	16,885	2006	4	16	5,932	1,152	1684	1	13
12	Zimnicea	553.2	16,919	2006	4	16	5,991	1,010	1858	1	15
13	Giurgiu	493.1	17,000	2006	4	16	6,011	1,030	1858	1	15
14	Olteniţa	429.8	17,303	2006	4	16	6,077	1,060	1858	1	15
15	Chichiu-Călăraşi	379.6	17,303	2006	4	16	6,107	1,041	1920	12	8
16	Călăraşi-Borcea Arm	94.5	3,203	1845	5	2	946	132	1985	10	6
17	Izvoarele	348.6	15,751	2006	4	16	5,148	839	1858	1	15
18	Bala Arm	8	9,516	2006	4	16	2,462	302	1858	2	26

Table 1 (continues)

19	Vlădeni Borcea Arm	1	11,120	2006	4	16	3,431	538	1858	2	26
20	Hârşova	248	7,846	1845	8	2	2,715	460	1985	10	6
21	Vadu Oii	238	17,372	2006	4	16	6,130	1,100	1864	2	1
22	Bălaia-Vâlciu Arm	1	3,739	2006	4	16	1,324	237	1864	2	1
23	Gropeni-Cremenea Arm	197.5	11,740	2006	4	16	4,164	745	1864	2	1
24	Smârdan-Măcin Arm	4.5	1,893	2006	4	16	665	118	1864	2	1
25	Brăila	167	17,525	2006	1	6	6,149	1,100	1864	2	1
26	Grindu	141.3	21,347	1897	7	2	6,410	1,446	1855	12	30
27	Isaccea	100.2	21,864	1897	7	2	6,516	1,303	1855	12	30
28	Ceatal Ismail Danube	80.5	21,867	1897	7	2	6,516	1,303	1855	12	30

Water discharge variation over longer time-intervals, as well as within one and the same year is influenced by the time-variation of climatic factors (atmospheric circulation, precipitations temperature, etc., ending up a short climatic cycle) within the Danube basin which generate the water flows.

Thus, once every 10 years, annual discharges may increase or diminish by some 25% versus the long-time multi-annual mean. Once every 100 year, water discharge is over 52% higher or 36% lower than the multi-annual mean.

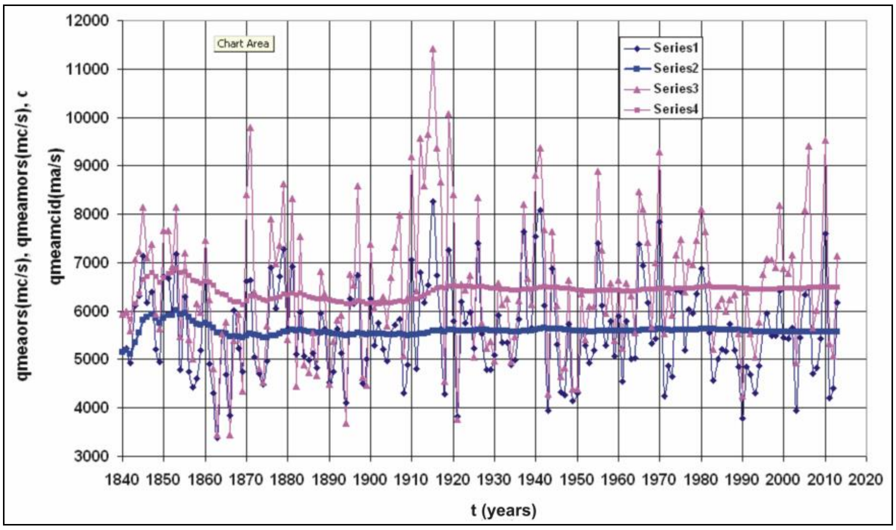

Fig. 1 – Danube water discharge, time-variation graphs of average annual and multi-annual flows (1.3 and 2.4, respectively) at Orşova (1.2) and Ceatal Ismail (3.4) over 1840–2013.

Water discharge within the annual hydrological cycles is unevenly distributed in time, with mounthly flows possibly oscilating by some +38% in May–June and –36% in September. In years with very great or very small water deviations from the long-time multi-annual mean of daily discharges, maximum and minimum values may reach 137%, and –75%, respectively.

- **Levels. Trends.**

Systematic Danube-level measurements go back to the 19th century, having been made first at Linz (1821), then in Bratislava and Budapest (1823), Ingolstadt (1827), Orşova (1839), Bezdan (1856), Sulina (1857), Tulcea (1858), Ruse (1898) and Ismail (1920).

In the upper Danube drainage basin, highest annual level variation amplitudes occurred in the warming season (March–June), with lowest ones in the cooling interval (September–October).

Table 2

Multi-annual characteristic variables of the Danube water level (1840–2011)

No	Metering station	Position (km)	Maximul level				Average level	Minimum discharge			
			Hmax cm	Year	Month	Day		Hmin cm	Year	Month	Day
1	Baziaș	1,072.5	820	2006	4	14	323	–117	1858	1	16
2	Moldova Veche	1,048.9	880	2004	11	14	343	–127	1866	1	11
3	Drencova	1,016.2	1,034	2004	8	3	372	–100	1866	1	11
4	Șviniţa	994.8	2,038	1995	8	21	646	–7	1866	1	11
5	Orşova	953.3	2,725	1996	12	24	799	–58	1866	1	11
6	Drobeta-Turnu Severin	931	981	1991	1	13	342	–122	1866	1	11
7	Gruia	851	898	2006	4	20	295	–196	1985	1	17
8	Calafat	794.6	861	2006	4	23	292	–124	1866	1	12
9	Bechet	679	871	1896	4	18	299	–117	1866	1	12
10	Corabia	625.5	882	1895	4	18	277	–138	2003	9	7
11	Turnu Măgurele	597	790	2006	4	24	252	–105	1866	1	12
12	Zimnicea	553.5	864	1895	4	10	297	–122	1868	1	12
13	Giurgiu	492.8	842	1895	4	18	287	–144	2003	9	8
14	Olteniţa	429.7	886	1895	4	18	285	–135	1866	1	14
15	Călăraşi-Borcea Arm	94.5	785	1895	4	18	246	–150	1866	1	15
16	Cernavodă	298.3	757	1895	4	18	244	–237	2003	9	10
17	Hârşova	252	764	2006	4	25	286	–136	1858	3	12
20	Brăila	169.4	701	2010	7	6	281	–86	1858	1	25
21	Isaccea	103.7	537	2010	7	6	217	–48	1921	10	31
22	Tulcea Tulcea Arm	71.6	458	1897	7	2	165	–45	1921	10	11
23	Sulina-Sulina Arm	0.0	137	2006	5	2	45	–36	1921	1	25

Water level and water discharge regimes are closely connected. Figure 2 diagram shows average water discharge variations of 0–16,000 m³/sec. alongside the Romanian sector of the Danube over the 1980–2010 interval. Flooding episodes on the Danube may last for several months even, e.g. in the years 1897, 1940, 1970, 1980, 2006 and 2010. Both historical and current measurements data attest to high flooding events in 1501, 1838, 1890, 1897, 1899, 1924, 1926, 1937, 1940, 1942, 1944, 1954, 1956, 1970, 1980, 2006 and 2010, producing material damage and casualties.

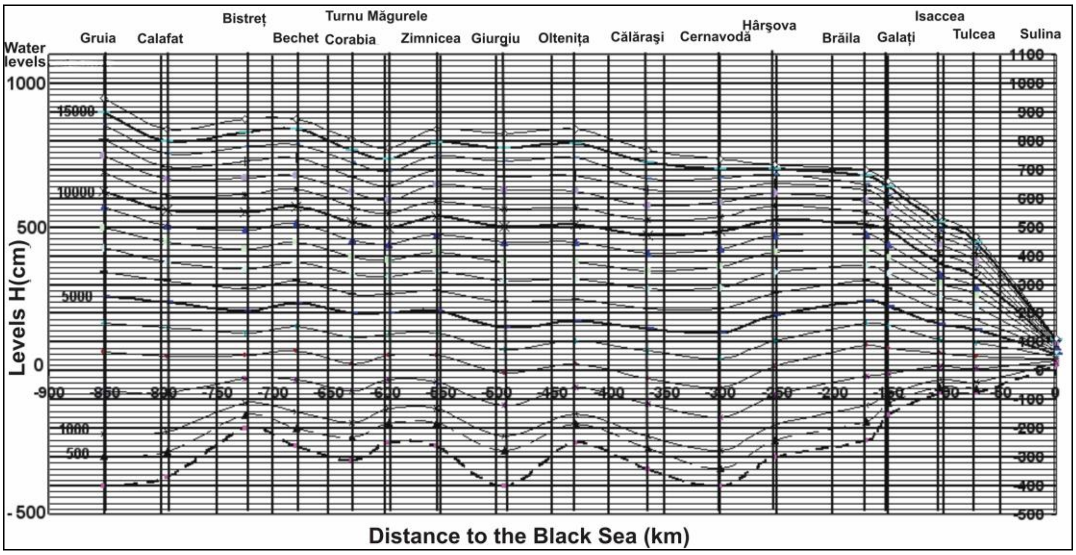

Fig. 2 – Water-table level variations along the Romanian sector of the Danube corresponding to 0–16,000 m³/s water discharges (mean values over 1980–2010).

Insofar as time level variation trends are concerned statistical data for the 1840–2010 interval show an annual level increase of 0.11 cm, 0.176 cm, and 0.109 cm at Călăraşi, Galaţi and Tulcea, and a temporal decrease trend of –0.368 cm at Cernavodă.

3.1.2. Sediment discharge

- **The nature and granulometry of sediments.**

The earth particles entrained by water and drained from the Danube hydrographic basin reach the mainstream in the form of sediment (alluvia). Sediment particles consist mainly of silica (specific porosity ca 1.65 kg/dm^3). Grain varies between bolders and clays. In the Lower Danube sector, the sediment granulometric composition consists of coarse sand and clay fractions. In terms of grain size, there are two categories of sediment, with different behaviour (laminar or turbulent) when falling into a mildly flowing water.

Grain fraction smaller than 0.063 mm display a turbulent behaviour when falling into mildly flowing water, being carried only in suspension under the influence of water current turbulence.

The laminar behaviour is specific to smaller grain fractions. If larger than 0.063 mm, they display a turbulent behaviour when falling into mildly flowing water and are carried by the water current by dislodging and in suspension. Dislodging the sediment on the channel-bed, or lifting it in suspension occurs when the water current velocity exceeds a certain limit, the so-called critical velocity of dislodging of sediment. Mean diametric values in measured years are given in Table 3.

Table 3

Mean values of water flows (Q), total discharge of suspended (Rs) and dislodged (Rg) sediments, alos of suspended (d50s) and dislodged (d20g) sediment particles corresponding to 50% of the granulometric composition in measurement years on the Danube

Metering sections	Measured years	Position	Q	Rs	d50s	Rg	d50g
		Km	mc/s	kg/s	mm	kg/s	mm
Baziaș	1971–1998	1,072.4	5,656	516	0.022	0.70	0.285
Moldova Veche	1973–1998	1,048.7	5,562	356	0.022	0.510	0.281
Drencova	1971–1997	1,016.4	5,559	341	0.022	0.433	0.282
Șvinița	1972–1998	995	5,414	402	0.022	0.991	0.020
Orşova	1971–1998	957.4	5,511	464	0.022	0.222	0.107
Drobeta-Turnu Severin	1969–1997	632	6,051	309	0.023	1.25	0.453
Gruia	1969–1995	856.5	5,673	354	0.024	9.37	0.462
Calafat	1969–1995	786.9	5,749	399	0.025	1.04	0.428
Bechet	1969–1995	678.7	6,202	522	0.025	11.69	0.297
Turnu Măgurele	1970–1985	596.3	6,503	1,474	0.026	14.96	0.302
Zimnicea	1972–1995	553.2	6,025	999	0.027	14.57	0.243
Giurgiu	1970–1995	493.1	6,198	991	0.023	16.12	0.247
Olteniţa	1969–1985	429.8	6,641	1,368	0.025	13.17	0.294
Chiciu-Călărași	1970–1985	379.6	6,713	1,434	0.024	14.83	0.261
Vadu Oii	1969–1995	238	6,738	1,202	0.020	5.89	0.245
Brăila	1971–1995	167	6,776	1,134	0.021	4.03	0.185
Grindu	1969–1985	141.3	7,428	1,703	0.022	7.60	0.181
Ceatal Ismail	1969–1995	80.5	7,123.741	1,534.169	0.020	3.50	0.155

where Q = Suspended sediment measurements yielded mean water discharge;
Rs = suspended sediment measurements yielded mean alluvia suspended discharge;
Rg = dislodged sediment measurements yielded mean dislodged alluvia discharge.

- **Hydraulic lifting of sediment in suspension.**

Channel-bed sediments are water-flow moved by hydrodynamic pressure and by friction. Another interaction between the water current and the sediment grains entailed by it is the action of the vertical components of pulsating velocities within the water current and the water falling velocity of the respective grains.

Water measurements on the Danube have revealed that the mean value of the pulsating velocity vertical component v_p(cm/s) is expressed by the empirical function (1) [3].

$$v_p = 6.76 * q_m / h_m^{0.961} \qquad (1)$$

where q_m(sqm/s) is the mean specific water discharge value.

On the other hand, the average sediment grains water fall velocity (w), called sinking velocity, is defined by functions dependent on grain-size (d) and water temperature (θ) [6]. With grain-size (d) of 0.1-0.6 mm, sinking velocity w (cm/s) is given by Zegjda's relation:

$$w = d * g^{2/3} / (5* \zeta^{1/3}) * (\rho_s/\rho - 1)^{2/3} \qquad (2)$$

where g = gravitation acceleration, ζ = water temperature-dependent kinematic viscosity coefficient (θ) (relation 3) and ρ_s/ρ, expressing the relation between solid density (ρ_s) and water density (ρ) equal with ca 1.65.

$$\zeta(cm^2/s) = 0.000001775 / (1 + 0.0337 * \theta + 0.00022 * \theta^2) \qquad (3)$$

For grains smaller than 0.06 mmm, the sediment water fall velocity is given by relation (4):

$$w = g * d^2 / (18* \zeta) * (\rho_s/\rho - 1) \qquad (4)$$

Whenever up $v_p >= w$, channel-bed silts are dislodged or turbulent suspended in the channel water current.

This is exemplified by checking the relation between water fall velocity w grains of 0.063 mm in diametre and the vertical component of vp pulsating current for the 11° mean Danube water temperature. In the case of 0.063 mm particles and 11° water temperature (eq. 2) w grain fall velocity = 2.8 mm/s. On the other hand, relation (1) shows that with minimum 0.2 m/s, average velocity in the Danube channel, pulsating vertical velocity is 13.5 mm/s. Hence, five particles smaller than 0.063 mm in diametre are maintained and carried exclusively in suspension by very mild Danube currents without being involved in channel-bed morphological processes. Therefore, it is only coarse sediments that take part in channel-bed hydromorphological processes.

- **Sediment water transport in the Romanian Danube sector**

Under the action of the water flow, solid sediments are detached from the channel walls by erosion produced by the current, by waves and by ice. Another category of solid particles in the Danube channel are brought by the tributaries that flow on the river drainage-basin slopes.

The type of water current-entailed movement is grain-size dependent. Under water-current action, sediment behaviour is grain-size dependent. Measurements made on the Danube have shown that sediments are being moved either by dislodging or in suspension.

Smaller than 0.063 mm grains, the so-called fine sediments, are moved solely in suspension, irrespective of the water current velocity.

Larger than 0.063 mm grains, the so-called coarse sediments, are moved by dislodging, or in suspension, depending on the water current velocity.

The different entailment in movement of fine and coarse sediments is due to the distinct hydraulic behaviour of solid particles deposition in water.

The Danube transport of coarse sediment begins when the water current velocity exceeds a certain critical value. The critical value of the dislodged coarse sediment and of the suspended coarse sediment entailed in movement is distinctively different. Thus, the different behaviour to the water current action makes the coarse sediment transport regime dependent on water current energy, whereas fine sediment discharge depends on natural factors outside the channel, such as precipitation.

Present-day assessment of (fine and coarse) sediment transport on the Danube

The transport of sediments is quantified by measuring the discharge of alluvia. Systematic measurements of water and alluvia flow-rates on the Danube are made by the Romanian Waters National Administration, the results being stored in the hydrographical data-base of the National Institute of Hydrology and Water Management. Processing these data yielded a series of characteristics regarding Danube suspended and dislodged sediments.

Two monographic hydrological works were elaborated at the Institute of Hydrotechnical Studies and Research of the State Committee for Waters between 1960 and 1967. The first, published in Romanian and Russian (1963), dealt with the Danube Delta (coordinator Eng. C. Diaconu, Ph.D.); the second (1967), covered the Danube course between Baziaş and its inflow to the Delta (coordinator: Eng. V. Stănescu, Ph.D.).

Between 1975 and 1985, a regional collaboration among the riparian countries of the Danube drainage basin, started under the UNESCO International Hydrological Programme (IHP), resulted in the elaboration (1988) of a *Monograph of the Danube Drainage Basin* (published in English, German, French and Russian). This monographic work describes the River's water regime from source-area to discharge into the Black Sea.

The hydrological Monograph of the Danube Delta provides data on sediment and water discharges at the river inflow to the Delta:

- Multi-annual average water flow-rate (1921–1960) = 6,290 m^3/s; maximum and minimum water flow values = 14,050 m^3/s, and 1,350 m^3/s, respectively.
- Multi-annual average suspended sediment discharge (1921–1960) 2,140 kg/s; 5,150 kg/s (1941) and 628 kg/s (1921), respectively;
- Suspended sediment granulometry of fractions between 0.002 mm and 1 mm is dominated by smaller than 0.1 mm particles.
- Dislodged sediment discharge (grain-size 0.08 and 0.6 mm) is at most 5–6% of the suspended sediment one.

Hydrological Monograph data on the Danube water and sediment discharge rates (1921–1962) between Baziaş and the river inflow to the Danube Delta, cheched at three metering stations: Orşova, Olteniţa and the Danube inflow to the Delta:

- Multi-annual average water flow-rate: 5,950 m^3/s at Orşova, 6,000 m^3/s at Olteniţa and 6,220 m^3/s at the Danube inflow to the Delta.
- Multi-annual average suspended sediment discharge: 1,110 kg/s at Orşova, 1,765 kg/s at Olteniţa, 1,800 kg/s at Brăila, and 2,110 kg/s at the Danube inflow to the Delta.
- Dislodged sediment discharge: ca 1.5% of the suspended sediment discharge. No information on sediment granulometry.

Monograph data on the Danube water and sediment discharge at four metering station in the Romanian border sector:

- Water flow-rates: Orşova 5,699 m^3/s; Zimnicea 6,150 m^3/s; Vadu Oii 6,216 m^3/s and at the Danube inflow to the Delta 6,550 m^3/s.
- Multi-annual average sediment discharge (1930–1990): Orşova 816 kg/s; Zimnicea 1,102 kg/s; Vadu Oii 1,356 kg/s and the Danube inflow to the Delta: l,457 kg/s.
- Suspended sediment granulometry: average grain-size particles measured at Turnu Severin: 0.0251 mm and at the Danube inflow to the Delta: 0.0212 mm.

- Multi-annual average discharged sediments (1930–1990) Orşova: 2.55 kg/s; Zimnicea 14.9 kg/s; Vadu Oii 4.32 kg/s and the Danube inflow to the Delta 2.21 kg/s. The average grain-size was 0.444 mm at Turnu Severin and 0.145 mm at the Danube inflow to the Delta.

Other in-depth information on the sediment transport of fine alluvia, on the one hand and of coarse alluvia, on the other, were partly published, yet without a characterisation of their regime. It is more than 50 years since Romanian specialist bodies have made a complex study of the Danube and its Delta water regime. An update of this issue is given furthermore.

Looking back at past data (down to 1840) on the overall (fine and coarse) sediment discharge has largely contributed to a better knowledge of their regime in the Romanian sector of the Danube (Table 4).

The time-variation graphs (1840–2012) of overall sediment discharge at the Baziaş, Gruia and Ceatl Ismail metering sections are given on Figure 3.

Table 4

Characteristic values (1940–2012) of the multi-annual average water flows Q (mean) and the annual average maxima (Rmaa), multi-annual average (Rmeam) and annual minima (Rmia) of total (fine and coarse) sediments at the metering sections placed alongside the Romanian sector of the Danube

No	**Metering stations**	**Position (km)**	**Qmeam**	**Rmaa**	**Rmeam**	**Rmia**
			m^3/s	**kg/s**	**kg/s**	**kg/s**
1	Baziaş	1,072.4	5,558	2,022	829	61
2	Moldova Veche	1,048.7	5,552	2,020	837	57
3	Drencova	1,016.4	5,563	2,023	832	14
4	Şviniţa	995	5,570	2,025	825	54
5	Orşova	957.4	5,568	2,045	822	53
6	Drobeta-Turnu Severin	632	5,587	2,165	845	54
7	Gruia	856.5	5,656	2,661	858	47
8	Calafat	786.9	5,655	2,978	1,080	57
9	Bechet	678.7	5,857	3,079	1,152	157
10	Turnu Măgurele	596.3	5,920	3,225	1,248	126
11	Zimnicea	553.2	5,976	2,631	1,102	150
12	Giurgiu	493.1	6,007	2,989	1,211	141
13	Olteniţa	429.8	6,079	2,962	1,291	170
14	Chiciu-Călăraşi	379.6	6,096	3,624	1,379	172
15	Vadu Oii	238	6,155	4,167	1,425	187
16	Brăila	167	6,181	4,062	1,430	142
17	Grindu	141.3	5,405	4,076	1,659	209
18	Isaccea	100.2	6,509	4,489	1,645	224
19	Ceatal Ismail	80.5	6,495	4,470	1,599	200

3.1.3. A study of coarse sediment transport on the Danube

According to national regulations in effect, measurements of sediment discharge on the Danube have in view suspended and dislodged alluvia as a whole, without any differentiation between fine and coarse sediments.

Since coarse sediment depositions have negative effects on navigation, the National Navigation Body assigned the Water Management Body the task of undertaking special measurements of this phenomenon.

Thus, the then Institute of Meteorology and Hydrology (IMH), benefitting from the material nad technical support of the National Navigation Authority, proceeded to organising a special campaign for water and sediment discharge measurements, headed by Eng. C. Bondar, who also participated in this endeavours; concentrations of fine and coarse sediments were measured separately.

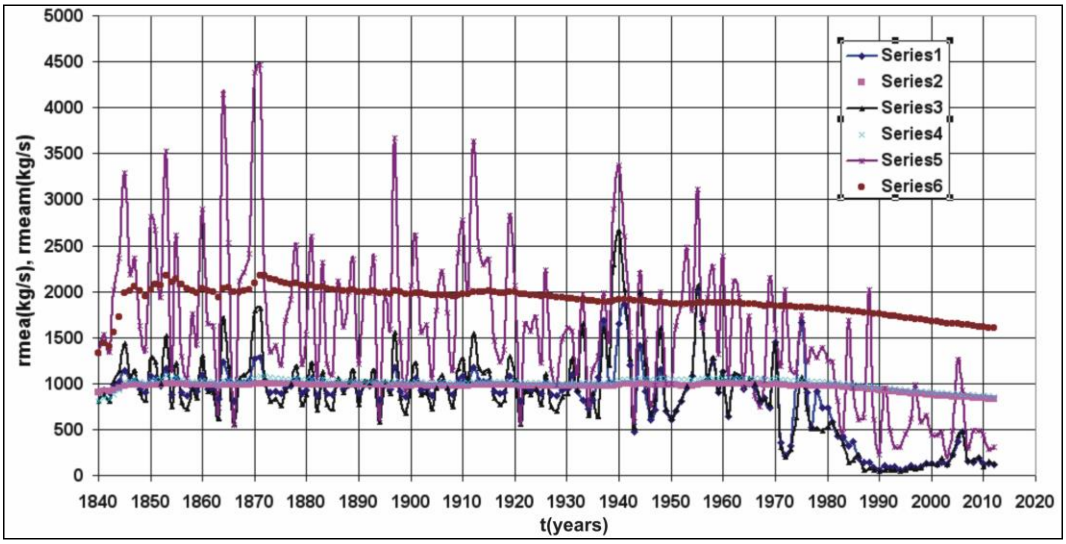

Fig. 3 – Graphical representation of the overall (fine and coarse) sediment discharge on the Danube (1840–2012), annual means (1,3,5) and multi-annual means (2,4,6).

The first such campaigns covered the whole Romanian Danube sector; research vessels were provided by the Navigation Body, and used between 1970 (a high-flood year) and 1975 until IMH would built its own vessel for complex water studies on the Danube, thus continuing the measurement of sediments. The National Institute of Meteorology and Hydrology (NIMH) would use this vessel (called LIPOVA) only until 1997.

Within that time-span, NIMH conducted biannual measurements with the LIPOVA both in high spring waters and in low autumn waters, focussing on water and sediment discharge throughout the Romanian sector on the Danube, inclusive of the Danube Delta arms. A number of ca. 1,070 measurements were made in 34 metering sections.

The data yielded by this special water-and-sediment-discharge measurements were processed, both coarse dislodged sediments and suspended sediments being correlated with specific water discharges in terms of the average channel depth where measurements had been conducted.

The mean specific water flow-rate by section **q** was taken to be the water-flow variable because, as hydrodynamic factor, the specific water flow within a channel represents the water current energy concentration grade/channel width unit. At the same time, the specific water flow-rate is also an indicator of water current turbulence. For the same total water flow-rate in the channel, the specific water flow is inversely dependent on channel length, being lower in the wide channel sections, and higher in narrow ones.

According to measurements and observations, channel depths multi-annual means are directly dependent on the specific water flow multi-annual means. Measurements of coarse sediments have shown that, for the same specific water flow, the transport of coarse sediments depends on average channel depth, since water current velocity is channel-depth dependent.

Proceeding from these findings, the specific average discharge of coarse sediment by section was globally correlated with the average specific water flow-rate by section in terms of average channel depths.

The partial results of distinctively processing past measurements by fine and coarse sediment discharge had been published at the time both in Romania [1] and abroad [4].

In order to complete and get an in-depth knowledge of coarse sediment transport on the Danube, also the other data, gathered from 1,070 measurements made between 1971 and 1997 at 34 metering sections, were used. Furthermore, an improved methodology of measurement data was resorted to.

The mean digital results of measurement processing led to establishing two basic empiric functions of coarse sediment transport:

$$gtm = agt * qm - bgt \quad (5)$$

$$gsm = ags * qm - bgs \quad (6)$$

where the average specific water-flows (qm) in the channel sectors is given in mp/s; specific discharge of average coarse sediment / section (gtm) is given in g/m/s and concentration of the average coarse suspended sediment by section (gsm) in g/m^3.

A simple transformation turns the empiric functions (5) and (6) into (7) and (8).

$$gtm = agt * (qm – bgt/agt) \quad (7)$$

$$gsm = ags * (qm – bgs/ags) \quad (8)$$

Analysing the structure of the empirical functions (7) and (8), one finds that bgt/agt and bgs/ags relations can be interpreted as critical values of mean specific discharges (qm) where coarse sediment transport begins from, so that,

$$qmcrgt = bgt/agt \quad (9)$$

$$qmcrgs = bgs/ags \quad (10)$$

According to relations (9) and (10), the empirical functions (7) and (8) grow into (11) and (12).

$$gtm = agt * (qm – qmcrgt) \quad (11)$$

$$gsm = ags * (qm – qmcrgs) \quad (12)$$

The processing of measurement data on dislodged and suspended coarse sediment discharge by the above-mentioned methodology, yielded the empirical functions (14) and (16) of the critical means of water specific flow-rates where coarse sediment transport begins from.

- Dislodged sediment

$$agt =6.497*exp(–0.085*hm) \quad r = 0.992 \quad (13)$$

$$bgt = 4.827*hm\text{^}0.306 \quad r = 0.607 \quad (14)$$

$$qmcrgt = 0.222 * hm \text{^}1.227 \quad r = 0.996 \quad (15)$$

- Suspended corse sediment

$$ags = 5.615*exp(–0.0259) \quad r = 0.979 \quad (16)$$

$$bgs = 4.281*hm\text{^}0.857 \quad r = 0.996 \quad (17)$$

$$qmcrgs = 0.517 * hm \text{^}1.147 \quad r = 0.998 \quad (18)$$

Hence, channel integral coarse sediment values are given in relations (19) and (20).

$$Gt(kg/s) = agt * (qm – qmcrgt) * B/1000 \quad (19)$$

$$Gs(kg/s) = qm * ags * (qm – qmcrgs) * B/1000 \quad (20)$$

where B stands for channel length.

The empirical functions (19) and (20) allow to determine the discharge of dislodged and suspended coarse sediments along the Romanian Danube channel sector, provided that channel morphometry and water flow-rates are known. On the basis of these two functions, two computation programmes were elaborated to assess: 1) the transport capacity of dislodged and suspended coarse sediments and 2) the daily discharge of dislodged and suspended coarse sediments on the Danube metering sections over the 1840–2012 interval.

The results of implementing the first programme are shown in Figures 4 and 5. Looking at the two figures, one may depict the following characteristics of coarse sediment discharge variation at the metering stations, located alongside the Romanian Danube sector, in terms of water flow-rates.

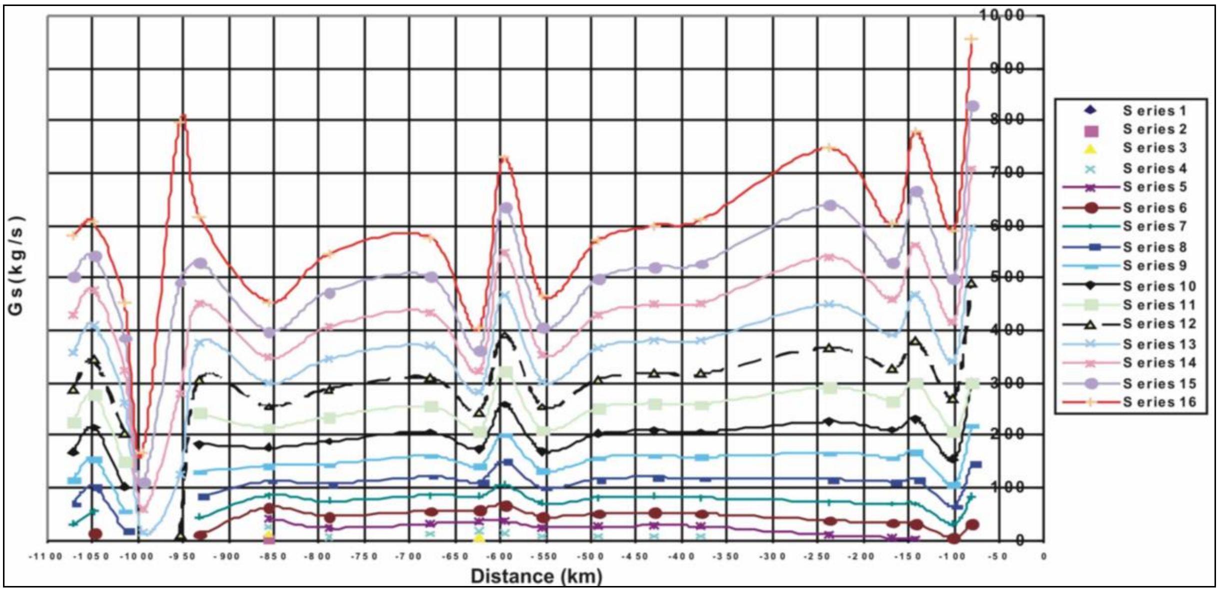

Fig. 4 – Graph of suspended coarse sediment discharge alongside the Romanian Danube sector, water flow-rate between 1,000 (1) m^3/s and 16,000 (16) m^3/s.

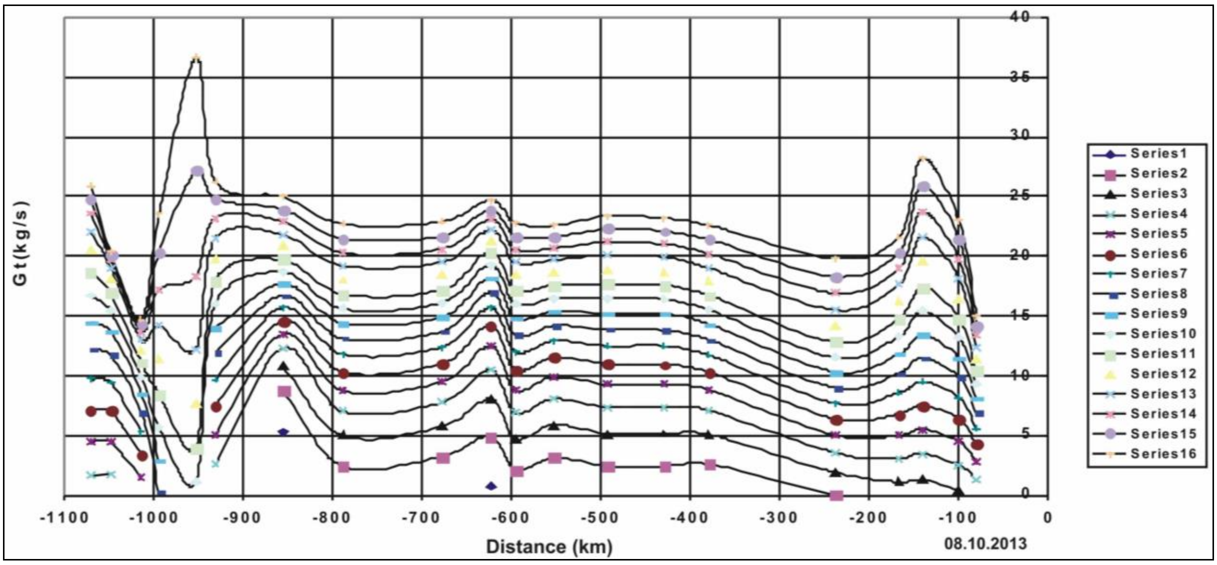

Fig. 5 – Graph of dislodged coarse sediment discharge of alongside the Romanian Danube sector, water flow-rate between 1,000 (1) m^3/s and 16,000 (2) m^3/s.

- Dislodged sediment discharge decreases from up-to-downstream, maximum value ca. 42 kg/s at Orşova metering station, water flow-rate 16,000 m^3/s.
- Suspended coarse sediment discharge increases from up-to-downstream, maximum value ca. 1,080 kg/s at Ceatal Ismail metering section, water flow-rate 16,000 m^3/s.

The results of implementry the second computation programme enabled us to determine, among others, the mean multi-annual and the maximum annual values of dislodged and suspended coarse sediments at the metering sections downstream of the Iron Gate over the 1840–2012 interval (Table 5).

Table 5

The mean multi-annual and the maximum annual values of dislodged and suspended coarse sediments at the metering sections of Danube, 1840–2012

Metering sections	**Dsilodged coarse sediments (kg/s)**		**Suspended coarse sediments(kg/s)**	
	Multi-annual means	**Annual maxima**	**Multi-annual means**	**Annual maxima**
Gruia	14.6	26.6	63.1	474
Calafat	10.2	24.6	54.9	598
Bechet	10.7	24.5	61.1	618
Corabia	13.9	25.1	58.0	400
Turnu Măgurele	10.8	25.5	91.0	891
Zimnicea	11.7	23.9	54.1	454
Giurgiu	11.9	25.6	74.6	694
Olteniţa	11.9	27.2	87.1	837
Chiciu-Călăraşi	11.0	26.2	75.4	775
Vadu Oii	7.1	24.4	72.4	1042
Brăila	7.6	26.1	66.8	842
Grindu	8.9	47.9	84.6	1844
Isaccea	7.8	35.9	57.2	1367
Ceatal Ismail	5.6	20.4	130.1	2048

Characteristic features of:

- Dislodged coarse sediments:
  - Multi-annual value range from 14.6 kg/s at Gruia to 5.6 kg/s at Ceatal Ismail.
  - Maximum value range from 23.9 kg/s at Zimnicea to 47.9 kg/s at Grindu.
- Suspended coarse sediments:
  - Multi-annual mean value range from 54.1 kg/s at Zimnicea to 130.1 kg/s at Ceatal Ismail.
  - Maximum value range from 400 kg/s at Corabia to 2,048 kg/s at Ceatal Ismail.

4. CONCLUSIONS

Proceeding from the fact that the granulometric structure of the Lower Danube sediments contains two main categories of grains, fine grains under 0.063 mm and coarse grains over 0.063 mm, the paper presents the main hydrological characteristics of the overall (fine plus coarse) sediment transport, as well as of dislodged and suspended coarse sediment transport.

Measurements of sediment discharges in the Romanian Danube sector are also analysed. Having in view the hydraulic criterion of sediment lifting in suspension, it follows that the Danube fine alluvia are carried by the water current exclusively in suspension.

Analysing the interaction between the water current and the channel physical structure, the empirical functions of the Danube channel hydromorphological stability and the empirical functions of dislodged and suspended sediment transport could be established.

The findings have revealed that the mean specific discharge by sections of dislodged coarse sediments, and the mean concentrations by sections of suspended coarse sediments are linear-dependent on the mean specific water flow-rates by sections.

On the basis of the empirical functions of coarse sediment transport yielded by processing the data-sets measurements, the daily discharges of dislodged and suspended sediments in the Romanian Danube sector over 1840–2012 were obtained. Further computation yielded the multi-annual means and the annual maxima of dislodged and suspended sediment discharges at the metering sections downstream of the Iron Gate point.

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ENHANCEMENT OF HIGH RESOLUTION LAYERS PRODUCED UNDER GMES – LAND MONITORING

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Key-words: GMES – Land Monitoring, High Resolution Layers, Imperviousness, forest, grassland, wetland, water bodies.

Abstract. The land monitoring data derived from satellite images for the 2006–2012 period provide information on land-cover changes in Romania. Availability and the quality of these data can contribute to new approaches of landscape assessment, for instance, in the context of environmental policies, the diversity of land use (patchiness) and surface as well, can show land dynamics in different regions, having in view that land cover reflects the biophysical state of the real landscape. In this paper, we present the results of the enhancement activity where we put an extra-work load aiming to have a more detailed thematic map that is missing in this country. These enhancements of the High-Resolution Layers (HRLs) products were derived from the service provider's products and in-situ data sets with a lot of manual editing. The products obtained are specifically for local-use and are different from those produced as part of contract obligation to the European Environmental Agency (EEA). HRLs are welcome products as no such recent thematic layers are available in Romania: e.g. a first wetland map of Romania, updated maps of forest and water bodies. This HRLs of 20 × 20 m pixel resolution may be of use in the monitoring of Natura 2000 sites, WFD, modelling projects, spatial planning, etc. The purpose is to show the usual omissions or discrimination of the sites and misclassification of Corine Land Cover classes. The overall area of misidentified land-cover changes in Romania between 2006–2012 was around 1.3% of their total area.

1. INTRODUCTION

High Resolution Layers (HRL) provide information on specific land-cover characteristics, and are complementary to land-cover or land-use mapping, such as in the CORINE land cover (CLC) datasets (Büttner and Kosztra, 2011). Within the Land monitoring service of the Global Monitoring of Environment and Security (GMES) – Initial Operation (GIO) the production of the 5 High Resolution pan-European layers by service providers started in 2011 under the coordination of the EEA. The National Focal Points and National Reference Centres Land Cover in 39 European countries has contributed to implementing GIO Land tasks including verification and enhancement process for the production of the five High Resolution Layers: Imperviousness (degree of imperviousness), Forest areas (tree-cover density and forest type), Agricultural areas (permanent grassland), Wetlands (wetland inventory), and Water bodies (permanent water bodies) (Langanke, 2016). Production of the HRLs of Romania was granted to the Danube Delta National Institute for Research & Development as National Reference Centre for Land Cover in Romania. General overview of data quality was done by intersecting the best in-situ data, e.g. LPIS data, city maps, versus HRL. Look-and-feel verification was done by visual inspection of the areas with potential classification errors. The verification was done in selected strata by comparing the HRL with the existing reference data in order to derive one of the five qualitative classes (excellent, good, acceptable, insufficient, very poor). Qualitative verification was done by strata. The 5 HRLs were checked for omission and commission errors. The risk of bias in

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direct area estimation from classified images is particularly strong if the targeted classes occupy a small proportion of the geographic area (Gallego *et al.*, 2016). For example: beaches and bare soil erroneously mapped as imperviousness; young wheat fields and young tree plantations erroneously mapped as permanent grassland; and permanent water bodies missing due to shadow effects in mountainous areas. Riparian areas appear heavily diminished compared to their potential extent, with figures varying regionally. Major losses can be attributed in the first place to historical agricultural land take, followed by extension of urban land use (Weissteiner *et al.*, 2016). We present a land-cover change detection methodology in the framework of the GMES. The generated data of high resolution layers cover 39 European countries with a total area of about 5 million square kilometers, scale 1:100,000. This makes use of the revised data layer and the Landsat ETM satellite images from 2012 for generation of the CLC 2016 data layer. The observed changes data layer is generated by the overlay of the HRLs data layers, from different years, with the change area of minimum 5 ha. This approach may overestimate and underestimate identified land-cover changes in some specific situations described in the paper. The results can be widely used in land management, nature conservation and water management.

2. MATERIALS AND METHODS

A high-resolution dataset of five high resolution layers (HRL) of 5 main land cover types: 1) The high-resolution **imperviousness** dataset representing all artificially sealed areas produced using automatic derivation based on calibrated normalized difference vegetation index (NDVI) 5; 2) The **tree cover density** and **canopy type**; 3) Permanent grassland; 4) Wetlands and 5) permanent water bodies. The maps were produced by the service providers using the semi-automatic image classification of the year 2012, 20m × 20m pixel resolution and in national projection system, Pulkovo 1942(58) / Stereo70, EPSG 3844.

The verification of the data was made by the national team. The verification method (György Büttner, 2012) of the high-resolution data consists of three parts: (I) General overview of data quality, (II) Checking “error prone” locations in each HRL by means of look-and-feel control and (III) Applying an additional, statistically-based quantitative verification by using randomly selected samples to estimate commission and omission errors.

Verification was made on the intermediate products at full resolution (20m x 20m, in national projection).

In-situ data include the topographic map of Romania, scale 1:25,000 (Resource Locator: http://geoportal.ancpi.ro/geoportal/catalog/search/search.), Land Cover TOPRO5, scale 1:5,000, Object class "CATEREN", of polygon type includes agricultural and non-agricultural land, water bodies, and forest, vineyard, pasture, etc. (Resource Locator: http://geoportal.ancpi.ro/ geoportal/catalog/search/search.), Ortho-photo plans of Romania in 2006, (Resource Locator: http://mmediu.ro/new/?page_id=1175), Forest Inventory, Up-dated forest database, (Resource Locator: http://geoportal.ancpi.ro/geoportal/catalog/search/search.page), National grassland inventories, scale 1:50,000, Grassland-type map covering 650,000 ha (Resource Locator: http://ddni.ro/nardus/),DEM, (Resource Locator: http://geoportal.ancpi.ro/geoportal/catalog/ search/search.page), Hydrographical Map of Romania, scale 1:50,000, The Digital Map of rivers and catchment river basins (ID between 1 and 6 for permanent courses), including also natural and anthropic lakes in Romania (Resource Locator: http://www.inhga.ro/) City maps, (Resource Locator: http://geoportal.ancpi.ro/geoportal/catalog/search/search.page), LUCAS database and photos, (Resource Locator: http://www.insse.ro/cms/), Agricultural statistics (LPIS), (Resource Locator: http://geoportal.ancpi.ro/geoportal/catalog/search/search.page) National land-cover inventories, (Resource Locator: http://www.ddni.ro/index.php?page_id=404&siteSection=5&sectionTitle=International%20Projects).

For the enhancement task, the data content was improved on the basis of the findings of the verification task. All enhancements were done for the full resolution datasets (20 m x 20 m, in national projection). In-situ data were used to support the enhancement process. The methodology of enhancement was semi-automatic with lots of manual editing. Enhancement was done for all HRLs, excepting the grassland layer, as verification conclusion drive to an overall insufficient classification.

The verification methods used to guide the enhancement were: general overview of data quality, look-and-feel analysis and statistical verification. The methodology of enhancement was Semi-automatic with lots of manual editing. For the removal of commission errors, all-country omission errors have been checked.

3. RESULTS

3.1. Enhancement of Water bodies HRL

Regarding commission errors, **w**e have found 6,978 ha of Black Sea water classified as water bodies (ALL ROMANIAN Black Sea shore); 307 situations of building areas (greenhouses, industrial, urban areas) classified as water body; 32 commission errors for lakes in mining areas; 24,417 ha of temporary water-logged areas from the 2006 flood events, while for omission errors we found 89 from 307 omissions for high-altitude lakes (all lakes from the Făgăraş and Retezat mountains, Fig. 1) 33 from 1,300 omissions for small lowland lakes < 25 ha and > 0.16 ha; 8 from 280 omissions for lakes in mining areas; 11 from 280 omissions for lakes in recreation areas; 43 from 1,600 omissions for fishponds.

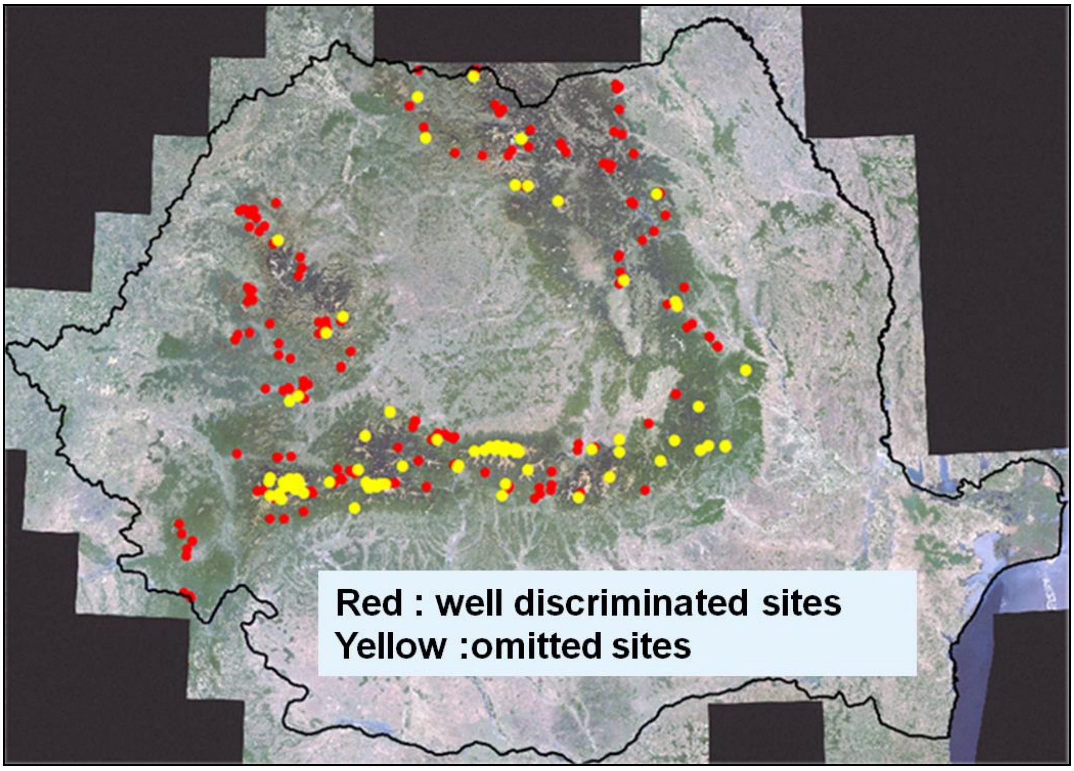

Fig. 1 – Water bodies ommision lake errors.

3.2. Enhancement of Wetlands HRL

In the analyses of commission errors for the enhancement of the wetland layer, we have found 6,631 commission errors for dry areas, such as forest, pastures, agriculture and 813 commission errors for dry areas, such as urban and industrial areas.

Regarding the removal of omission errors (Fig. 2) we found 2,824 omissions for wetlands associated to permanent water bodies and 854 omissions for wetlands with vegetation (macrophyte).

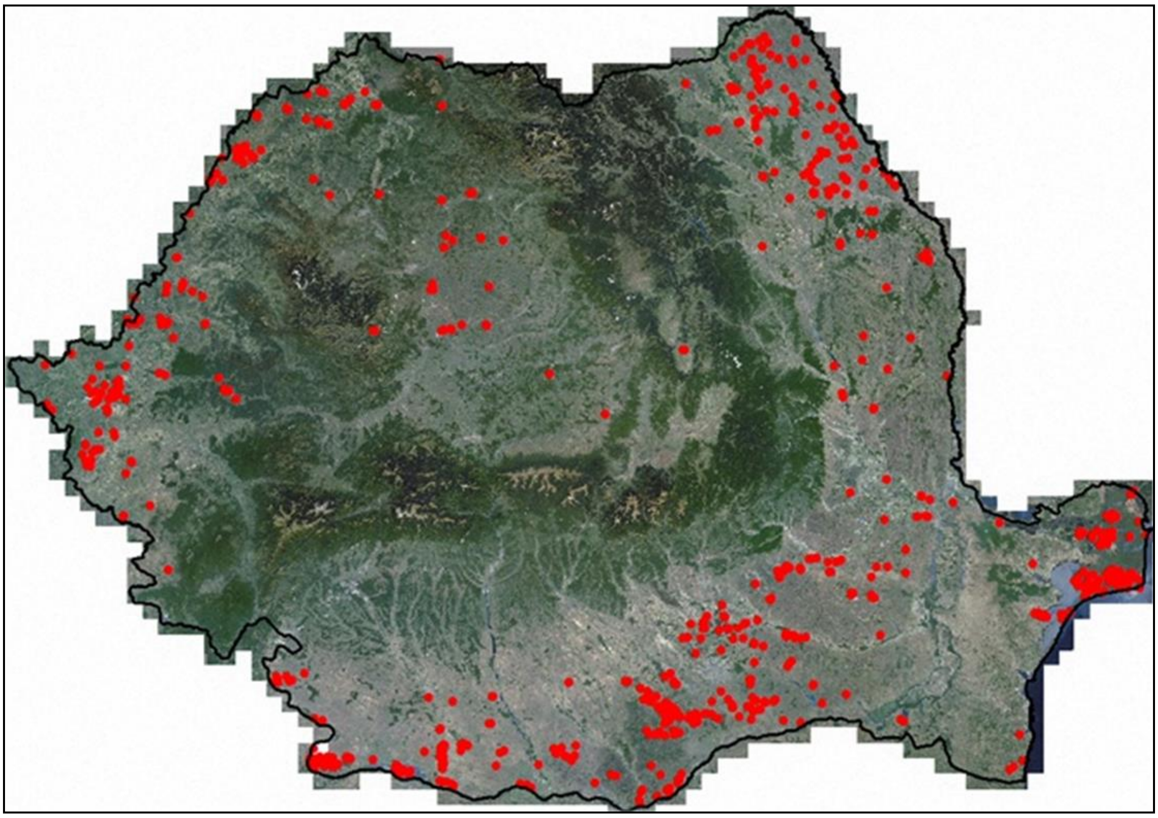

Fig. 2 – Wetlands ommision lake errors.

3.3. Enhancement Imperviousness Density

The results of the enhancement of the imperviousness density layer show that 1,497 commission polygons have been found counting a total area of 3,860 ha (Fig. 3). A description of the commission errors type is presented in Table 1.

Table 1

Misclassification of CLC classes as built up areas

CLC class	No. poly	S(ha)	%poly	%ha
511, 512	324	1,392.76	21.64%	36.08%
122	509	1,417.52	34.00%	36.72%
131, 132, 133	136	559.68	9.08%	14.50%
211	65	57.6	4.34%	1.49%
112, 121, 141, 142	267	215.52	17.84%	5.58%
322, 323, 332, 333	196	217.12	13.09%	5.62%

Regarding the removal of omission errors (Fig. 3), 4,294 omission polygons have been found summing an area of 3,495 ha. A description of the omission errors type is presented in Table 2.

Table 2

CLC classes as built up areas

CLC	**No. poly**	**S(ha)**	**%poly**	**%ha**
112	3,880	1,680.23	90.36%	48.08%
122 (railway stations)	14	235.49	0.33%	6.74%
122 (major roads)	400	1,578.82	9.32%	45.18%

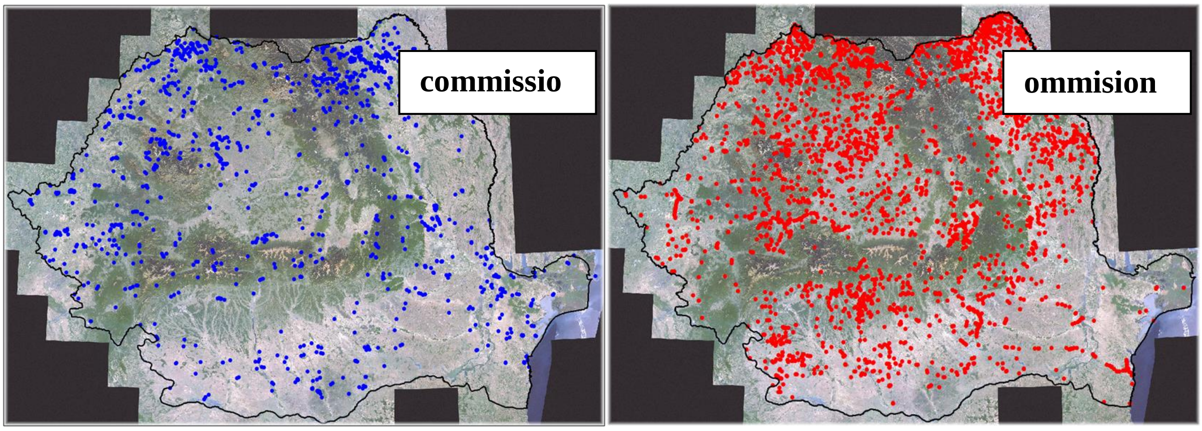

Fig. 3 – Imperviousness Density errors.

3.4. Enhancement forest DENSITY MAP

During enhancement of forest DENSITY MAP, 1,564 commission polygons have been found with an area of 27,145 ha. In the process of removal of omission errors (Fig. 4) 1,855 omission polygons have been found with an area of 4540 ha. Class C254 (meaning no data) has been replaced by real forest digitizing 715,111 ha in total (101 = 454,754 ha, 102 = 260,357 ha).

3.5. Enhancement of FOREST TYPE

During the removal of commission errors we found 17,671 ha of dwarf mountain pine shrubs, 322 class, classified as forest, Fig. 5). A total of 2,164 commission polygons have been found with an area of 26,183 ha (817 ha are from the additional intermediate layer). In the process of removal of omission we found 1,919 omission polygons, summing an area of 4,750 ha (19 polygons with 31 ha are from the additional intermediate layer). The class C254 has been replaced by real forest digitizing, 715,111 ha in total (101 = 454,754 ha, 102 = 260,357 ha.

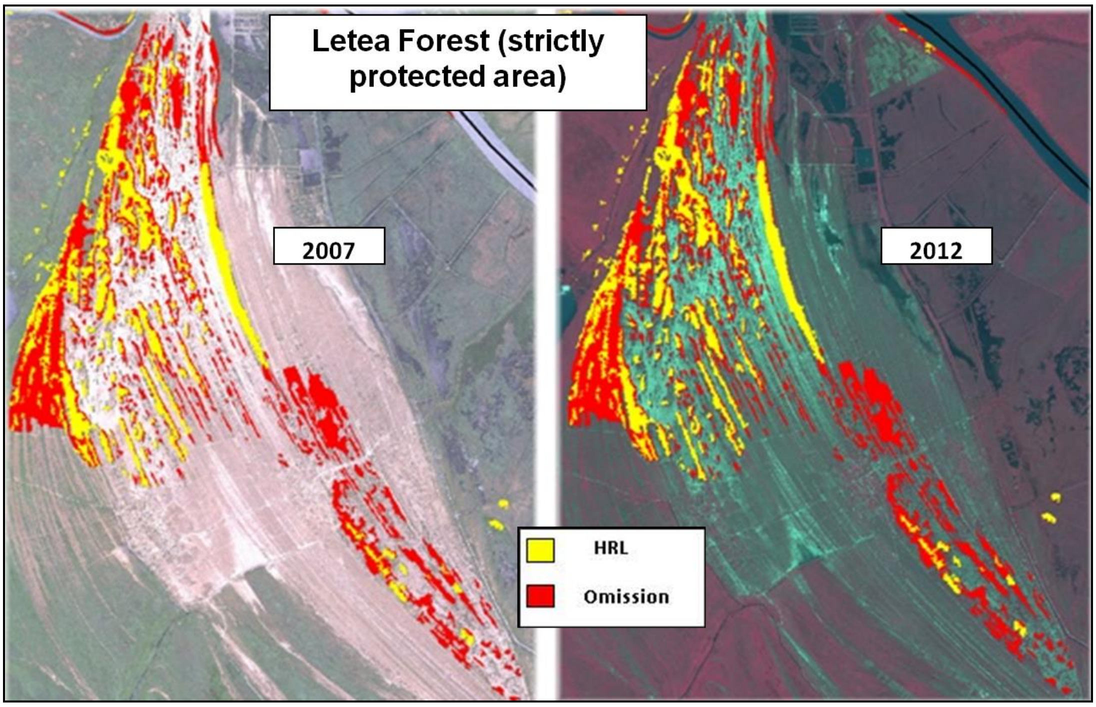

Fig. 4 – Forest density ommision errors.

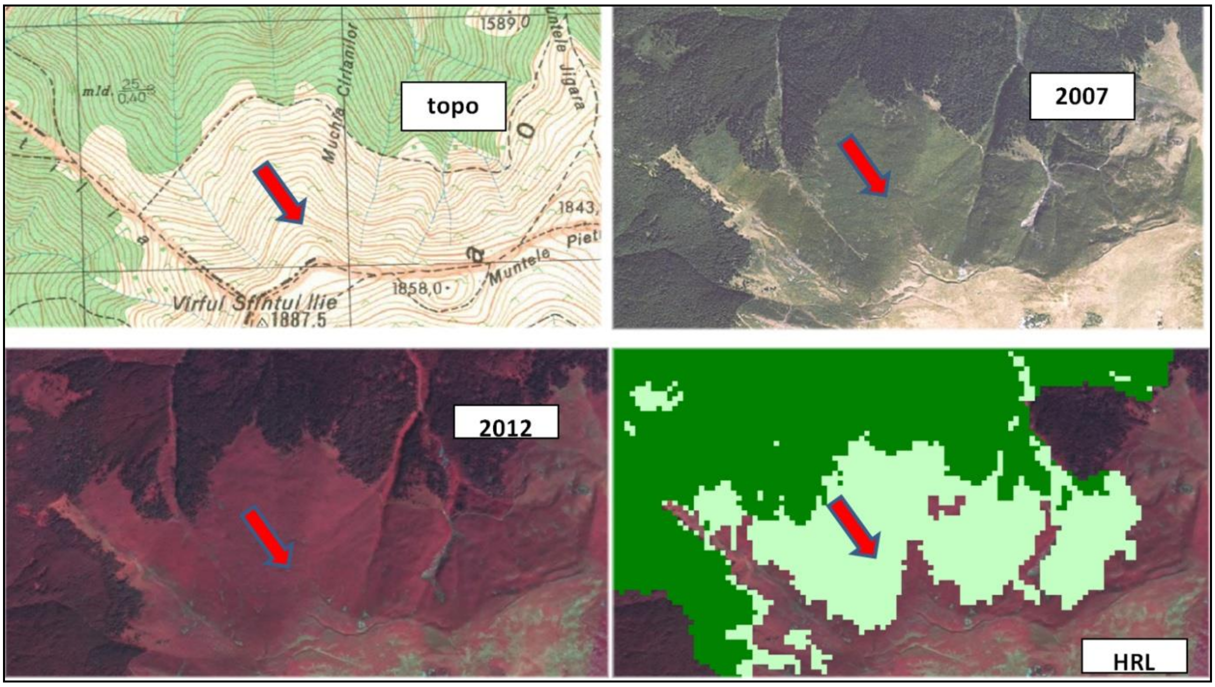

Fig. 5 – Forest commission errors.

4. CONCLUSIONS

Production of five high-resolution layers as artificial surfaces, forest areas, agricultural areas, wetlands and water bodies at pixel level and validated at 1 ha grid cell are of high interest for Romania since such integrated layers are not yet available for the country from other sources. Therefore, we have paid a special attention to and effort for enhancement of Copernicus HRLs in view of using them in potential future projects, e.g.: better delineation of Natura 2000 sites, grassland inventory, etc.

The most remarkable omissions/discriminations identified in Romania were observed in arable land (complex cultivation pattern), forests and wetland classes.

Acknowledgment This work is part of the project funded by The European Environment Agency (EEA) within the activity "GMES Initial Operations (GIO) Land Monitoring 2011–2013 in the framework of regulation (EU) No. 911/2010 – Pau-EU component", Grant Agreement no. 3541/B2012/RO-IO/ EEA.55011 and of the MARS project (Managing Aquatic ecosystems and water Resources under multiple Stress) funded under the 7th EU Framework Programme, Theme 6 (Environment including Climate Change), Contract No. 603378 (http://www.mars-project.eu)

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QUANTIFICATION DE L'EROSION HYDRIQUE SUR LES SOLS MARNEUX DES ALPES DE HAUTE PROVENCE (REGION DE LA MOTTE DU CAIRE), FRANCE

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Key-words: Quantification, erosion, marls, TCSP, Southern French Alps, Motte du Caire, ablation, deposition.

Hydric erosion quantification on the marly soils of the Southern French Alps (la Motte du Caire region). A study on marly soils erosion quantification as undertaken in the Motte du Caire region (Southern French Alps) to quantify erosion rates on different types of marl. Measurements of ablation and deposition rates were made using a dense network of stakes covering the study area. The mean annual ablation values calculated over a period of 3 years of study were: 3.04 cm / year on Oxfordian marl, 1.67 cm / year on Bathonian marl and 1.9 cm / year on Callovian marl. The Oxfordian marl are most affected by erosion phenomena. There is a positive correlation between erosion rates and vegetation cover. The 'TCSP' model developed in this study offers a considerable advantage in identifying areas of ablation or sedimentation in order to treat and reduce erosion rates.

1. INTRODUCTION

L'érosion des terres noires est un problème à la fois dynamique et endémique en montagne méditerranéenne et en particulier dans les Alpes françaises du sud. Les terrains marneux sont exposés à de graves problèmes d'érosion qui se manifestent sous forme de ravinement et de glissement de terrain. Pour lutter contre les méfaits de l'érosion, les hommes font appel à toute une panoplie de moyens anti-érosifs (reboisements, gabionnage). L'efficacité de ces moyens nécessite un suivi permanent et d'importants moyens financiers. Dans la plupart des cas, la mauvaise connaissance du fonctionnement de l'érosion peut être l'une des causes principales d'exaspération de l'érosion. Cependant il est primordial de bien analyser le processus d'érosion, par le biais des dispositifs expérimentaux; afin d'adopter des solutions adéquates à mettre au point.

L'estimation de l'érosion implique la manipulation d'une somme considérable d'informations pour décrire l'environnement du bassin versant et l'emploi de modèles mathématiques complexes pour simuler les processus hydrologiques et sédimentologiques en jeu. Le recours aux modèles informatiques d'érosion hydrique est alors de mise. Dans le présent travail nous exposerons les résultats de notre étude sur la quantification des taux d'érosion sur différents types de marnes du bassin versant du Saignon (Fig. 1) dans les Alpes de Haute Provence.

L'érosion actuelle des marnes noires dans les Alpes du Sud est de taille. L'érosion sur les marnes est réputée comme le plus important taux d'érosion mesuré (Delannoy et Rovéra, 1996). En dépit de ce taux, les déserts de marnes et de cailloux ne sont pas un climax abiotique en Haute – Provence (Vallauri, 1997). Ils constituent uniquement le niveau ultime de la perturbation «érosion», suite à une crise climatique forte et /ou à l'action humaine. La restauration de l'environnement en montagne demeure possible et demande réflexion, effort et persévérance afin d'imiter au mieux les processus naturels dans leurs dynamique.

Les phénomènes d'érosion sur les marnes noires constituent un enjeu pour la région sur le plan hydraulique et agricole. Selon le service départemental «RTM[1]» des Alpes de haute Provence, la commune de la Motte du Caire, illustre par ailleurs très bien dans son ensemble l'étendue des

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[1] Restauration des Terrains en Montagnes.

problèmes d'érosion. L'envasement de la retenue du Saignon à vocation hydro–agricole fournit une bonne illustration des dégâts occasionnés par l'érosion sur les marnes noires. Le volume initial de la retenue est de 120000 m^3, le bassin versant est d'une surface de 360 hectares, dont 144 hectares de terrains nu. La retenue s'est envasée en 18 ans, le barrage n'ayant pu être utilisé pour l'irrigation que 5 ans (1964 à 1669).

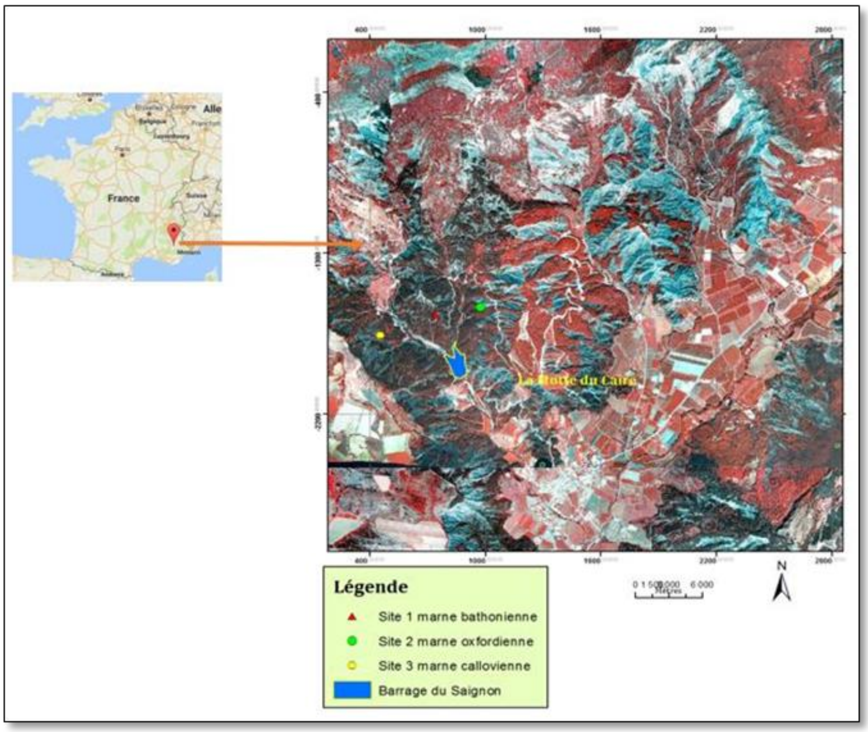

Fig. 1 – Localisation de la zone d'étude.

2. MÉTHODOLOGIE

1. Description de la zone d'étude

Une majeure partie de la Motte du Caire est constituée d'une couche épaisse de terres noires qui date du Jurassique (moyen et supérieur, Fig. 2). Ces terres noires sont consolidées par une couche calcaire tithonique qui date du Jurassique supérieur, on trouve aussi une couche de calcaires marneux appartenant au Crétacé inférieur. La région d'étude présente une succession de marnes noires épaisses de 1500 à 2000m. Ces marnes sont modérément feuilletées et assez tendres, dans la quasi – totalité des cas à patine brunâtre (Gidon *et al.*, 1991).

Les formations géologiques rencontrées dans la région d'étude se présentent comme suit:

Bathonien «moyen»: à l'Ouest de la Motte du Caire on rencontre des marnes à faciès de terres noires. Elles sont composées de fines plaquettes, l'épaisseur de ces dernières décroît vers le haut.

Bathonien supérieur: formé de plaquettes «médianes», de calcarénites rousses très bioturbées, caractérisées par l'abondance de petits bancs centimétriques. Leur épaisseur est de l'ordre de 50 à 150 m. Ils peuvent se dédoubler.

Bathonien – Callovien: cette formation est constituée de bancs de calcaire brun, d'une épaisseur décamétrique. Ils forment des bancs isolés épais de 0,2 à 0,5 m et espacés de 5 m environ. Ces bancs sont caractérisés par un calcaire brun à pâte fine et à patine jaune ocre. Ces bancs de calcaires reposent directement sur les plaquettes du Bathonien supérieur, à l'Ouest de la Motte du Caire et de la vallée de la Sasse.

Callovien inférieur: On rencontre à l'Est de la Motte du Caire et de la vallée du Sasse, la partie supérieure des plaquettes «médianes», formée de marnes qui présentent un aspect boursouflés, d'une épaisseur de 150 m.

Callovien inférieur-moyen: On constate à l'Est du transect, qui passe à l'Ouest de Melve, la Motte du Caire et la vallée du Sasse, le développement de bancs gris clair à dominance calcaire au sommet des plaquettes. Ces bancs ont une épaisseur de 10 à 30 cm espacés tous les 1 à 5 m dans les marnes.

Callovien moyen: cette formation se distingue par sa couleur brune ocre, sa richesse en plaquettes d'ordre centimétrique voire millimétrique. L'épaisseur de cette formation est de 100 m, ces plaquettes sont rares de manière progressive vers le haut comme le bas.

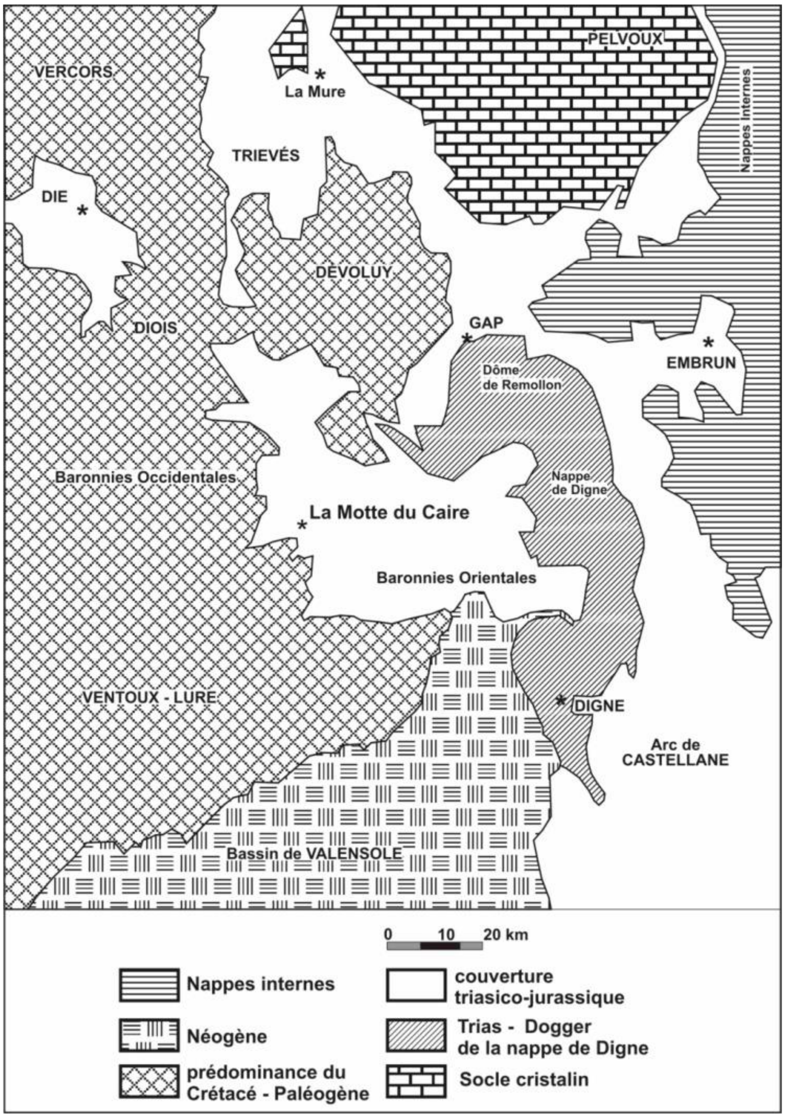

Fig. 2 – Schéma structural des Alpes externes méridionales, d'après Guidon *et al.* (1990).

Callovien supérieur: on distingue à l'Est de la Motte du Caire, des marnes feuilletées caractérisées par l'abondance de petits amas de miches grises. Cette formation à une épaisseur de 100m, elle est relativement pauvre en fossiles.

Oxfordien inférieur: on remarque que les marnes de cette formation sont de couleur grise sombre, un peu bleutées, elles contiennent un nombre important des miches décimétriques. Ces miches sont alignées en lits espacés de 0,5 à 2 m, vers le haut des plaquettes les miches deviennent graduellement importantes. Elles ont une couleur de brique d'où leur appellation «galettes rouge».

La région d'étude est dotée d'un climat subméditerranéen, caractérisé par la concentration des pluies à l'époque froide de l'année, la coïncidence de la sécheresse avec les mois chauds qui présentent des températures élevées et contrastées. Cette région est caractérisée par une pluviométrie annuelle moyenne de l'ordre de 714,3 mm et une température moyenne mensuelle maximale de 29,6°C du mois le plus chaud. La moyenne des températures du mois le plus froid est de – 4,2°C. L'hiver thermique dure pendant 4 à 5 mois où la moyenne des températures à 7°C. Nous avons noté que l'hiver dans cette région est caractérisé par une longue période de temps ensoleillé, sec et froid avec gel la nuit et dégel en journée, entrecoupée de courtes périodes de précipitation. Dans un hiver classique on compte de 70 à 100 cycles gel – dégel (Vallauri, 1997).

2. Végétation de la zone d'étude

Après plus d'un siècle de restauration des terrains en montagnes, les marnes noires du bassin du Saignon sont aujourd'hui en majorité recouvertes de forêts composées principalement du pin noir d'Autriche (*Pinus nigra*). Quelques roubines sont encore en activité. Les marnes nues et peu colonisées représentent 13,77% de la surface du vallon. 46% de sa surface est boisée, 32% en Pin noir et 14% en feuillus (chênaie et hêtraie). Le reste de la surface est composé de terrains non érodés (pelouses et landes). On constate que la pinède de pin noir a occupé la quasi-totalité du substrat marneux, les sols se sont développés en un temps assez court.

La végétation sur les adrets est constituées d'un cortège floristique varié: *Juniperus communis, Ononis spinosa, Thymus vulgaris, Aphyllanthes monspeliensis, Calamagrostis argentea.*

3. MATERIEL ET MÉTHODE

L'objectif de ce travail est de quantifier l'érosion des sols marneux, en utilisant les données les plus précises disponibles pour la région de la Motte du Caire et en s'appuyant sur les connaissances les plus récentes des différents processus impliqués dans les phénomènes d'érosion hydrique des sols. La quantification de l'érosion devrait à la fois rendre compte de l'intensité de l'aléa et des types érosifs correspondants, afin de faire ressortir les spécificités de la région. Enfin, une autre spécificité de ce travail réside dans la **différenciation saisonnière de l'aléa** qui permet de rendre compte de la réalité du régime climatique de la région.

Cette approche saisonnière permet en outre de prendre en considération les interactions entre facteurs climatiques et occupation des sols de manière beaucoup plus précise que dans une approche annuelle et donc de mieux prendre en compte les différents types d'aléas érosifs.

3.1. Dispositif expérimental: le dispositif de mesure micrométrique

La technique de mesure adoptée pour notre travail est celle utilisée par de nombreuses équipes de recherche (Lecompte *et al.*, 1998; Coubat, 1998; Lecompte *et al.*, 1997; Robert, 1997). Une estimation de la variation de la hauteur du piquet permet donc une mesure de l'ablation ou du dépôt. Parmi les avantages de cette technique, nous pouvons citer la précision des mesures avec la jauge micrométrique, la mesure étant de l’ordre du demi-millimètre. La taille fine des piquets perturbe moins les conditions du milieu. La tête du piquet sert comme base pour la jauge qui permet d’effectuer les mesures, la tête est considérée comme une surface de référence. Pour un meilleur suivi de l’évolution du paysage à l’échelle millimétrique quatre mesures sont réalisées pour chaque piquet suivant les quatre directions cardinales. À la fin une moyenne des quatre mesures est prise. Les transects de piquets sont installés en différentes situations données par le Tableau 1.

Tableau 1

Les caractéristiques des sites d’étude.

	Zones	**Taux de couverture végétale % (TC)**	**Pente % (S)**
Site 1 Marne bathonienne	Z1	25	20
	Z2	55	25
	Z3	30	20
	Z4	25	20
Site 2 Marne oxfordienne	Z1	25	30
	Z2	25	35
	Z3	35	30
	Z4	20	35
	Z5	25	15
	Z6	30	25
Site 3 Marne callovienne	Z1	15	45
	Z2	30	30
	Z3	35	20
	Z4	20	30
	Z5	60	25

4. RÉSULTATS ET DISCUSSION

4.1. Évolution de la vitesse d’ablation selon le type de marne

Les valeurs d’ablation moyenne annuelle calculées sur une période de 3 années d’étude sont les suivantes: 1,67 cm/an sur le Bathonien, 1,9 cm/an sur le Callovien et 3,04 cm/an sur l’Oxfordien. Il s’avère que le suivi des phénomènes d’ablation et de sédimentation est plus intéressant sur une période de 3 années, car les dispositifs expérimentaux nous ont permis de cerner le phénomène d’érosion sur les terrains marneux de la commune de la Motte du Caire. Les différents taux de couverture végétale et positions topographiques sont bien représentés grâce à l’implantation de réseaux de piquets sur les différents types de marnes. Il en résulte d’ailleurs une erreur – type moins importante sur ce substrat marneux.

4.1.1. Variation de la vitesse d’ablation et de sédimentation sur marne bathoniene

Le suivi régulier des taux d’ablation et de sédimentation a mis en lumière les nombreuses difficultés pour la quantification des taux d’érosion sur ce type de substrat. Les zones Z1, Z2 et Z3 (Fig. 3) présentent des taux d’ablation important ce phénomène peut s’expliquer par les quantités de sédiments déplacées par le ruissellement de l’amont de la roubine. Nos résultats concordent avec ceux de plusieurs auteurs (Corona *et al.*, 2011; Mathys *et al.*, 2003; Rovéra *et al.*, 1999). Les mécanismes d'érosion sont dominés par le dépôt des sédiments dans les zones Z1, Z2 et Z3. La zone Z4 présente des taux d'ablation importants sur une année, il est intéressant de souligner que la concentration du ruissellement dans cette zone a engendré l'apparition de nombreuses griffures et rigoles. Les zones Z1 et Z4 enregistrent des taux d'ablation importants, ces derniers sont en nette augmentation. Nous enregistrons des valeurs moyennes annuelles d'ablation de 1,67 cm et 0,43 cm respectivement pour les zones Z1 et Z4. Nous notons que les mécanismes de sédimentation sont dominants dans les zones Z2 et Z3, ces mécanismes s'expliquent par l'importance du taux de couverture végétale et la position topographique (Gärtner, 2007).

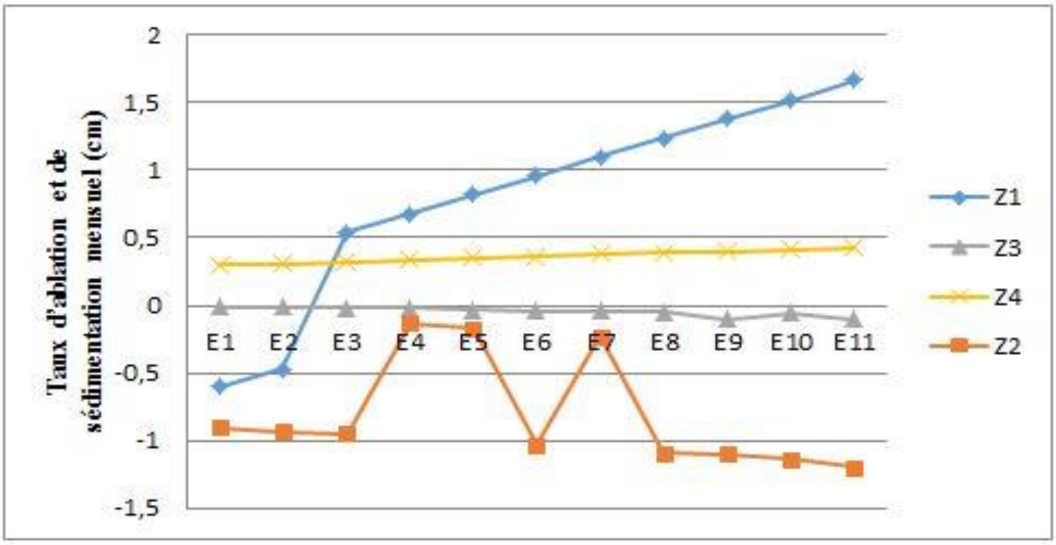

Fig. 3 – Variation de la vitesse d'ablation et de sédimentation mensuelle sur marne bathonienne.

4.1.2. Variation de la vitesse d'ablation et de sédimentation sur marne oxfordienne

Site équipé de 80 piquets pour mieux représenter les différents taux de couverture végétale et positions topographiques (Tableau 1). Les zones (Z1, Z2 et Z3) expriment des taux de sédimentation important, ceci s'explique par l'importance du couvert végétal qui joue un rôle énorme dans le piégeage des sédiments (Lecompte *et al.*, 1998) Au cours de notre étude, nous avons augmenté le nombre de piquets pour affiner les résultats de la campagne de mesure et aussi mettre en exergue le rôle de la strate herbacée comme de lutte anti – érosive.

Les zones Z4 et Z5 enregistrent des taux forts d'ablation, il est évident que les taux de couverture végétale et les positions topographique (pente) en sont responsables. Nous enregistrons la valeur de 5,3 cm pour la zone 4 caractérisée par un taux de couverture de 20% et une pente de 45%. Les zones Z1, Z2 et Z3 (Fig. 4) enregistrent des taux d'ablation important, cette tendance résulte du fait que la couche superficielle de la marne commence à se désagréger sous l'effet des facteurs climatiques tels que le gel –dégel et les précipitations (Coubat., 1998). Pour la zone Z6 dont le couvert végétal est constitué d'une strate herbacée *(Ononis spinos, Aphyllanthes monspeliensis*) la sédimentation est prédominante comme processus d'érosion. Sur 9 mois, la zone Z6 a enregistré 0,6 cm comme taux de sédimentation. La strate herbacée dissipe l'énergie des eaux de ruissellement et stabilise les sédiments transportés de l'amont de la roubine (Lecompte *et al.*, 1998; Lhenaff *et al.*, 1993).

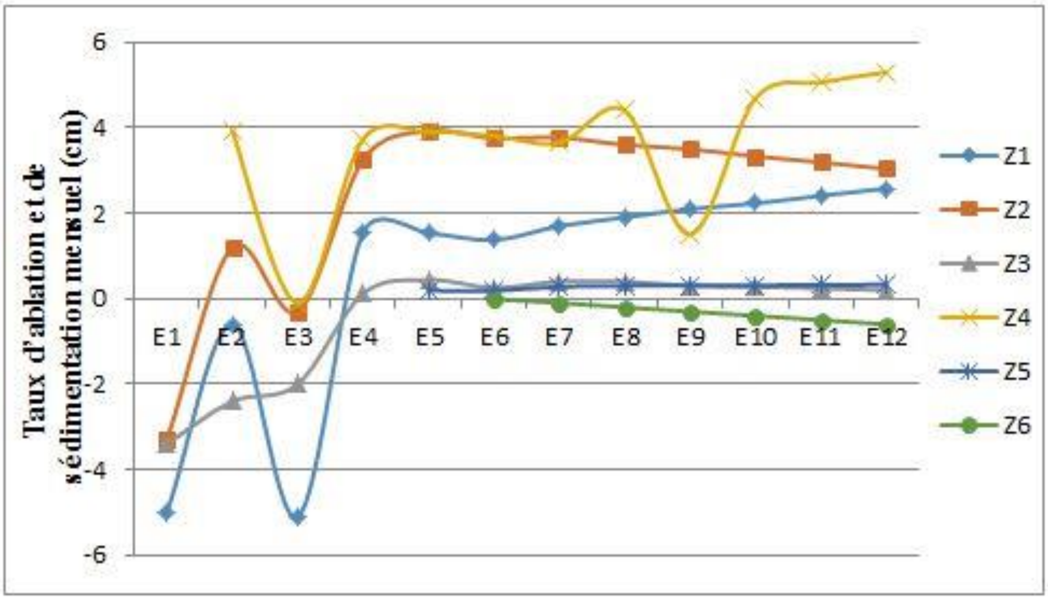

Fig. 4 – Variation de la vitesse d'ablation et de sédimentation mensuelle sur marne oxfordienne.

4.1.3. Variation de la vitesse d'ablation et de sédimentation sur marne callovienne

Les zones Z1, Z2, Z3 et Z4 enregistrent des taux d'ablation en augmentation. Une autre zone (Z5) a été équipée pour prendre en compte les différents taux de couverture végétale et positions topographiques. Pour les zones Z1, Z2, Z3 et Z4 les mécanismes d'ablation sont dominants (Fig. 5). Le taux d'ablation moyenne annuelle enregistré est de 1 cm/an. Les sédiments des zones pourvoyeuses de particules sont piégés par la strate herbacée de la zone (Z5) nous enregistrons un taux de sédimentation égale à (–3,8 cm/an).

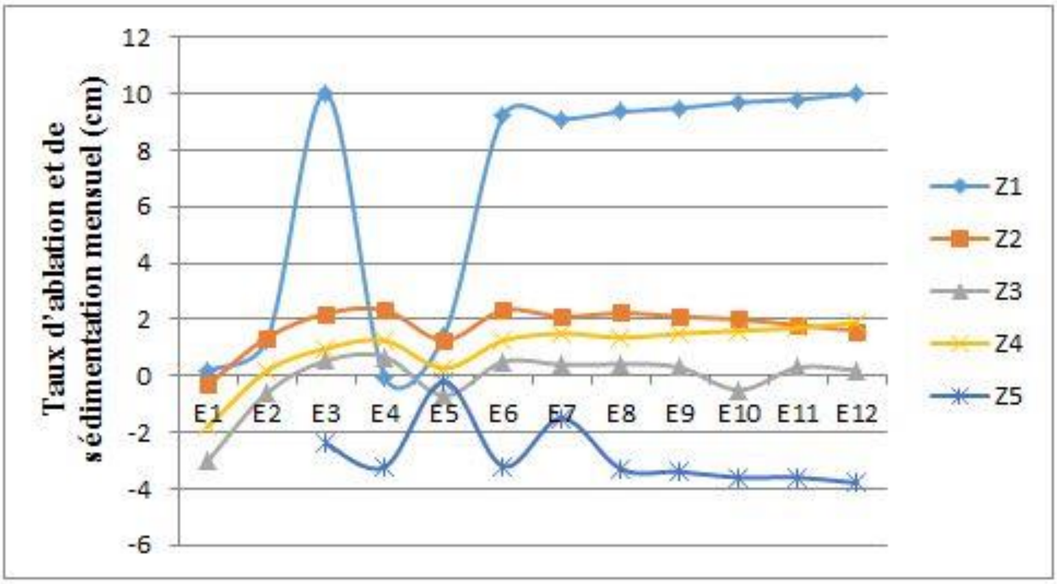

Fig. 5 – Variation de la vitesse d'ablation et de sédimentation sur marne callovienne.

4.2. Corrélation entre taux d'ablation – sédimentation et pluviométrie moyenne mensuelle

Les diverses formes d'écoulement engendrées par les précipitations jouent un rôle important dans l'ablation des marnes dans la commune de la Motte du Caire. Il est important de constater que toutes les intensités enregistrées sur une année sont susceptibles de déclencher une ablation et ou un dépôt fort et généralisé. Nos résultats rejoignent ceux de (Chodzko et Lecompte, 1992), ils notent qu'une averse de 250 mm/h durant 10mn) peut provoquer l'incision généralisée des roubines, avec l'apparition de nombreuses rigoles. Les coefficients de corrélation sont positivement significatifs (Tableaux 3, 4 et 5).

Tableau 2

Coefficient de corrélation entre taux d'ablation – sédimentation et pluviométrie moyenne mensuelle site 1.

Site1/zones	R^2 Pluviométrie- Ablation/sédimentation
Z1	0,82
Z2	0,34
Z3	0,79
Z4	0,82

Tableau 3

Coefficient de corrélation entre taux d'ablation – sédimentation et pluviométrie moyenne mensuelle site 2.

Site2/zone	R^2 Pluviométrie- Ablation/sédimentation
Z1	0,76
Z2	0,69
Z3	0,78
Z4	0,39
Z5	0,8
Z6	0,79

Tableau 4

Coefficient de corrélation entre taux d'ablation – sédimentation et pluviométrie moyenne mensuelle site 3

Site3/zone	R^2 Pluviométrie- Ab/sédimentation
Z1	0,88
Z2	0,51
Z3	0,55
Z4	0,77
Z5	0,48

Tableau 5
Coefficient de corrélation entre ablation/sédimentation, couverture végétale et pente.

Eléments de corrélation	R^2
Ablation/sédimentation vs Couverture végétale	0,67
Ablation/ sédimentation vs pente	0,75

Il est important de souligner que les intensités enregistrées par la station météorologique de la commune de la Motte du Caire sont fortement supérieures à celles citées par de nombreux auteurs. Des intensités de 5 mm/h sur sol sec et 1,7 mm/h sur sol humide peuvent déclencher un ruissellement sur les terres noires (Bufalo, 1989). Certains seuils expérimentaux sont fixés par des études (Brochot et Meunier, 1993), 12 mm sur sol sec et 5mm sur sol humide. La réponse du sol à la pluie dépend de sa teneur en eau en d'autre terme son état hydrique initial. L'état hydrique du sol, intervient dans la résistance contre l'érosion hydrique.

L'apparition du ruissellement dépend en grande partie de la teneur du sol (Collinet et Valentin, 1985; Casenave, 1989; Le Bissonnais et Le Souder, 1995). La réponse du sol à la pluie est en étroite relation avec l'humidité de la couche superficielle (Roose, 1996). Selon (Langdale *et al.*, 1975), la teneur du sol en eau réduit la dispersion des agrégats et la formation d'une croûte de battance.

Les travaux de certains auteurs ont mis en lumière l'importance de l'état hydrique initial du sol dans la résistance au ravinement et à l'incision, (Guerif, 1990; Guerine, 1998) ont mis en évidence le rôle principal de la cohésion du sol, cette dernière dépendante des caractéristiques texturales et de l'état hydrique du sol. En climat tempéré une pluie tombant sur un sol sec favorise davantage l'encroûtement superficiel et l'érosion, qu'une pluie survenant en hiver sur un sol humide (Bajracharya et Lal, 1992).

4.3. Relation entre ablation/sédimentation, couverture végétale et la pente

Les différents tests et analyses mettent en exergue les interactions existantes entre les taux d'ablation – sédimentation, la couverture végétale et la pente. L'analyse de la Figure 6 révèle des résultats intéressants: l'augmentation du couvert végétal engendre une diminution de l'érosion des marnes. L'érosion et le ruissellement sont toujours négligeables sous couvert dense, la forêt avec sa frondaison dispersée sur plusieurs étages, couvre le sol et le protège contre l'énergie des gouttes de pluie.

Parmi les facteurs qui conditionnent l'érosion, le couvert végétal est certainement le facteur le plus important puisque l'érosion passe de 1 à 1000 tonnes lorsque toutes les choses étant égales par ailleurs, le couvert végétal d'une parcelle diminue de 100% à 0% (Roose, 1994). Les résultats (Tableau 4) qu'on a obtenus de la corrélation «taux d'ablation – sédimentation et couvert végétal», présentent un coefficient de corrélation de 0,67. L'équation de la régression est de type logarithmique ceci explique l'influence de la végétation dans la diminution des taux d'érosion. Plusieurs auteurs indiquent le rôle indispensable du couvert végétal dans la lutte anti – érosive, ce rôle ne se restreint pas à la protection du sol des gouttes de pluie mais il intervient aussi dans le maintien de l'humidité du sol qui conditionne son comportement vis à vis du ruissellement (Fransen *et al.*, 2001; Weltz *et al.*, 1987; Laflen *et al.*, 1985; Mutchler *et al.*, 1982).

Nous constatons (Fig. 6) que les mécanismes d'ablation interviennent quand l'inclinaison de la pente dépasse le seuil de 20%. Au-dessous d'une inclinaison de 25% on assiste à des mécanismes de sédimentation. Les mécanismes d'ablation sont dominants quand la pente est supérieure à 25% (Foster *et al.*, 2000). Les résultats obtenus des corrélations entre taux d'ablation/sédimentation et pente présentent un R^2 positivement significatif égal à 0.75 (Tableau 5).

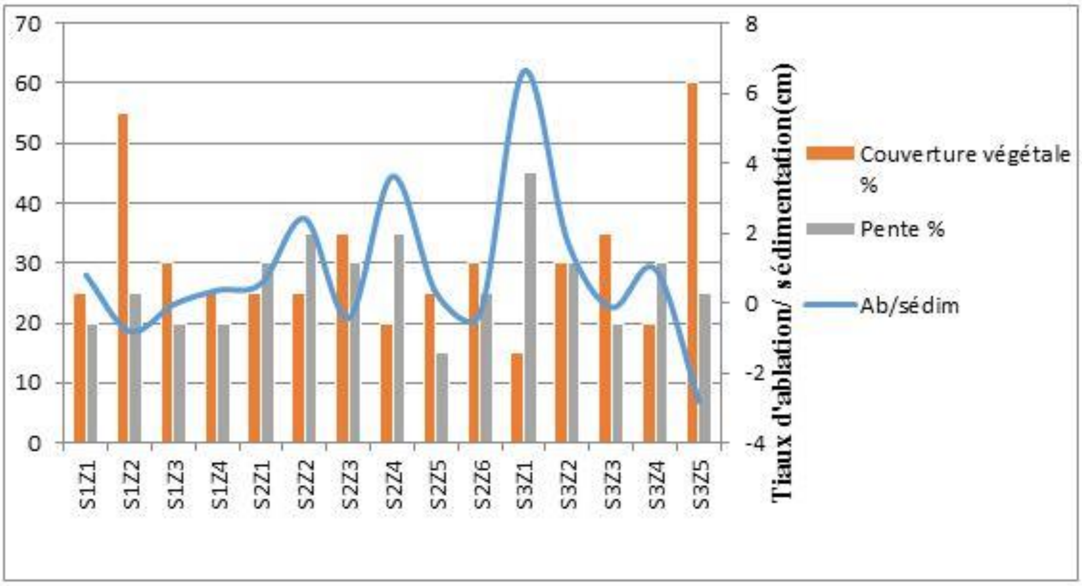

Fig. 6 – Relation entre ablation/sédimentation, couverture végétale et la pente.

4.4. Elaboration d'un modèle explicatif du phénomène d'érosion sur terrain marneux

Parmi les objectifs de cette étude est la compréhension des phénomènes d'érosion sur les terres noires (marne), et leur corrélation avec différents facteurs (pente, taux de couverture végétale et pluviométrie). L'élaboration d'un modèle d'érosion est l'aboutissement de 3 années de mesures dans la région de la Motte du Caire (Alpes du sud). La conception d'un modèle d'érosion constitue une étape importante dans l'aménagement du territoire et un outil d'aide à la décision. Le modèle «TCSP» développé au cours de cette étude est basé sur le traitement des taux d'ablation – sédimentation collectés des trois sites.

Cependant, pour les objectifs de notre étude, les taux d'ablation, de sédimentation moyens mensuels, les taux de couverture végétale, les classes de pentes et les moyennes mensuelles de pluviométries enregistrées sur le terrain au cours de 3 années ont fait l'objet d'un traitement sous le logiciel 'MATHLAB'. Nous avons élaboré un modèle qui explique le phénomène d'érosion sur les terrains marneux de la localité de la Motte du Caire. Le modèle en question, offre une idée précise sur le phénomène d'érosion, tout en identifiant s'il s'agit de processus d'ablation ou bien de sédimentation.

$$E = -10.3176\ TC + 4.5963\ S - 0.0293\ P + 4.0089$$

A savoir:
E: érosion [avec E (+) ablation / E (–) sédimentation]
S: pente
P: pluviométrie
4.0089: constante

5. CONCLUSION

Le présent article propose une nouvelle méthode permettant de réfléchir sur la manière de cibler les zones problématiques (ablation / sédimentation) sur les terrains marneux de la commune de la Motte du Caire. Nous avons adopté une nouvelle approche, qui considère les processus d'érosion comme étant le résultat d'une interaction de plusieurs facteurs du milieu (type de marne, topographie, pluviométrie et taux de couverture végétale) et dont la distribution spatiale est le fruit d'une organisation dans l'espace et le temps.

D'après les résultats obtenus au cours de cette étude, il ressort que les valeurs d'ablation moyenne annuelle calculées sur une période de 3 années sont les suivantes: 1,67 cm/an sur le Bathonien, 1,9 cm/an sur le Callovien et 3,04 cm/an sur l'Oxfordien. Il s'avère que le suivi des phénomènes d'ablation et de sédimentation est plus intéressant sur une période de 3 années. Ainsi, les marnes de l'Oxfordien sont les plus touchées par le phénomène d'érosion. Ces résultats expliquent l'envasement du barrage du Saignon dans un laps de temps très court (5 ans).

Parmi les objectifs de notre étude est d'élaborer un modèle de quantification d'érosion. Le modèle 'TCSP' développé au cours du présent travail est le fruit du traitement des données (moyennes mensuelles d'ablation / sédimentation en incluant celles des taux de couverture végétale, de pluviométrie et des classes de pentes) collectées sur le terrain durant 3 années. Le modèle 'TCSP' offre la possibilité d'identifier les zones problématiques pourvoyeuses de sédiments dans le but de les traiter ainsi réduire les taux d'érosion.

Lors de notre étude, nous avons observé que la présence d'une strate herbacée était capable de réduire les taux d'érosion en piégeant les sédiments provenant des zones en amont. Les corrélations entre taux d'ablation – sédimentation et taux de couverture végétale sont positivement significatifs.

Les phénomènes de ruissellement et d'érosion touchant les terres noires de la commune de la Motte du Caire ne peuvent pas être correctement analysés sans intégrer les effets du couvert végétal, de la pente et de la pluviométrie sur la genèse et la circulation du ruissellement. La complexité des phénomènes étudiés impose aussi un recours à la modélisation pour estimer l'efficacité des aménagements et pour trouver les mesures adaptées à chaque situation.

La prise en compte du taux de couverture végétale et de la pluviométrie a permis de distribuer spatialement les paramètres contrôlant les mécanismes d'ablation – sédimentation ainsi que les facteurs à l'origine des processus de détachement et de transport des particules solides. Par ailleurs, l'intégration des différents facteurs tels que le taux de couverture végétale et des classes de pentes a contribué à une nette amélioration des résultats de quantification par rapport à celles effectuées en n'intégrant que la topographie comme paramètre orientant la circulation du ruissellement.

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LES GEOSITES A KESRA (DORSALE TUNISIENNE). DIVERSITE DES PAYSAGES, PATRIMONIALISATION ET DEVELOPPEMENT TERRITORIAL LOCAL

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Key-words: Kesra shelf, landscapes, natural heritage, geo-sites, patrimonialization, rural tourism.

Kesra's geosites (Tunisian Dorsale). Diversity of landscapes, heritage and local territorial development. Kesra and its borders, situated in the Tunisian Dorsal, represent a very rich patrimonial basin where diversified natural resources, the result of a long environmental evolution, and original historical monuments reveal the ancient human presence in this Mediterranean region of Tunisia. This work attempts first to reveal the value and the wealth of that area by characterizing and classifying various geosites of geo-tourist interest based on pre-established criteria. Secondly, this research makes a new approach to the heritage listing in this very specific domain in order to promote rural tourism (especially in the mountains), and to integrate various geosites into a new geo-tourist circuit that contributes to the development of that inner part of Tunisia.

1. INTRODUCTION

Le Nord-Ouest de la Tunisie constitue un bassin patrimonial très riche où se mêlent des vestiges historiques datant de différentes périodes de l'histoire tunisienne et méditerranéenne et des monuments naturels (ou géosites) divers et remarquables.

Dans ce paysage, le plateau de Kesra (ou "*Alhmada*") dans la Dorsale constitue le témoin le plus éloquent de la diversité de cet héritage culturel et naturel. A côté de multiples traces d'occupation humaine ancienne, cette région recèle des géosites de haute valeur qui s'observent aussi bien dans les paysages morphologiques que dans la végétation spontanée et cultivée (reliefs ruiniformes, modelés karstiques divers, terrasses à tufs (ou travertins), sources d'eau, nombreuses espèces et peuplements végétaux rares, endémiques et remarquables, hydro-systèmes et pratiques agricoles ancestraux).

Ce potentiel patrimonial à la fois riche et varié mais insuffisamment valorisé, mérite d'être mieux connu et plus étudié, non seulement au vu de sa valeur scientifique et culturelle, mais aussi comme ressource précieuse pour le développement économique, à un moment où les territoires sont appelés à mobiliser leurs ressources pour un développement autocentré et harmonieux.

Après la présentation du cadre géographique de la région d'étude, ce travail essaye dans un premier volet d'envisager un inventaire exhaustif et une caractérisation des géosites dans le plateau de Kesra. Ces divers monuments sont certes des ressources symboliques étroitement liées à la question de la mémoire et de l'identité de la région, mais pourraient également être considérés comme une ressource économique inépuisable. En effet, l'exploitation et la mise en valeur de ces différentes potentialités sont susceptibles de soutenir efficacement le développement de la région de Kesra à travers des activités économiques, muséologiques, scientifiques et autres. Une telle revalorisation pourrait être l'objet d'un processus de patrimonialisation qui devrait conduire à un développement local, durable et intégré de cet espace revalorisé. L'examen des processus de patrimonialisation de ces divers géosites et la conception d'un circuit géo-touristique qui relie et met en valeur ces différents monuments, dans un second volet, pourraient participer à la promotion du tourisme rural (ou d'alternance) dans cette région intérieure peu développée.

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2. TERRAIN D'ÉTUDE, SOURCES DES DONNÉES ET APPROCHE MÉTHODOLOGIQUE

2.1. Un secteur montagneux au cœur de la Dorsale précocement humanisé

La région d'étude correspond au plateau de Kesra et à ses abords situés au cœur de la Dorsale tunisienne (Fig. 1).

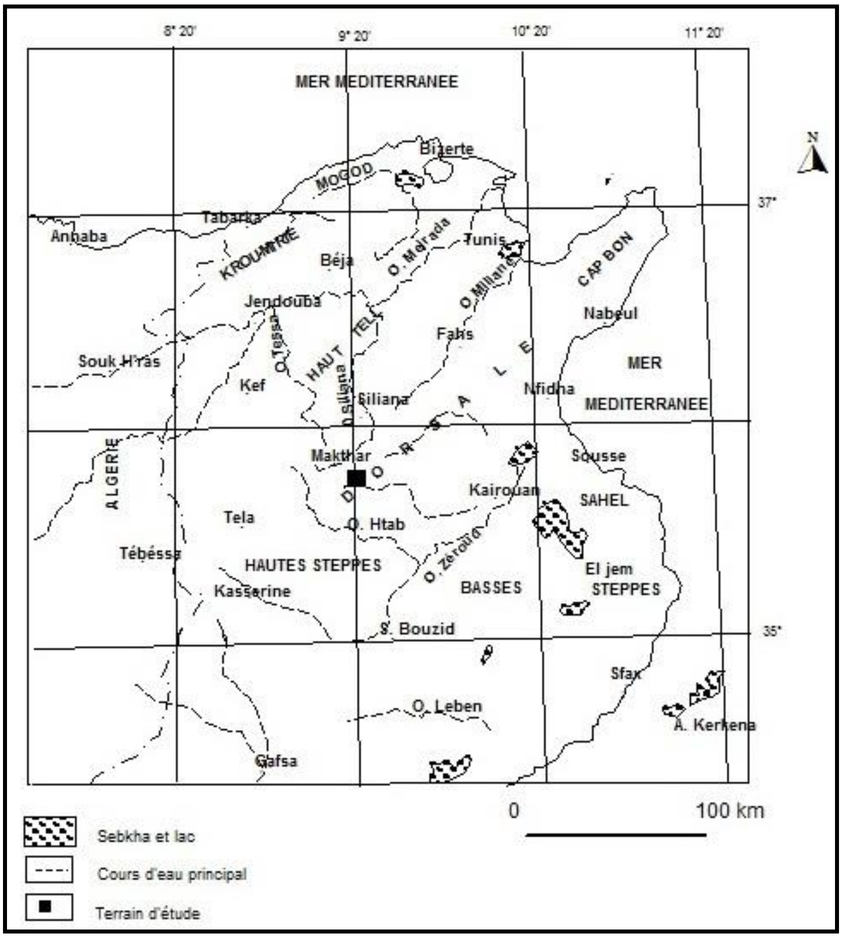

Fig. 1 – Localisation de la région de Kesra.

Comme nous l'avons déjà mentionné, nous avons choisi ce terrain d'investigation pour la diversité de ses paysages et pour la richesse de son patrimoine géo-scientifique. En effet, Kesra et ses abords se situent dans une zone charnière entre la région tellienne au Nord et le vaste domaine steppique au Sud.

Du point de vue climatique, la région d'étude est intéressée par des influences climatiques multiples (méditerranéenne, saharienne). Elle est sous une ambiance bioclimatique générale semi-aride supérieure à hiver froid, avec 13.8°C de température moyenne annuelle et une pluviométrie moyenne annuelle de l'ordre de 450 mm, mais son caractère montagneux est souvent à l'origine des variations locales sensibles dans la répartition de principaux paramètres climatiques. L'opposition est surtout nette entre les versants sud et nord d'une part et les bas et les hauts des versants d'autre part. Par conséquent, la variabilité thermique et hydrique à l'échelle spatio-temporelle accentue la rudesse du climat de Kesra.

Malgré une altitude modeste (1179 m), la région de Kesra possède un relief montagneux aux pentes accidentées et aux crêtes escarpées qui dominent de plusieurs centaines de mètres les plaines environnantes de Siliana (au Nord) et Oueslatia (au Sud) (Fig. 2). Deux grands ensembles d'unités morpho-structurales peuvent être soulevées (Gammar, A. M., 1979):

– Le grand relief calcaire constitué par le plateau de Kesra ou «le Dyr» qui correspond à un synclinal perché ou un simple replat structural (Jauzein, A., 1967; Gammar, A.M., 1979; Jendoubi, S., 2000). Il s'étend sur environ 25 km² sous la forme d'un quadrilatère taillé dans des calcaires francs très résistants et des marnes d'âge éocène inférieur.

– Les versants à dominance marneuse occupent de vastes superficies autour du plateau de Kesra. Ils forment un complexe marneux épais datant du Crétacé moyen et supérieur. Ces versants sont déchiquetés par un réseau dense de vallées de formes et de tailles extrêmement variables.

Par endroits, particulièrement sous la paroi rocheuse du plateau, jaillissent des sources d'eau d'excellente qualité et dont le débit diffère beaucoup selon les saisons.

Dans les détails, la région d'étude présente une diversité des formes topographiques résultant d'un héritage géomorphologique très riche et d'une dynamique actuelle très active.

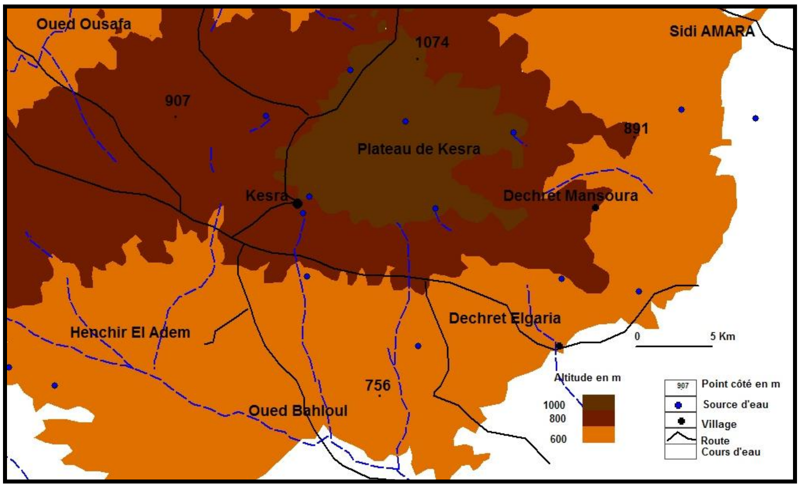

Fig. 2 – Hypsométrie de la région de Kesra.

La couverture végétale actuelle de Kesra est une mosaïque d'unités végétales composées des groupes floristiques d'affinités écologiques différentes imbriqués dans le paysage de la région. Les formations les plus évoluées forment soit une pinède à pin d'Alep, localement riche en genévrier rouge, oléastre, lentisque et genévrier oxycèdre, sur les moyennes et les basses altitudes, soit une pinède mixte à pin d'Alep et de chêne vert, localement riche en *Pistacia terebenthus* et *Celtis australis* sur les hauts versants du plateau de Kesra. Leurs dégradations sous l'effet d'une forte pression humaine passée et actuelle, du décapage continu des sols et surtout des incendies ont donné naissance à une multitude des peuplements jeunes de type garrigues (garrigues à chêne vert, pin d'Alep, romarin, dys, genêt d'Espagne, thym, bruyère multiflore, genêt épineux, cistes). L'extrême détérioration des conditions locales du milieu et la mise en culture des terres ont favorisé l'extension des formations herbeuses de substitution (ermes et pelouses) et l'infiltration d'un lot d'espèces steppiques (alfa, sparte, *Erinacea anthyllis*, *Diplotaxis harra*).

Par ailleurs, la flore de Kesra est très riche en espèces rares, endémiques et remarquables pour la biodiversité, notamment aux niveaux des escarpements rocheux, des points d'eau et des éboulis des pentes.

L'occupation du sol est très ancienne à Kesra comme en témoigne la présence des vestiges préhistoriques sous forme des structures funéraires (dolmens, peintures rupestres).

Malgré les changements socio-démographiques et des formes d'implantations humaines qu'avaient connues la région surtout depuis les années 1970, Kesra et ses abords ont gardé un caractère rural traditionnel. En effet, l'agriculture demeure la principale activité dans la région. Elle est basée sur l'élevage extensif, la céréaliculture de faible rendement pratiquée dans les hautes terres de «*Alhmada*» et l'arboriculture fruitière dans le cadre de petites exploitations à systèmes fortement intensifiés sur les versants.

Enfin, l'isolement des paysans, le sous développement socio-économique et la faible intégration de cet espace montagneux dans le tissu et les échanges économiques du pays sont à l'origine d'une forte pression sur les ressources naturelles de la région d'étude (végétation, sol, eau).

2.2. Données utilisées

La réalisation de ce travail a nécessité le recours à deux sources de données.

2.2.1. La consultation d'une bibliographie variée

Kesra et ses abords ont fait l'objet de plusieurs recherches qui ont touché des disciplines variées: Histoire, Géographie, Botanique, Géologie. Nous citons surtout les travaux de Monchicourt, Ch. 1913; Jauzein, A., 1959; Gammar, A.M., 1979 et 1984; Jendoubi, S., 2000; Karray, M.R., 2010; Poitteier-Alapetite, G., 1955).

L'analyse de diverses données bibliographiques permet de cerner la richesse des composantes matérielles et immatérielles des milieux et des paysages dans la région de Kesra.

2.2.2. L'investigation de terrain

Trois campagnes de terrain ont été réalisées entre août 2014 et novembre 2015 dans l'ensemble de la région d'étude qui visaient l'observation et la caractérisation des unités des paysages, des milieux et de l'occupation des sols. En outre, une enquête socio-économique exhaustive a été menée auprès des agriculteurs-producteurs de figues dans les différents vergers de Kesra, afin de mettre en valeur les caractéristiques essentielles de cette activité cette activité qui marque la région.

2.3. Méthodologie développée dans l'inventaire, la caractérisation et la classification des géosite

2.3.1. Le géosite: quelles définitions pour quel objet?

La notion de «géosite» couramment employée depuis quelques décennies surtout par les géologues et les géomorphologues dans une approche appliquée de patrimonialisation, a fait l'objet de plusieurs concepts (Suominen, V., 1999; Panizza, M., 2001; Ralong, J.P., 2005; Reynard, E., 2005; Comănescu, L, Nedelea, A., 2010), géosite, géotope, monument naturel, géomorphosite, site géologique… qui présentent des définitions complexes et sujettes parfois à controverses.

Pratiquement, deux grandes écoles en matière de terminologie peuvent être soulignées: l'école allemande qui adopte le concept de «géotope» et l'école scandinave qui emploi le terme de «géosite».

En Afrique du nord, ce sont surtout les marocains qui ont beaucoup travaillé sur cette question (Akasbi et al., 2001; Rachidi, A., 2002; Malaki, A., 2004 et 2006). En Tunisie, les recherches académiques sur les géosites sont extrêmement rares (Gasmi, N., Dassy, K. et Talbi, M., 2000).

Selon Barca et Di Gregorio (1991) les monuments géologiques et géomorphologiques sont «ces éléments du paysage ayant une spécification particulière, correspondant à des caractéristiques significatives de type génétique (lithologique, morphologique, structurelle) ou possédant des particularités qui leur confèrent une valeur scientifique, culturelle ou esthétique évidente». Les géosites, selon la définition de Wimbledon et al., 1996, «sont toute localité, zone ou territoire où on peut définir un intérêt géologique ou géomorphologique»;

Selon Dassy, K., Gasmi, N. et Talbi, M. (2000) «On entend par géosite (géomorphosites ou géotopes géomorphologiques), tout monument, paysage naturel ou élément de paysage, possédant des caractéristiques particulières (lithologiques, morphologiques, structurales), ou présentant une valeur scientifique, culturelle, environnementale, esthétique ou patrimoniale remarquable et représentative de l'histoire locale ou régionale. Il s'agit de sites composés d'éléments chargés de valeurs scientifiques, historiques, socio-économique, etc., déterminées par la perception objective ou subjective et/ou par l'exploitation rationnelle ou irrationnelle de l'Homme…»

Quelle définition à retenir pour le géosite dans ce travail?

La définition du terme «géosite» employée est inspirée de la notion de géographie ; discipline de synthèse qui interroge à la fois «les traces» laissées par les sociétés (mise en valeur des espaces) ou la nature (éléments bio-physiques) et les dynamiques en œuvre aussi bien dans les sociétés qu'au sein de l'environnement physique. Par ailleurs, un géosite désigne des parties de la géosphère (éléments naturels ou d'origine anthropique), de taille variable, bornées dans l'espace qui s'individualisent clairement du reste de leur environnement proche par des caractéristiques remarquables (composition, structure, localisation, extension, empreintes anthropiques, dynamique…), qui présentent des valeurs scientifique, culturelle, environnementale, esthétique ou patrimoniale remarquables et représentatives de l'histoire géologique et humaine, locale ou régionale.

2.3.2. L'approche méthodologique suivie

La démarche employée pour la sélection des géosites de la région de Kesra comporte quatre étapes essentielles: l'inventaire, la caractérisation, la classification et la proposition des processus de patrimonialisation des géosites (Serrano Cañadas, E. & Gonzáles-Trueba, J. J. 2005; Pereira, P. et al., 2007; Reynard, E., Fontana, G., Kozlik, L., Scapozzac, 2007; Zouros, N. 2007; Bruschi, V.M., Cendrero, A. 2005...) .

2.3.2.1. Un inventaire systématique des géosites

Le nombre des géosites, leurs valeurs et leur diversité sont des éléments essentiels pour la réussite de toute offre géo-touristique. L'analyse bibliographique, la lecture des documents cartographiques et photographiques multi-scalaires (cartes topographiques et géologique, photographies aériennes et images Google Earth…) et les prospections de terrain ont permis d'établir un inventaire des géosites à intérêt touristique dans l'ensemble du plateau de Kesra. L'objectif de cet inventaire est d'établir une liste la plus exhaustive possible de ces monuments. Pour chaque site, le centre d'intérêt principal ainsi que les centres d'intérêt secondaire ont été précisés (Pralong, J.P., 2006).

2.3.2.2. La sélection et la classification des géosites

Un ensemble des critères scientifiques peut être retenu pour aboutir à la détermination d'un indice conduisant à la classification des sites selon l'intérêt de ce qu'ils peuvent offrir aux visiteurs et le degré d'attractivité qu'ils peuvent exercer sur eux (Reynard, E., 2005).

Les critères de sélection utilisés dans la sélection des géosites retenus sont au nombre de six:

***La rareté**

Elle représente l'unicité du phénomène observé qui se mesure par rapport à un espace de référence. Ce critère sert à identifier les monuments naturels et culturels exceptionnels dans la région d'étude. Les géosites peuvent être communs, sans aucune particularité dans l'espace de référence, ou ils présentent: des dimensions intéressantes; des dimensions exceptionnelles.

***La représentativité**

La représentativité concerne l'exemplarité du géosite par rapport à un espace de référence (région). Les géosites offrent une représentativité: locale, régionale, nationale, internationale.

***Les valeurs**

Elles peuvent être scientifique, culturelle, esthétique, historique, environnementale, didactique. Par ailleurs, un seul géosite peut présenter des valeurs multiples. Selon ce critère, les géosites peuvent être: sans aucune valeur, à valeurs limitées, riches en valeurs.

***L'accessibilité**

Elle constitue une donnée déterminante pour la promotion touristique de ces monuments, mais elle pourrait être au contraire contrariante, car une accessibilité trop aisée ouvrirait la porte à toutes sortes d'abus et d'actes incontrôlés. L'accès au géosite pourrait être en voiture ou à pied moyennant des marches plus ou moins longues sur une piste. Selon ce critère les sites peuvent être répartis en trois catégories: extrêmement difficile, assez difficile. Facile.

***La richesse et la pertinence de l'information disponible**

L'information à mettre à la disposition des visiteurs des géosites est capitale pour évaluer l'attractivité des sites d'une part et pour valoriser ces sites sur le plan touristique d'autre part. On ne dispose pas toujours de la même qualité d'information pour tous les géosites de la région de Kesra. Selon la disponibilité de l'information existante, les sites peuvent être classés en trois catégories: 1). limitée, quelques informations éparses mais insuffisante pour satisfaire les visiteurs; 2). peu abondante; 3). abondante et pertinente, répondant à l'attente des visiteurs.

***La vulnérabilité et l'état de conservation des composantes des géosites**

Les géosites sont des composantes fragiles, facilement endommageables et exposées à de nombreuses menaces d'origine naturelles et/ou anthropiques. Les éléments inventoriés dont les composantes sont bien conservées présentent un intérêt certain pour les visiteurs qui peuvent observer dans leurs détails ces différentes composantes. D'autres sites sont relativement conservés avec quelques composantes encore observables. Les sites en grande partie peu conservés ou en ruine ne présentent pas d'intérêt pour la visite étant donné le manque d'éléments à observer. Trois catégories peuvent être distinguées: site peu conservé, site relativement conservé et site bien conservé et/ou restauré.

3. LES GÉOSITES À KESRA: UN POTENTIEL RICHE ET VARIE

Le plateau de Kesra ou la "*Alhmada*" s'individualise clairement dans le paysage par sa forme relativement ovale et par sa structure synclinale perchée taillée dans le calcaire de l'éocène et les marnes du crétacé (Cf. plus haut). Il constitue un élément fort de la diversité des paysages dans la région d'étude.

Dans le détail, l'inventaire systématique des sites d'intérêts géo-scientifiques a montré que cette région recèle des géosites variés (Tableau 1).

Tableau 1

Classification et caractérisation des géosites retenus dans région de Kesra

Critères / Géosites	Rareté	Représentativité	valeur	L'état de conservation des composantes du géosite	La richesse et la pertinence de l'information disponible	L'accessibilité au géosite
Les champs de lapiez	Des dimensions intéressantes	Locale/régionale	Riche	Peu conservé	Abondante	Extrêmement difficile
Dolines	Des dimensions intéressantes	Locale/régionale	Riche	Peu conservé	Abondante	Extrêmement difficile
Le paysage travertineux	Des dimensions exceptionnelles	Régionale	Riche	Relativement conservé	Peu abondante	Facile
Les champignons ruiniformes	Des dimensions intéressantes	Locale/régionale	Riche	Peu conservé	Abondante	Extrêmement difficile

Tableau 1 (continué)

Le paysage de trainés de blocs	Des dimensions intéressantes	Locale/régionale	Riche	Bien conservé	Abondante	Assez difficile
Les aménagements hydro-agricoles ancestraux	Des dimensions exceptionnelles	Locale/régionale	Riche	Peu conservé	Peu abondante	Assez difficile
Les anciens vergers de *Kesra*	Des dimensions intéressantes	Locale/régionale/ nationale	Riche	Peu conservé	Peu abondante	Facile/ assez difficile
Les stations isolées à *cyprès de Makthar*	Des dimensions exceptionnelles	Nationale et internationale	Riche	Peu conservé	Peu abondante	Facile
Les stations isolées à *Celtis australis*	Des dimensions intéressantes	Locale/régionale	Riche	Peu conservé	Peu abondante	Extrêmement difficile
Les stations ripicoles et rupicoles	Des dimensions intéressantes	Locale/régionale	Riche	Peu conservé	Peu abondante	Facile/assez difficile
La forêt à chêne vert	Des dimensions intéressantes	Nationale	Riche	Peu conservé	Abondante	Facile/assez difficile
La pinède à pin d'Alep	Des dimensions intéressantes	Régionale/ nationale	Riche	Peu conservé	Abondante	Facile
Les olivettes âgées et d'architecture remarquable	Des dimensions intéressantes	Régionale/ nationale	Riche	Peu conservé	Peu abondante	Facile/assez difficile
Les vestiges historiques	Des dimensions intéressantes	Locale/régionale	Riche	Relativement conservé	Peu abondante	Facile/assez difficile

3.1. Les géomorphosites

3.1.1. Des champs de lapiez

Elément marquant les corniches du plateau de Kesra, ce paysage ruiniforme et pittoresque est constitué en surface par un modelé caractéristique du relief karstique de surface: les lapiez. Il s'agit de surfaces criblées de trous, semées d'arrêts tranchantes et rangées par des alvéoles remplis de limons rouges. Elles présentent plusieurs aspects dont les plus importants sont: lapiez en cannelures, lapiez circulaire et les Kaménitzas (Fig. 3).

Bien étudiés par Gammar, A. M. (1979), Jendoubi, S. (2000) et Karray, M.R. (2010), les lapiez constituent la forme mineure la plus banale du relief karstique résultant d'une érosion ancienne qui a produit des cannelures et des vasques qui s'élargissent avec le temps, créant ainsi des fentes larges et assez profondes. Une telle importance de ce modelé est en rapport avec le réseau des fissures qui affectent le calcaire éocène dans lesquelles est taillé le plateau de Kesra.

3.1.2. Des dolines

Ce sont des cavités plus ou moins arrondies et d'extension et de profondeur variables de la surface dans laquelle le calcaire éocène a été dissout par l'eau en profitant de la présence d'un champ de failles qui affectent la roche en place. Ces modelés karstiques hérités des périodes pluviales du Quaternaire sont présents en particulier sur les surfaces structurales de la crête du plateau de Kesra où ils forment un élément qui apporte de la diversité dans des paysages parfois monotones. Dans le détail, ce type de modelés montre une grande variété morphologique: certaines dolines ont un fond en berceau et se trouvent délimitées par un talus dissymétrique dont le commandement peu dépasser 3 mètres, d'autres types offrent une forme plutôt en entonnoir ou ovale. En outre, les dolines peuvent être soient séparées soient communicantes (Fig. 4).

L'accumulation des argiles dans les fonds de ces dépressions fermées peut parfois les rendre complètement étanche et permettre l'apparition des zones humides de type mare (ou *grâa*) surtout durant les épisodes humides hivernaux abritant une flore extrêmement riche.

Outre sa valeur paysagère, ces dolines contribuent à une bonne recharge en eaux des nappes souterraines et alimentent les nombreuses sources qui jaillissent du plateau de Kesra (Fig. 5). Les argiles de décalcification s'accumulent au fond des dolines, retenant l'eau et rendant ces surfaces fertiles et cultivables. Dans certains secteurs, ces dépressions ont été aménagées en les pavant de calcaire pour en faire des abreuvoirs pour les animaux ou bien des parcelles agricoles sur lesquelles les *Kesraouis* ont pratiqué de la céréaliculture dans le cadre d'un système traditionnel connu sous l'appellation des «*Sraouates*». Ces parcelles d'altitude ont un rôle important dans la sécurité alimentaire de la population dans le cadre d'une agriculture traditionnelle de subsidence.

Fig. 3 – Paysage remarquables de Kaménitzas sur la crête du plateau de Kesra (Cliché de l'auteur, 2014).

Fig. 4 – Des dolines de taille variables sur la crête du plateau de Kesra (Cliché de l'auteur, 2014).

Fig. 5 – Un dépôt de travertins reposant en discordance angulaire sur le calcaire Crétacé jouxta posant les vergers de l'ancienne Kesra (Cliché de l'auteur, 2015).

3.1.3. Un paysage travertineux près des sources d'eau

Les travertins sont des roches carbonatées qui doivent leur formation à la sursaturation locale des eaux en bicarbonate de calcium. Ils se distinguent par des faciès et des séquences sédimentaires variés.

Occupant une vaste étendue (de la source jusqu'aux vergers situés au dessous de l'ancien village), ce type de géosite marque le versant sud du jebel Kesra. Il s'agit de blocs épais de tufs calcaires qui forment de vraies terrassettes étagées d'extension très variable. Sur le bas versant drainé par un ravin assez encaissé, le dépôt travertin se trouve en position de discordance angulaire avec les affleurements marno-calcaires du Crétacé (Fig. 6).

Par ailleurs, ces dépôts travertins abritent un cortège floristique très riche en espèces rupicoles et hydrophytes rares et caractéristiques: divers *Sedums, Asplenium ceterach, Ruscus hypophyllum, Seseli varium,* divers *Umbilicus, Celtis australis, Salix pedicellata, Rosa sicula, Prunus spinosa, Melandrium album, Lamium longiflorum*.

Des nouvelles recherches morpho-stratigraphiques et bio-stratigraphiques fines ainsi que des datations sur ces dépôts travertins pourraient fournir des renseignements importants sur le paléo-fonctionnement et les conditions paléo-environnementales de cette région.

3.1.4. Un paysage original de champignons ruiniformes

En Tunisie, ce type de modelé caractérise la plupart des corniches taillées dans le calcaire éocène dans les domaines bioclimatiques semi-arides, sub-humides et humides. Il est nettement visible au niveau des parois rocheuses du plateau de Kesra. Il s'agit d'un paysage minéral d'origine karstique. La corniche du Kef Mnara-Tassila sur le versant nord-ouest du jebel Kesra offre l'exemple le plus développé de ce type de modelé (Jendoubi, S., 2000). Dans le détail, ce sont des colonnes calcaires hautes de plus de 20 m, détachées de la corniche par des cannelures de 5 à 6 m, de profondeur.

L'aspect des roches champignons que montre ce paysage est en rapport avec une évolution polygénique où se mêle l'action de la corrosion avec celle de la gélifraction.

3.1.5. Plusieurs générations de trainés de blocs

Les versants du jebel Kesra se distinguent nettement dans le paysage de la région d'étude par la présence d'un aspect remarquable de mouvement de masse. Il s'agit des champs assez étendus de traînées de blocs qui constituent un paysage singulier sur le versant nord-ouest de ce massif montagneux.

Bien étudiées par Jauzein, A. (1967), Gammar, A.M. (1979) et Jendoubi, S. (2000), ces unités de modelés se présentent sous des formes chaotiques sur des longueurs de plus de 500 mètres et de largeurs de l'ordre de la centaine de mètres. Souvent pauvre en matrice, le matériel montre l'aspect de blocs dont les plus gros peuvent avoir des dimensions de 3*2*2 m. L'absence de toute stratification et de structure indique que la mise en place de ces accumulations s'est faite à la suite d'un détachement brutal sous l'effet d'un déplacement rapide résultant de la vulnérabilité des corniches calcaires du plateau de Kesra.

D'après Jendoubi, S. (2000) au moins trois générations de traînées de blocs se développent sur le versant nord du jebel Kesra. Le modelé le plus remarquable s'observe sur le versant de Krouma Essouda (1033 m.) (Fig. 7).

Fig. 6 – Paysage de reliefs champignons sur le versant nord-ouest du plateau de Kesra (Cliché de l'auteur, 2015).

Fig. 7 – Des traînés de bloc des différentes générations marquant le paysage sur le versant nord-ouest du plateau de Kesra (Cliché de l'auteur, 2015).

3.2. Des aménagements hydro-agricoles ancestraux

La région de Kesra donne un exemple du rôle de l'eau et des savoirs-faire locaux dans le façonnement des paysages et le développement territorial local dans un contexte agro-forestier relativement contraignant. En effet, la modestie de la pluviométrie annuelle (aux alentours de 450 mm), l'exiguïté de l'espace agricole et la forte érosion des sols sur des pentes raides ont poussé les *Kesraouis* depuis fort longtemps à valoriser un potentiel hydraulique local très limité (quelques 20 sources d'eau jaillissant du plateau) dans la création d'un agro-système intensément cultivé et diversifié caractéristique des vergers de Kesra.

Ces aménagements qualifiés de petits hydrauliques consistent à installer des canaux d'irrigation à ciel ouvert (ou *Séguias*) qui conduisent l'eau par gravité des sources situées généralement sur les replats dans les hauts versants du plateau vers les petites terrassettes légèrement aplanies et partagées par des murettes faites en terres sèches ou en petits moellons calcaires tufeux.

Par ailleurs, les terrassettes se succèdent d'amont en aval sur le versant et forment ainsi un paysage original de petits périmètres irrigués, avec des jardins en gradins et fortement marqués par l'intervention de l'Homme.

Ces aménagements hydro-agricoles constituent un patrimoine culturel de haute valeur qui mériterait d'être sauvegardé (Fig. 8).

3.3. Les vergers de Kesra: un paysage agro-forestier original

Basée principalement sur la céréaliculture en sec et l'arboriculture (oliviers, figuier, grenadier, etc.), l'agriculture constitue la principale activité économique à Kesra. Cette localité est également connue par la culture des figues en mode biologique. Cette spéculation est pratiquée dans le cadre de petites exploitations fortement intensifiées et conduite en irriguée à partir des eaux de sources jaillissant du haut relief. En outre, elle profite des topo-climats spécifiques influencés par le jebel Kesra, des savoirs-faire locaux ancestraux et des systèmes d'irrigation efficaces qui remontent à des périodes très anciennes. Les vergers de l'ancienne Kesra renferment des dizaines de cultivars locaux de figues (Fig. 9) bien adaptés aux conditions locales des milieux où ils sont plantés, dont le plus connu est le «*Zidi*» (Tableau 2). Pour toutes ces raisons, les figues de Kesra ont un goût spécial et jouissent d'une bonne réputation en Tunisie et à l'étranger. Un festival des figues est organisé en pleine période de collecte des figues à Kersa qui vise la promotion de cette activité.

Fig. 8 – Un système ancestral de partage des eaux dans les anciens vergers de Kesra (Cliché de l'auteur, 2014).

Fig. 9 – Un système agro-forestier original caractérisant les anciens vergers de Kesra (Cliché de l'auteur, 2015).

Tableau 2

Les principaux cultivars des figues à Kesra (enquête personnelle 2014).

Zidi Hor, Khedhri Hor, Khedhri Makloub, Sefri Hor, Sefri gars, Tiri Makloub, Tiri Boulaânak, Tiri Haj, Souidi, Onk Hajla, Bezoul Khadem, Badhenjel, Sakni, Bou abda, Karmous Ahmed Khmis, Dem froukh, Dchicha wa Asl, Bidhi, Soltani, Dorghami, Dyr Ayoun, Zergui, Nêb jmel, Wahchi

3.4. Des peuplements végétaux rares et remarquables pour la biodiversité

La végétation de la région de Kesra a été bien étudiée depuis les travaux de Gammar, A. M. 1979). A côté des éléments floristiques et paysagers caractéristiques de la pinède thermo-méditerranéenne, cette végétation recèle plusieurs aspects originaux qui constituent en fait, des composantes essentielles du patrimoine végétal de la Tunisie méditerranéenne.

3.4.1. Des stations isolées à cyprès de Makthar

En Tunisie, le cyprès d'origine locale est représenté par quelques centaines de pieds repartis entre trois stations séparées: Khanguet Ez-Zelga, Jebel Satour et Sidi Bouabdillah situées sur le rebord nord du plateau de Kesra.

Du fait qu'elles renferment une forme endémique[1] de *Cupressaceae* (*Cupressus sempervirens L. f. numidica Maire*), uniques en son genre dans tout le Grand Maghreb, les cyprières de *Khanguet Ez-zelga* et *Sidi Bouabdillah* sont des éléments forts du patrimoine végétal national et maghrébin. En fait, il s'agit d'une station à cyprès relique des périodes anciennes du Quaternaire (Fig. 10).

Fig. 10 – Les cyprières situées *aux alentours du plateau de Kesra* constituent un élément fort du patrimoine végétal national (Cliché de l'auteur, 2014).

Par ailleurs, l'originalité de ces cyprières réside dans l'architecture des arbres qu'elles forment. En effet, les individus de cyprès s'y présente sous forme d'un peuplement pur dont les sujets reposent sur un sol très dégradé du type marneux avec des affleurements calcaires en certains endroits. Les arbres, d'un âge très avancé, sont fortement mutilés, de forme irrégulière, très fourchus et ébranchés. La hauteur des individus ne dépasse pas les 12 m. Leurs racines sont très grosses et affleurent aux endroits où la pente est très forte. Le sous-bois est dégradé, il est formé essentiellement d'espèces xérophytes telles que: *Juniperus oxycedrus L., Ampelodesma mauritanica L., Calicotome villosa L.* et *Marubium vulgare L.* (Fig. 11).

[1]Espèce végétale ou animale dont l'aire de répartition est strictement limitée à un espace géographique donné, souvent de faible extension.

3.4.2. Des stations isolées à Celtis australis sur les parois rocheuses du plateau de Kesra

Les escarpements rocheux du plateau de Kesra forment un anneau particulièrement favorable à l'implantation de la végétation des rochers et des éboulis (ou végétation rupicole) nettement riche et variée qui participent à la biodiversité régionale et nationale.

A côté des dizaines d'espèces rares et remarquables dans la région (*Rupicapnos numidicus, Lamium longiflorum*), *Celtis australis (*ou micocoulier de *Provence*, famille de *Cannabiaceae*) est un taxon bien apprécié dans les paysages méditerranéens. En Tunisie, c'est une espèce remarquable qui caractérise les hauts reliefs telliens et dorsaliens (altitude supérieure à 1000 m.). A Kesra, cette espèce occupe les escarpements rocheux sur les corniches et dans les vergers. La flore compagne comporte toutes les espèces rares de l'iliçaie qu'on observe accrochées aux rochers (*Rupicapnos numidicus, Lamium longiflorum*) (Fig. 12).

Fig. 11 – L'architecture interne et externe des arbres de cyprès fait l'originalité de ces individus endémiques (Cliché de l'auteur, 2009).

Fig. 12 – Des individus de *Celtis australis* accrochés aux fissures de calcaire éocène participant à la diversité paysagère et floristique de Kesra (Cliché de l'auteur, 2015).

3.4.3. Les stations ripicoles et rupicoles

Les 20 sources d'eau douce qui jaillissent au pied de l'escarpement rocheux du plateau de Kesra et à la base de son versant extérieur favorisent le développement d'une végétation ripicole riche et assez rare: des herbacées (*Ulmus campestris, Fraxinus angustifolia, Populus alba, Salix pedicella, Rosa sicula, Rosa canina*), plusieurs espèces méditerranéennes et halophytes grimpantes. Loin de l'escarpement du plateau, les sites humides correspondent aux principaux talwegs et ruisseaux bien alimentés en eau par des sources notamment au cours des années particulièrement humides. Ils abritent une végétation ligneuse et herbacée d'une forte originalité qui nécessiterait des recherches plus approfondies.

D'un autre côté, les escarpements rocheux, les fissures taillées dans les calcaires et les champs des lapiez au sommet et sur la crête du plateau de Kesra renferment un groupe d'espèces riches (Gammar A.M. 2001), où on trouve surtout: *Bupleurum spinosum, Erinacea anthyllis,* plusieurs *Sedums, Rhamnus alaternus, Asplenium ceterach, Rucus hypophyllum*… Sous l'effet des vents et de la baisse sensible des températures avec l'altitude, certains individus présentent des formes en coussinet et plaquées sur les sols assez originales (Fig. 13, Fig. 14).

3.4.4. Forêt à chêne vert de la crête du plateau de Kesra

En Tunisie, les paysages d'iliçaies (peuplements arborés à chêne vert *Quercus ilex / Ballout*) bien conservé sont extrêmement rares. En effet, les peuplements à chêne vert se présentent souvent sous l'aspect des formations secondaires de type matorral (ou garrigue) d'extension modeste et généralement sous l'aspect des peuplements mixtes (pin d'Alep, genévrier oxycèdre).


Fig. 13 et 14 – Les points d'eau douce à Kesra renferment plusieurs espèces hydrophiles rares et remarquables pour la biodiversité (Clichés de l'auteur, 2012).

Les dolines et les fissures de calcaire sur la crête du jebel Kesra offrent un exemple d'une belle formation végétale sous l'aspect de forêt ou matorral haut de chêne vert. Par sa structure particulière, son emplacement en altitude sur des affleurements calcaires massifs surmontés d'un sol peu profond, humifère à texture limoneuse et à proximités des habitations forestières, et sa diversité floristique originale (*Celtis australis Bupleurum spinosum, Rhamnus alaternus*), cette formation végétale constitue un autre élément fort du patrimoine végétal de la Tunisie (Fig. 15).

Fig. 15 – L'iliçaie de Kesra: un paysage rare en Tunisie (Cliché de l'auteur, 2014).

Fig. 16 – Un four traditionnel d'extraction des fruits de pin d'Alep "*Zgougou*" dans la pinède de Kesra (Cliché de l'auteur, 2016).

3.4.5. Une Pinède à pin d'Alep riche, étendue et source de revenus

Etendue sur plus 20 000 ha, cette pinède à pin d'Alep constitue l'un des massifs forestiers les plus vastes et riches du pays (Gammar, A. M., 1979). Son originalité s'observe à plusieurs niveaux;

– la forte diversité floristique et physionomique en rapport avec la variété des compartiments morpho-pédologiques et le poids de l'action anthropozoïque passée et actuelle. En effet, plusieurs faciès peuvent être identifiés au sein de cette pinède dont on cite les plus importants:

* Une pinède jardinée témoignant d'une longue coexistence entre la forêt et la paysannerie locale. La faible pression pastorale exercée par les riverains sur le milieu est à l'origine d'une structure étagée et une flore diversifiée dans ce type de végétation; *Arbutus unedo, Clematis flammula, Smilax aspera, Prasium majus, Tamus communis, Crataegus azarolus*. Ces taxons témoignent du bon état de la végétation et du sol.

* Une pinède méso-méditerranéenne caractérise les hauts versants marneux qui entourent le plateau de Kesra à bioclimats semi-aride et subhumide. Son cortège floristique s'individualise par un lot d'espèces forestières, qui, sans être rares, sont étroitement liées aux pinèdes des hauts reliefs de la Dorsale intérieure: *Medicago sativa, Astragalus incanus, Lotus creticus, Erinacea anthyllis, Linum spp. Corolnilla spp…, Quercus ilex, Pistacia terebenthus, Viburnum tinus, Bupleurum spinosum, Juniperus oxycedrus, Celtis australis, Spartium junceum, Coronilla minima, Hypocrepis scabra.*

* Un jeune peuplement à pin d'Alep à structure monotone résultant soit des plantations forestières soit de la régénération spontanée de la pinède après incendies.

– Une forêt paysanne. Bien qu'elle bénéficie d'une mise en défens totale par le Code Forestier (Domaine Forestier de l'Etat), la forêt de Kesra est le lieu d'une fréquentation humaine et animale intense. La pinède sert de terres de parcours pour le cheptel et les abeilles, fournit des produits ligneux divers pour satisfaire les besoins en bois de feu et de chauffage de la population locale qui utilise la forêt comme cadre de vie et l'intègre dans leur système de production (Gammar, A.M. 2001). Si la coexistence entre la pinède et les paysans observée dans plusieurs milieux a abouti à un allègement sensible de la pression sur les ressources forestières dans la pinède jardinée, certains secteurs souffrent d'une forte dégradation qui se traduit par le recul du taux de recouvrement végétal, le grignotage de l'espace forestier, la banalisation de sa flore et la destruction de la végétation par les feux.

– Un savoir faire patrimonial en matière de valorisation des produits forestiers non ligneux de la pinède. En effet, les riverains de l'espace forestier implantés à Kesra ancienne, Ouled Mrabet, Kesra Hammem, Jabnoun sont connus à l'échelle nationale par l'exploitation des fruits de pin d'Alep ou «*Zgougou*» par des techniques traditionnelles grâce à un savoir-faire authentique à la région qui se transmet de génération en génération depuis plusieurs décennies. Plusieurs fours traditionnels construits en terres et pierres sèches dans cette forêt qui reflètent l'importance de cette activité dans la vie des *Kesraouis* et qui valorisent parfaitement cette pinède à pin d'Alep (Fig. 16).

3.4.6. Des olivettes âgées et d'architecture remarquable

Les anciens vergers de Kesra abritent une variété locale d'olivier bien connue dans la région sous l'appellation de «*Zitoun Roumani* ou *Lguim* ou *Zitoun Hor*». Il s'agit d'un cultivar issu des opérations de greffage à partir de l'espèce spontanée l'oléastre (*Olea europea/ Zabbouz*) très répandue dans la région; technique ancestrale héritée des périodes les plus reculées de l'histoire du peuplement dans la région. Cette variété locale supporte parfaitement les spécificités climatiques de cette région dorsalienne marquées surtout par un régime très irrégulier de la réparation des précipitations, la durée et l'intensité de la sécheresse estivale et la rigueur du froid hivernal, avec notamment la fréquence de chute de la neige, en particulier sur les hauts versants de «l'*Alhmada*». En outre, ces olivettes valorisent parfaitement les terrains calcaires accidentés et extrêmement érodés.

Par ailleurs, les pieds d'oliviers dans les anciens vergers du versant sud du plateau de Kesra se distinguent nettement par une morphologie particulière qui s'observe au niveau de l'enracinement et dans l'aspect des troncs et du feuillage. Il s'agit d'individus très âgés[2] comme en témoigne l'ampleur de la taille des circonférences des individus (Figs. 17 et 18) et les fissurations des troncs qui montrent plusieurs cavités dues au vieillissement du bois.

[2] Une étude dendrochronologique est projetée afin d'estimer l'âge de ces vieux oliviers.


Fig. 17 et 18. Les olivettes séculaires de Kesra: un élément du patrimoine rural dans la region (Clichés de l'auteur, 2014).

Malgré la diminution sensible de la productivité de ces types d'olivettes, les «*Kesraouis*» continuent aujourd'hui à entretenir ces parcelles, car elles constituent pour eux une activité authentique et le témoignage d'un savoir-faire agricole local ancestral.

3.5. Des vestiges historiques datant des périodes les plus reculées de l'histoire de la «Tunisie»

Kesra et ses abords abritent des vestiges appartenant à plusieurs civilisations qui remontent aux différentes périodes de l'histoire humaine dans la région. Ce sont surtout les monuments protohistoriques et antiques sous forme des structures funéraires de types *Dolmens, Tumulus mégalithiques*, *tombes* taillées dans le calcaire qui attirent les mieux l'attention, notamment sur les parois rocheuses du côté Sud-est du plateau de Kesra (Figs. 19 et 20).

Fig. 19 – Des structures funéraires de type tombes d'âge antique sur la crête du plateau de Kesra (Cliché de l'auteur, 2014).

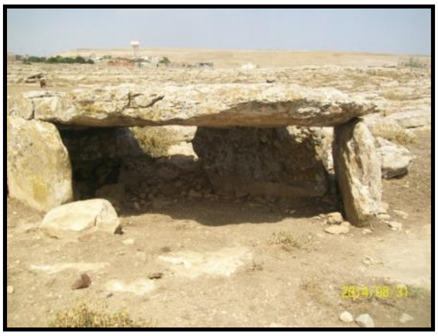

Fig. 20 – Des structures funéraires de type *Dolmens* d'âge protohistorique sur la crête du plateau de Kesra (Cliché de l'auteur, 2014).

4. POUR LA PATRIMONIALISATION DES GÉOSITES DE KESRA

Le «géo-patrimoine» est un concept novateur qui fait référence aux composantes de la planète sujettes à des actes de patrimonialisation (reconnaissance collective, protection, labellisation, valorisation). La patrimonialisation d'un géosite ou d'un monument (naturel ou culturel), n'a pas pour seule fonction de le mettre en valeur, mais aussi d'induire un régime juridique protecteur.

4.1. Des géosites menacés et méritant un statut patrimonial

4.1.1. Les peuplements isolés à cyprès de Makthar subissent de diverses agressions

Malgré les valeurs scientifiques et patrimoniales que présentent les îlots reliques à cyprès de Makthar à l'échelle nationale et maghrébine, ils souffrent actuellement de plusieurs agressions dont les plus importantes sont;

– le déboisement illicite des arbres en rapport avec le niveau de vie très bas des riverains;

– la pollution génétique due au croisement avec les peuplements artificiels issus des actions de reboisement (*Cupressus sempervirens australis*);

– l'érosion des sols (Fig. 12).

4.1.2. Une pinède à pin d'Alep en danger!

Actuellement, la forêt de Kesra connaît une forte pression pastorale qui se manifeste sous plusieurs aspects:

– une forte exploitation des produits ligneux (prélèvement des bois de feu) et non ligneux (sur-collecte des graines de pin d'Alep (*Zgougou*). Quoi qu'elles valorisent la forêt, ces activités menacent sérieusement le maintien de la couverture forestière de cette pinède et perturbent sa régénération spontanée suite à la raréfaction progressive des semences (grains);

– des incendies fréquents et graves qui affectent l'espace forestier (Figs. 21 et 22). Cette situation est aggravée par des conditions favorables aux feux de forêt: sécheresse estivale assez prolongée, vents secs, baisse de l'humidité relative en été, présence des biomasses végétales très inflammables (pins, dys, genévriers), continuité de l'espace forestier en particulier dans certains secteurs, forte fréquentation de la forêt (par les paysans, les visiteurs, les ramasseurs de grains des pins, les chasseurs). A ceci, s'ajoutent les conflits permanents entre l'Administration Forestière et les paysans autour des droits d'usage. Les incendies du mois d'août 2014 sur les versants ouest et nord qui ont ravagé plusieurs dizaines d'hectares de forêt à pin d'Alep constituent un exemple de l'ampleur de ce fléau.

Fig. 21 et 22. Le feu constitue la principale menace pour la pinède de Kesra: içi, les incendies d'août 2014 (Clichés de l'auteur, 2014).

4.1.3. Des aménagement hydro-agricoles en ruines

Les transformations socio-économiques et territoriales (apparition de nouveaux centres de peuplement en dehors du noyau historique) qu'avait connu la région de Kesra durant les dernières décennies ont engendré l'apparition de plusieurs signes de démantèlement de ce système agricole ancestral: manque d'entretien des vergers, vieillissements de certaines plantations, destruction de l'ancien artère d'irrigation, pollution des vergers (les petits périmètres irrigués sont devenus des lieux de décharge des ordures, les sources d'eau sont contaminées par les eaux usées provenant des ménages situés sur la crête).

4.1.4. La dégradation des géosites des reliefs ruiniformes

Les modelés champignons taillés dans les calcaires éocènes très fissurés situés sur les parois externes du plateau de Kesra sont le siège d'éboulements importants sous l'effet de la gravité mais particulièrement suite à l'extraction des roches marbrières. Le détachement des gros blocs est surtout visible sur le versant nord-ouest tout près de la source de Ain Kef.

4.1.5. Des parcelles agricoles sur les dolines laissées à l'abandon

Appelées auparavant les «*Sraouates*», les terres fertiles et particulièrement humides en rapport avec l'altitude occupant les dolines sur la crête du plateau de Kesra sont actuellement délaissées sous l'effet de l'érosion des sols et surtout de l'émigration massive (surtout vers Kesra nouvelle ou les autres villes) (Fig. 23).

Fig. 23 – Des parcelles sur dolines (ou *Sraouates*) laissées à l'abandon
(Cliché de l'auteur, 2014).

4.2. Conditions et retombées d'un développement touristique durable

Les magnifiques monuments précités constituent une richesse réelle de cette région de la Dorsale tunisienne qui connaît l'isolement, l'insuffisance de l'infrastructure et le sous-emploi. Pour cette raison, beaucoup d'espoir peut être placé dans le développement des activités touristiques à Kesra. En effet, les sites remarquables identifiés dans les différentes secteurs de la région et intégrés dans un circuit géo-touristique (Fig. 24.) peuvent constituer des centres d'intérêt qui pourraient alimenter un mouvement éco-touristique important et bénéfique pour la population locale en matière de création d'emplois non agricoles.

Malheureusement, ces géosites ne sont ni mis en valeur ni même protégés contre les multiples formes de dégradation. Par ailleurs, il faut bien avouer que ce potentiel, si important, est faiblement connu, voire totalement ignoré dans certains cas. Un grand effort de publicité, de promotion et de mise en valeur des différentes potentialités s'impose, dans l'objectif de dynamiser le secteur touristique qui pourrait être un catalyseur des autres secteurs économiques et sociaux dans la région et un moyen de maintenir la population sur place.

Le tourisme rural, pour lequel la montagne est particulièrement bien placée et n'exige pas de grands investissements de départ, peut avoir un certain succès par l'amélioration de l'offre avec un grand effort de promotion et d'installation d'une infrastructure adéquate (aménagement de pistes, de gîtes ruraux et de campings dans les fermes). Les habitants semblent prédisposés à collaborer à des projets touristiques qui leur apporteraient des revenus complémentaires[3]; néanmoins leurs faibles moyens sont très insuffisants pour mettre en place et gérer des projets.

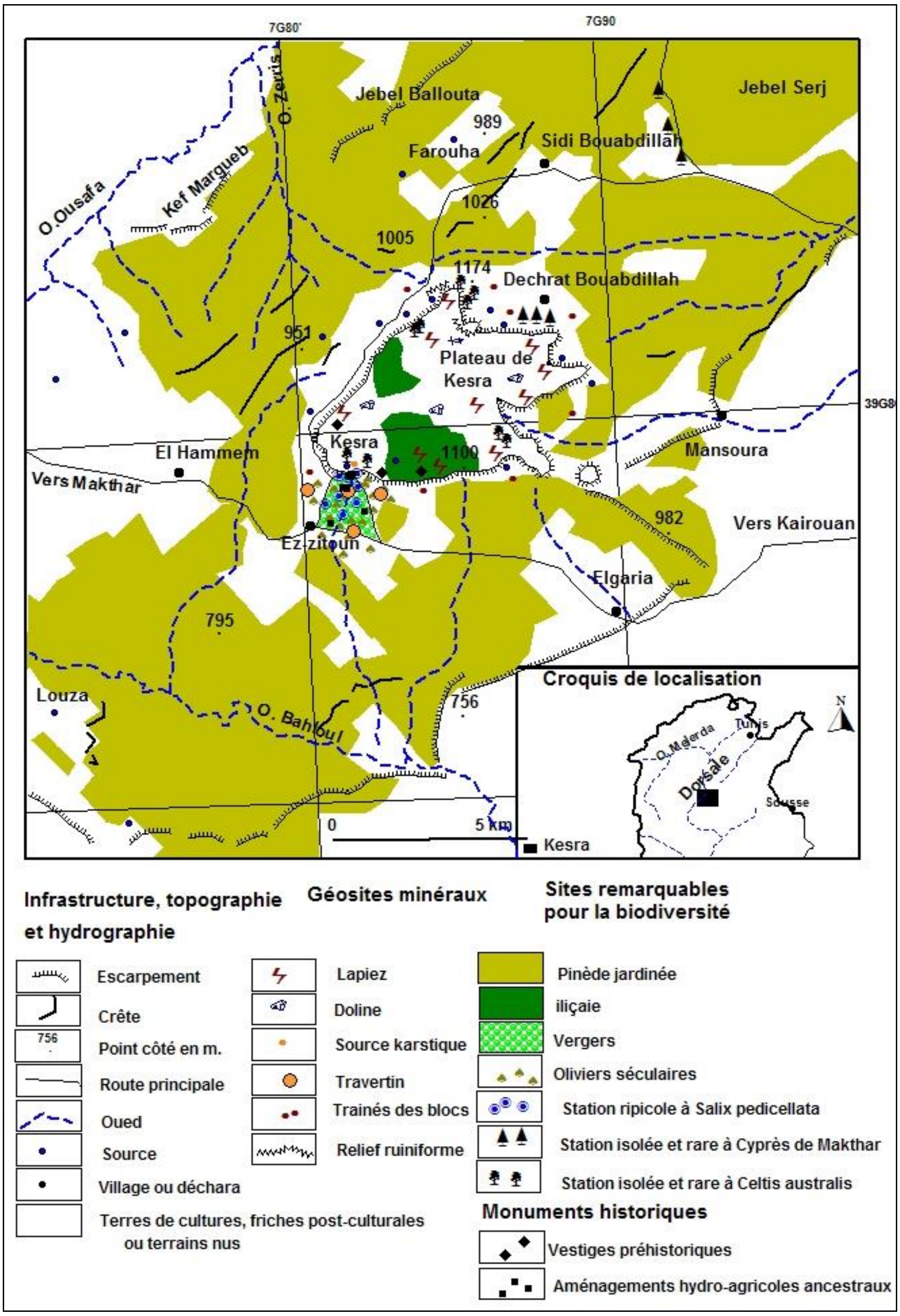

Fig. 24 – Carte des géosites d’intérêt géo-touristique de Kesra et ses abords.

[3] Selon nos enquêtes de 2014.

5. CONCLUSIONS

La région de Kesra, au cœur de la Dorsale tunisienne, forme une entité géographique bien distincte. Elle renferme des géosites particulièrement riches et variés. La synthèse de l'offre a permis la proposition d'une carte des géosites (circuit géo-touristique). A côté de leurs valeurs paysagères et scientifiques, ces monuments originaux devraient être considérés comme des leviers de développement économique, social et territorial aux échelles locale et régionale.

En Tunisie, l'offre touristique est restée longtemps basée sur la seule activité balnéaire mais tend depuis peu à développer de nouveaux produits dont le tourisme rural et l'éco-tourisme.

La proposition de plan d'aménagement spécifique et rationnel, constitue une valorisation participative pour une meilleure protection de ces sites souvent vulnérables. La promotion des activités touristiques valorisant ces géosites des hauts intérêts dans un contexte rural et montagnard peut avoir un rôle intrinsèque dans le développement territorial durable et alternatif de cet arrière-pays défavorisé de la Tunisie. Il permettrait de diversifier les revenus de la population et de réduire sa pression sur les milieux.

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POST-COMMUNIST DEMOGRAPHIC CHANGES IN ROMANIAN MOUNTAIN COMMUNITIES. CASE STUDY: THE POIANA RUSCĂ MOUNTAINS

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Key-words: population decline, Poiana Ruscă Mountains, rural area, mountain area, demographic aging.

Abstract. One of the main demography-related problems in Romania, aggravated in mountain areas, is population decline, associated with demographic aging, out-migration of adult population, low living standards, etc. The Poiana Ruscă Mountains is one of the Romanian areas representative of this demographic phenomenon. The paper is focused on the analysis of post-socialist demographic trends (since 1992), based on which a demographic projection of the community in the area was produced. An intense and continuously downward demographic trend was observed in a number of settlements and, in a smaller degree, stagnation or a slightly upward demographic trend in other settlements. We conclude that in the absence of concrete housing policies, the number of abandoned villages will be increasingly higher and more settlements will become extinct; hence, other derived negative effects.

1. INTRODUCTION

The European mountain areas experience different demographic trends, depending on the degree of attractiveness and connectivity of the mountain massifs, the degree of comfort offered by the housing structures or the socio-cultural activities in these areas. However, increasingly more areas become repulsive, the demographic changes in the recent decades affecting the viability of settlements. It is also the case of the Romanian rural areas, most of them facing a sharp demographic decline up to the extinction of increasingly more settlements.

Thinking solutions for economic recovery by copying or replicating foreign, European models is unnatural and unlikely to give the desired results (Rey, 2014, p. 16). The different territorial context for the development of mountain areas is a prime factor to support the above-mentioned statement.

The type of economy dictated by the political regime of the Eastern European countries, unlike the democratization of the western economy, was reflected also in the degree of stability of the mountain settlements. Collectivization imposed on the Romanian territories by the socialist regime, excepting the mountain areas proper, caused the economic exploitation of the existing agricultural landscapes. The agricultural marginalization of the mountain areas was multiplied in the post-socialist period by the restructuring of the secondary sector and the closure of several iron, marble, and coal mines and quarries in the Poiana Ruscă Mountains, which affected the livelihood of inhabitants. The most visible effect was the exodus of population.

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In the post-socialist period, the entire Romanian economy has experienced a period of transformation and adaptation to market conditions, a phenomenon strongly influenced by the accession of Romania to the EU and the compliance of the Romanian legislation with the European regulations on various types of policies (agricultural, social, housing, etc.). The most widespread social phenomena were unemployment, extreme poverty and subsistence farming (Mihalache and Croitoru, 2011, p. 28). Against this background, negative demographic mutations have occurred in the mountain area as well. In the area under study, the extent of demographic disparities is growing and increasingly more settlements are on the verge of extinction in the absence of any inhabitants.

The main objectives of this paper were to identify the demographic trend in the Poiana Ruscă Mountains, determine the population development scenario for the coming decades, and outline the problematic areas in terms of depopulation.

Mountain areas – neuralgic demographic areas

At European level, mountain areas have evolved differently in a series of states, mountain tourism representing the means of socio-economic recovery for some of them. According to the estimates made by the authors of the project *PADIMA: Policies against Depopulation in Mountain Areas* (2012), the phenomenon of depopulation in the European rural areas is continuously growing so that, by 2025, about 90 of these regions may be subjected to this phenomenon and mountain areas are expected to be most affected.

According to a study on mountain areas funded by the European Commission, demographic decline is recorded in Bulgaria, Finland, Norway, Portugal, Romania and Sweden, but also in the mountain areas of Corsica, Sicily and the central Apennines of Italy, while in countries such as France, Spain, Slovenia, Switzerland, western Austria, parts of Germany or Italy some mountain areas have recorded positive population changes (Nordregio *et al.*, 2004). Nevertheless, recent studies (Alpine Convention, 2015, p. 13) indicate that wide areas of the Alps have experienced “a severe depopulation trend” in the 20^{th} century. A similar trend has been reported for the North Plateau, the Iberic System and the Pyrinees in Spain (OECD, 2009, p. 44), but also for the Southeastern Europe, where “depopulation in some mountains has taken staggering proportions” (Zhelezov, 2011). Although generally characterized by a demographic vitality (Soja, 2012), large spatial disparities of population changes have been noticed in the Polish Carpathians as well.

Triggering factors may differ from one mountain area to another (economically or politically induced depopulations, natural constraints, etc.), but no matter the cause, depopulation has serious medium and long-term consequences on this special type of areas, generally characterized by high economic, social, cultural, and environmental potential, which explains the growing number of initiatives and the increasing attention paid to strategies to fight depopulation in these areas (PADIMA, 2012; Bausch, Koch and Veser, 2014). As the phenomenon is complex and territorially specific, practice indicates that holistic (Gløersen *et al.*, 2016) and place-tailored approach to tackling the demographic challenge in mountain areas is vital.

In Romania, mountain areas and the problems they face are known most in terms of their agricultural productivity, land fragility or the precariousness of human resources. This is confirmed by the inclusion of 71,341 km^2, namely 30% of the national territory, in the less-favoured mountain area category (LFMA), according to the Council Regulation (EC) No 1257/1999 (*Strategia de dezvoltare teritorială a României. România policentrică 2035*, 2014, p. 231).

The *National Rural Development Plan 2014–2020* (*Programul Naţional de Dezvoltare Rurală pentru perioada 2014–2020*, 2014) provides measures to support the mountain area, namely to encourage the emergence of farms and household-made products, but also the revitalization of the mountain villages by valorising their cultural heritage. In addition, it envisages the identification of solutions to mitigate demographic decline by supporting the creation of mountain cooperatives and groups of producers, with their own warehouses to facilitate the trade of mountain products.

According to *Law No. 350/2001 on spatial and urban planning*, less-favoured areas (LFAs) are strictly territorially delineated geographical areas with certain characteristics. Of those specified by law, the area under analysis is characterized by industrial restructuring and collective layoffs, as well as by an underdeveloped infrastructure. Additionally, several typologies of less-favoured areas can be identified, such as less-favoured agricultural areas, including less-favoured mountain areas, former less-favoured areas (with inactive legal status) and special economic areas – industrial restructuring areas and resorts (*Strategia de dezvoltare teritorială a României. Studiul de fundamentare 23. Zone cu specific geografic*, 2014, p. 15).

Another solution to support mountain areas is provided by the *Mountain Law No. 347/2004*, which encourages the consolidation of associative forms and the valorisation of the mountain area resources.

The *National Rural Development Plan 2014–2020* (2014) redefines LFAs in compliance with the new Community criteria. Therefore, for the programming period 2014–2020, LFAs are recognized as areas facing natural or other specific constraints (ANCs), with three categories of areas, namely “mountain areas”, “areas affected by significant natural handicaps” and “areas affected by specific handicaps”. *Measure 13. Payments for areas facing natural or other specific constraints*, included under the Romanian Rural Development Plan 2014–2020, is meant to support farmers in order to mitigate the risk of land abandonment in these areas and, hence, other associated risks such as loss of biodiversity or loss of valuable rural landscape.

The National Strategy for the Sustainable Development of the Mountain Area 2014–2020 (*Strategia Naţională pentru Dezvoltarea Durabilă a zonei montane 2014–2020*, 2014) recognizes the need for specific measures in order to address the specific challenges of the Romanian mountain areas. Out of its four overall objectives, one is specifically focused on increasing the attractiveness of the mountain areas and stabilizing the mountain population.

However, the current national measures meant to support the development of the mountain area make no reference, except tangentially, to concrete solutions applied to communities in demographic decline.

2. STUDY AREA

The study area broadly overlaps the Poiana Ruscă Mountains. Covering an area of 2,109.3 km^2, the study area overlaps the administrative territory of three counties (Caraş-Severin, Hunedoara, and Timiş) and 30 LAU 2 units, and includes 110 settlements, out of which 68 are located in the mountain area proper and 42 outside the mountain area, at the feet of the Poiana Ruscă Mountains. Some of these settlements currently have no inhabitants; however, they were included in the study area because buildings are still preserved.

The delineation of the area was made by taking into account both the settlements located in the mountain area and the ones with mountain-based economic activities. The economic activities of the latter, mostly in the secondary sector, contributed to attracting labour force from the mountain villages around. On the other hand, the exploitation of underground resources (charcoal, iron, marble) in the mountain settlements led to a strong polarization of the human resources from the immediately adjacent area (Hunedoara, Oţelu Roşu, etc.).

3. METHODOLOGY

The identification of demographic disparities in a mountain area affected by profound demographic changes, such as the Poiana Ruscă Mountains, is crucial and compulsory in any spatial planning and regional development strategy designed to respond to local needs. The analysis of demographic changes in a period of intense socio-economic transformations, such as the post-communist period, is a first step both to developing a sound understanding of the trend and reasons having led to certain demographic development and to forecasting the most likely trend that must be considered for further decision making and planning.

In order to identify the demographic evolution in the 110 settlements of the area (108 villages, one town: Oţelu Roşu, and one city: Hunedoara), we analysed population changes between the censuses of 1992 and 2011, with focus on the population growth/decline rate recorded between the two reference points and expressed as a percentage change from the initial value for 1992.

In the second phase, we estimated the size of the population expected by 2031 based on a business-as-usual (BAU) scenario.

Statistical data provided by the National Institute of Statistics Bucharest was processed and analyzed using Microsoft Excel 2016. Proportional and graduated symbol maps were then generated using ArcGIS 10.3 software to represent both the geographic location and the attribute value (number of inhabitants in each settlement in 1992 and 2011, number of inhabitants projected for 2031, absolute population change in each settlement between 1992 and 2011, population growth/decline rate in each settlement between the two reference years).

4. RESULTS

The evolution of the human communities in the Poiana Ruscă Mountains is rendered by three reference points, reflected by the population dynamics between 1992 and 2011 and by a population change projection for 2011–2031.

a). Population dynamics between 1992 and 2011

A large number of settlements in the area under analysis have developed as result of the exploitation and valorisation of the soil and underground resources of the Poiana Ruscă Mountains. Others, such as cities or towns (Hunedoara, Oţelu Roşu – two strong industrial centres, with long tradition in metallurgy), formed polarised areas by attracting the human resources from the mountain villages to work in the factories that used raw materials from the mountains nearby. At the same time, a number of inhabitants from the urban area moved and settled in the mountain villages that owe their existence to the exploitation of raw material resources.

With the industrial privatization and destructuring, this mountain area experienced the effects of transition. In 1992, very small, small and medium-sized settlements, between 15 and 1,000 inhabitants, were predominant (Table 1). In addition, there was only one settlement with no inhabitants (Curpenii Silvaşului in Hunedoara County) (Fig. 1).

Table 1

Human communities in the Poiana Ruscă Mountains in 1992

No. of inh.	No. of settlements					Population (1992)				
	CS	HD	TM	Total	%	CS	HD	TM	Total	%
0	-	1	-	1	0.9	-	-	-	0	0.0
1-14	-	4	-	4	3.6	-	28	-	28	0.0
15-49	1	11	-	12	10.9	19	405	-	424	0.3
50-99	-	15	1	16	14.5	-	954	51	1,005	0.8
100-249	1	24	4	29	26.4	100	3,908	756	4,764	3.7
250-499	5	15	8	28	25.5	1,977	5,241	2,895	10,113	7.9
500-999	2	6	3	11	10.0	1,637	3,887	1,972	7,496	5.9
1,000-1,999	2	2	1	5	4.5	3,751	2,898	1,133	7,782	6.1
2,000-4,999	-	1	1	2	1.8	-	2,675	3,277	5,952	4.7
5,000-12,000	1	-	-	1	0.9	-	11,799	-	11,799	9.2
40,000-80,000	-	1	-	1	0.9	-	78,551	-	78,551	61.4
Total	**12**	**80**	**18**	**110**	**100**	**7,484**	**110,346**	**10,084**	**127,914**	**100**

Source: 1992 Population and Housing Census.

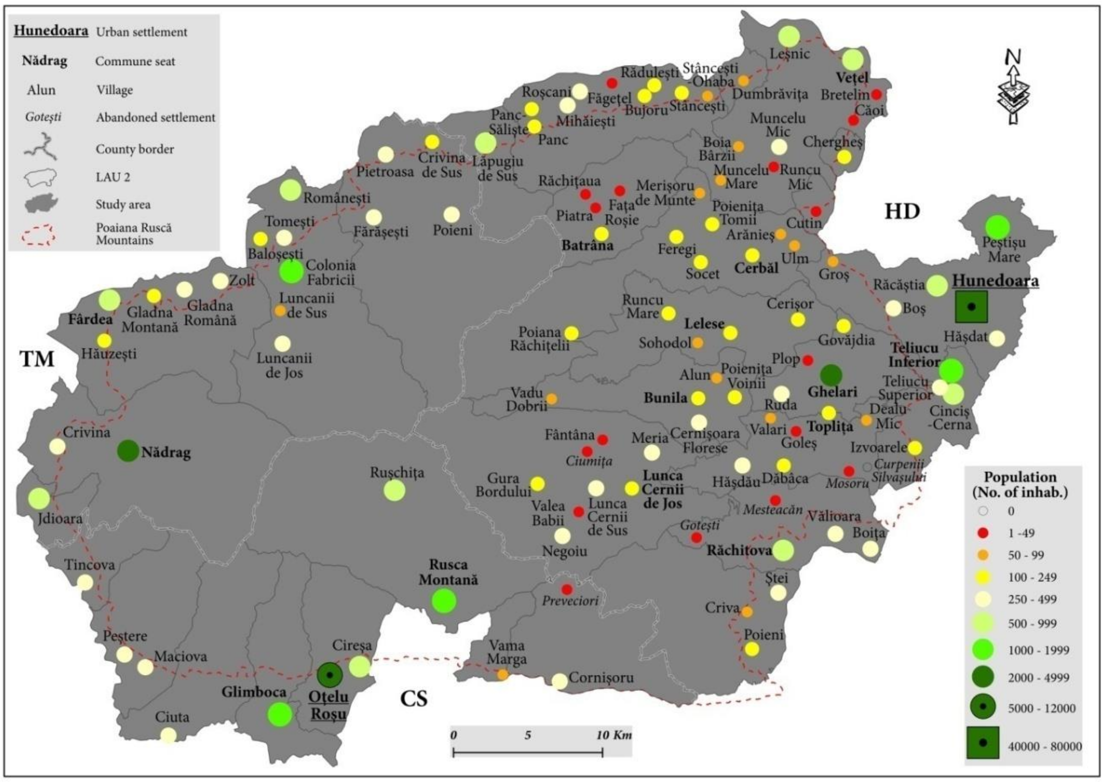

Fig. 1 – Human communities in the Poiana Ruscă Mountains in 1992.
Source: 1992 Population and Housing Census.

Twenty years later, the effects of economic transition were felt even more strongly in the evolution and population size of settlements. These demographic differences are observed both at the level of the study region and at the level of settlements, where particular situations arise. The general demographic trend is downward, resulted from a decrease in the total number of inhabitants from 127,914 inhabitants in 1992 to 96,320 inhabitants in 2011 (Table 2).

Table 2

Human communities in the Poiana Ruscă Mountains in 2011

No. of inh.	**No. of settlements**					**Population (2011)**				
	CS	**HD**	**TM**	**Total**	**%**	**CS**	**HD**	**TM**	**Total**	**%**
0	1	5	-	6	5.5	-	-	-	0	0.0
1-14	-	3	-	3	2.7	-	26	-	26	0.0
15-49	-	20	1	21	19.1	-	556	31	587	0.6
50-99	1	15	-	16	14.5	79	1,036	-	1,115	1.2
100-249	-	20	6	26	23.6	-	3,026	1,051	4,077	4.2
250-499	6	9	6	21	19.1	2,128	3,403	1,978	7,509	7.8
500-999	1	4	4	9	8.2	651	2,627	2,411	5,689	5.9
1,000-1,999	2	3	-	5	4.5	3,314	4,109	-	7,423	7.7
2,000-4,999	-	-	1	1	0.9	-	-	2,548	2,548	2.6
5,000-12,000	1	-	-	1	0.9	9,461	-	-	9,461	9.8
40,000-80,000	-	1	-	1	0.9	-	57,885	-	57,885	60.1
Total	**12**	**80**	**18**	**110**	**100**	15,633	**72,668**	**8,019**	**96,320**	**100**

Source: 2011 Population and Housing Census.

At settlement level, very small and small-sized settlements continued to face a negative demographic evolution. The same downward trend was recorded in Hunedoara area and in the two urban centres (Hunedoara and Oţelu Roşu). In the mountain border area, five more settlements were reported to have no inhabitants (Preveciori, Goteşti, Mesteacăn, Mosoru and Ciumiţa) (Fig. 2).

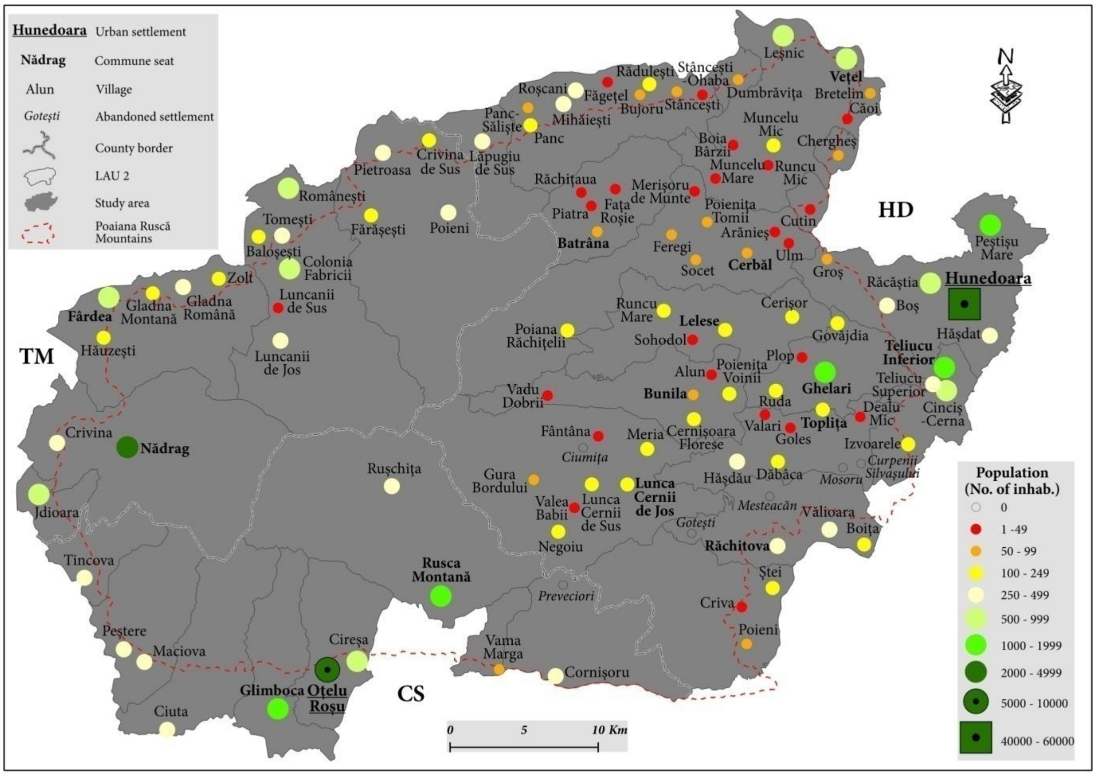

Fig. 2 – Human communities in the Poiana Ruscă Mountains in 2011.
Source: 2011 Population and Housing Census.

The population growth/decline rate, expressed as a percentage change from the initial value for 1992, highlights some particular situations. Of the total of 110 settlements in the area, only nine settlements (of which two very small and seven medium-sized settlements) recorded an upward demographic trend and one settlement is stagnant (Curpenii Silvaşului, with no inhabitants) (Table 3). It must be noted that the two very small settlements, namely Căoi and Bretelin (Hunedoara County), are likely to follow a downward trend because the number of newcomers is not consistent.

Table 3

Population growth/decline rate in the settlements of the Poiana Ruscă Mountains

No. of inhabitants	Population growth rate												Population decline rate																Total
	+50 - 100 (%)				+0.1 - 25 (%)				0 (%)				-0.1 - 24.9 (%)				-25 - 49.9 (%)				-50 - 99.9 (%)				-100 (%)				
	CS	HD	TM	T	CS	HD	TM	T	CS	HD	TM	T	CS	HD	TM	T	CS	HD	TM	T	CS	HD	TM	T	CS	HD	TM	T	
< 50		1		1		1		1		1		1		1		1		3		3		5		5	1	4		5	17
50-99														4		4		1	1	2		10		10					16
100-249													1	2	3	6		17	1	18		5		5					29
250-499	1			1		2	2	4					3	4	5	12	1	6	1	8		3		3					28
500-999						2		2					1	3	3	7		1		1	1			1					11
1,000-1,999													2	2		4			1	1									5
2,000-4,999															1	1		1		1									2
5,000-12,000													1			1													1
40,000-80,000																		1		1									1
Total	1	1	0	2	0	5	2	7	0	1	0	1	8	16	12	36	1	30	4	35	1	23	0	24	1	4	0	5	110

Source: 1992 and 2011 Population and Housing Censuses.

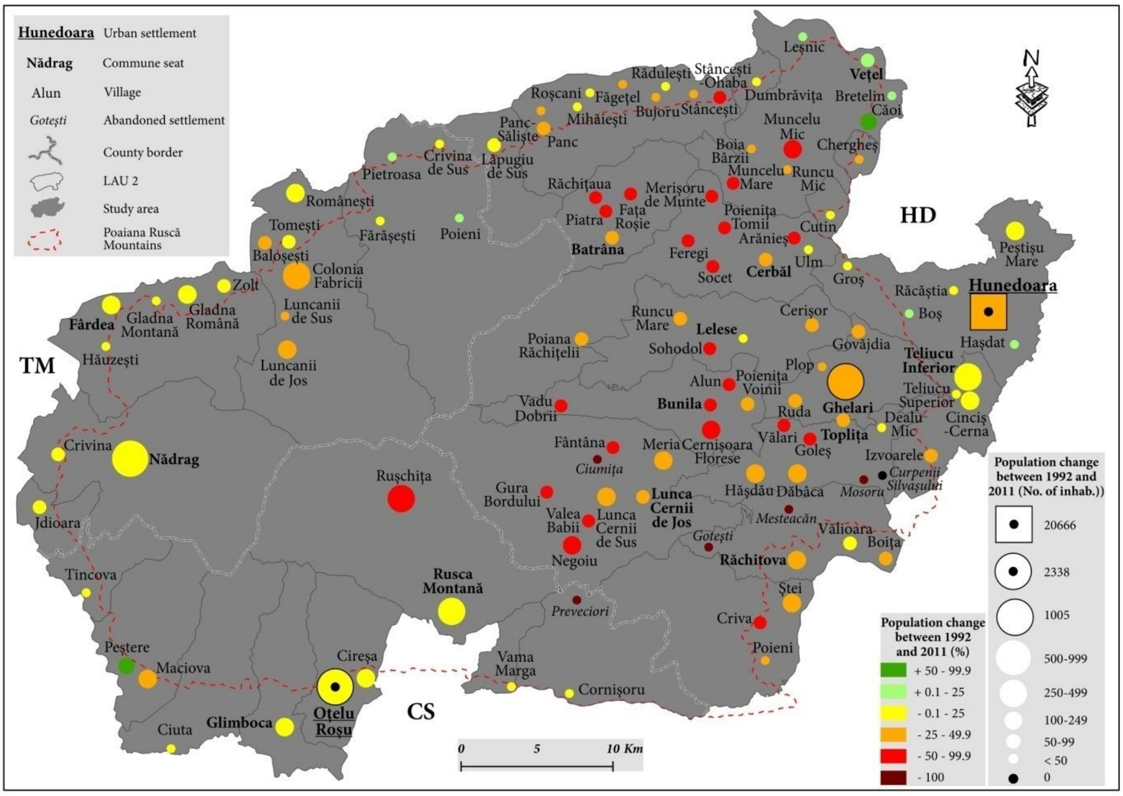

Fig. 3 – Population changes in the settlements of the Poiana Ruscă Mountains between 1992 and 2011.
Source: 1992 and 2011 Population and Housing Censuses

The vast majority of settlements recorded a negative demographic evolution. The settlements most affected by population loss were the very small ones (with less than 100 inhabitants), mostly located in Hunedoara county (Fig. 3). The causes of this substantial decline (between –50 and –99.9%) is due to a negative natural and migratory balance, population aging and cessation of some economic activities.

b). Estimated population changes in the settlements of the Poiana Ruscă Mountains

If we start from the premise that the demographic trend recorded so far is preserved, the demographic state of the mountain area will get worse by the next two censuses as result of an estimated loss of 20,000 inhabitants at regional level.

Table 4

Estimated population changes in the Poiana Ruscă Mountains (2031)

No. of inh.	No. of settlements					Population (2031)				
	CS	HD	TM	Total	%	CS	HD	TM	Total	%
0	1	5	-	6	5.5	-	-	-	0	0.0
1-14	-	16	-	16	14.5	-	141	-	141	0.2
15-49	-	17	1	18	16.4	-	544	18	562	0.8
50-99	1	16	1	18	16.4	62	1,083	81	1,226	1.7
100-249	3	12	7	22	20.0	514	1,861	1,240	3,615	4.9
250-499	2	6	7	15	13.6	761	2,292	2,627	5,680	7.7
500-999	2	4	1	7	6.4	1,181	2,645	500	4,326	5.9
1,000-1,999	2	3	1	6	5.5	2,939	3,100	1,981	8,020	10.9
2,000-4,999	-	-	-	0	0.0	-	-	-	0	0.0
5,000-12,000	1	-	-	1	0.9	7,586	-	-	7,586	10.3
40,000-80,000	-	1	-	1	0.9	-	42,656	-	42,656	57.8
Total	**12**	**80**	**18**	**110**	**100**	**13,043**	**54,322**	**6,447**	**73,812**	**100**

The settlements that will be the most affected by population decline are the very small ones, especially those with a population ranging between 1 and 50 inhabitants (Table 4), and many of them are most likely to become abandoned settlements. Spatially, the highest level of population scattering will occur in the villages located in Hunedoara County (Fig. 4).

The absence of concrete housing policies and the lack of regional or local initiatives for the conservation of traditional villages entail irretrievable loss of a number of permanent residents, which inevitably results in the extinction of the respective settlements.

5. CONCLUSIONS

Analysis of the 1992 and 2011 population census data indicates a general downward population trend. However, population changes are unevenly distributed across the Poiana Ruscă Mountains. The nine settlements (two of them in the very small size category) that observed an increase in their population are located at the very border or outside the mountain area and show a concentration in the north-east (Leşnic, Veţel, Bretelin, and Căoi, all located in the commune of Veţel, in the proximity of the city of Deva; Boş and Hăşdat, component settlements of the city of Hunedoara). One settlement (Curpenii Silvaşului) was stagnant, recording no inhabitants both in 1992 and in 2011, while the other 100 settlements, including the two urban centres (Hunedoara and Oţelu Roşu) fell in the settlements with negative demographic evolution category. All the settlements with a population decline rate ranging between –50 and –100% (Ruşchiţa in Caraş-Severin County and other 28 settlements in Hunedoara County) are located in the heart of the mountains.

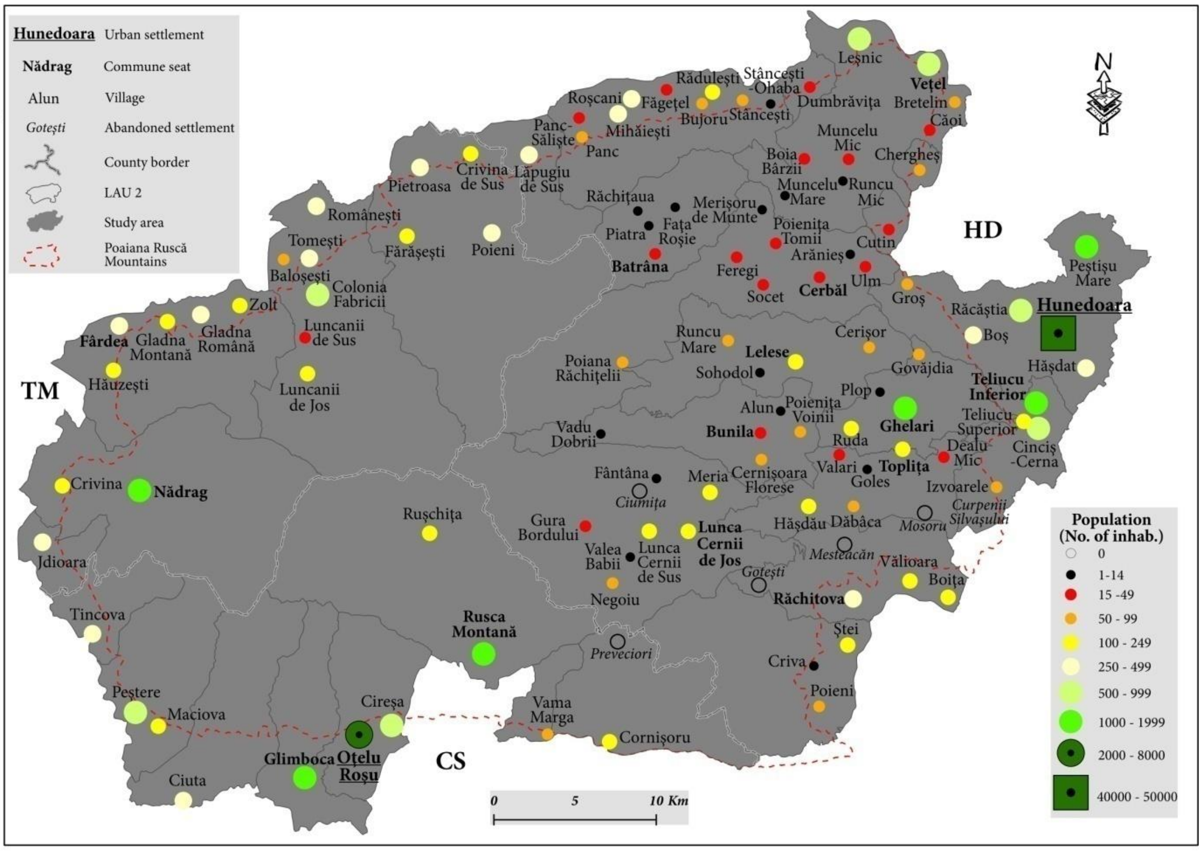

Fig. 4 – Human communities
in the Poiana Ruscă Mountains by 2031.

Although demographic risk phenomena, including depopulation of villages, are perceived as potential threats to mountain areas, the actions to mitigate or eliminate them are not explicitly found among the national intervention measures aiming at reviving the mountain area, which are mostly oriented towards its agricultural valorisation, within the framework of the existing financial mechanisms. Faced with an irreversible exodus associated with a sharp demographic aging phenomenon, most of the very small-sized settlements in the study area do not have the necessary lever to maintain their viability and, therefore, they are most likely doomed to extinction in a not too far away future. And the population projection for 2031 that we made based on a business-as-usual (BAU) scenario clearly indicates this direction.

Consideration of policies to revive rural settlements, and especially the ones located in mountain areas, diversification of rural activities or even the identification of different settlement functions and other segments of population (e.g. holiday villages) along with supporting certain complementary economic activities and investments in infrastructure are the main directions to follow.

However, in order to support the knowledge-based planning and decision support making strategies that must be in line with the local needs, further attention should be paid to analysing the perception of the local community on the demographic phenomena they live, to identifying the dysfunctions they perceive and the potential solutions they foresee for themselves.

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RECENT CHANGES IN ROMANIA'S ETHNICAL STRUCTURE. THE CHINESE MINORITY – A CASE STUDY

RADU SĂGEATĂ[*]

Key-words: ethnical structure, recent changes, Chinese community, Romania.

Abstract. People of Chinese origin currently constitute one of the largest overseas populations in the world, with over 50 m people studying working and living outside of China today. The country has a long tradition of emigration. Indeed, since the 16th century, China has seen multiple populations waves move to North America and Southeast Asia. Countries such as Singapore, Thailand, Malaysia and Indonesia host flourishing Chinese communities, which play an active and in some cases dominant role in their respective countries' finance and trade with China. Romania could not avoid these evolution. The downfall of the communist system in Central and Eastern Europe and the abolishment of ideological barriers has created the premises for closer globalizing links within the urban systems from this part of the Continent. The majority of the Chinese who live in Romania are engaged in commercial activities concentrated in the Colentina–Dobroești–Voluntari area ("China Town") but in some production activities (bicycle factories, wood processing industry, construction materials, print technology, recycling, etc.).

1. INTRODUCTION

The ethnical structure of any territory is the outcome of a long process of evolution marked by a succession of political-ideological changes experienced in the course of time. Thus, some ethnical communities would disappear, lose considerable numbers and impact due to political circumstances (wars, deportations, persecutions) and/or to economic disparities between the territory of origin and the new residential one; on the other hand, new ethnical communities would emerge once political-ideological barriers fell and globalizing flows acquired momentum, generalizing.

Romania made no-exception to those evolutions. After the Second World War and especially after 1989, the German community (the Transylvanian Saxons and the Swabians from Banat), as well as the Jewish and Armenian communities would decline numerically, their place being filled by newcomers from thousands of kilometers afar (e.g. the Chinese and the Arabs).

2. THE CHINESE DIASPORA

Nowadays, the *Made in China* brand has increasingly become synonymous with globalization. The biggest demographic power in the world (ca. 19% of the global population), China is also a great economic power, coming second after the USA. According to World Bank reports, the Chinese economy would increase approximately twice versus the American one, while India (third place) toppled Japan. As a result, the three great demographic powers came to disputes also the place in the world's economic hierarchy. The Chinese economy relies on the largest diaspora worldwide (over 50 million inh.), that is, almost thrice Romania's population. For a better understanding of the Chinese demographic phenomenon let us recall that towns like Shanghai or Beijing exceed all of Romania's population.

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The Chinese emigration is in no way a recent phenomenon. Given the geographical proximity to China of Indochina, Korea and Indonesia coastal zones, Chinese populations colonized them as early as the Antiquity, having substantially contributed to shaping their cultural identity.

As early as the Ming Dynasty, the Chinese navigator Zhèng Hé was assigned seven expeditions (1405–1433) in the Indian and Pacific Oceans to fight piracy, which threatened Chinese trade, and also make coastal investigations, reaching as far as Arabia and East Africa. During the Qing Dynasty (1644–1912), several normative acts were issued, constantly restricting migratory flows; those who left the country without official permit were considered traitors and executed. Having a high natural increase rate and restricting emigration, led to a substantial numerical rise of population, pushing China into the forefront of the world hierarchy.

Yet, it was only in the second half of the 19th century, that the imperial authority declined and European influences penetrated into the country; the Chinese diaspora emerged (largely after 1910), when the monarchy was abolished and the Republic of China came into being (1911–1949). The normative barriers limiting emigration fell and a sudden outflow of population, especially to South-East Asia, but also to Australia and beyond the Pacific, took place. Widespread poverty, particularly in the country-side, famine and the dissolution of the British, French, and Dutch colonial systems produced a shortage of labour in the new South-Asian states because many European citizens, or their heirs, residents in these countries, migrated to the former colonial metropoles looking for better living conditions.

In this way, Chinese communities appeared in Singapore, the Philippines, Indochina, Indonesia and Korea, Australia and America, mostly in the USA. These communities would substantially grow numerically especially after the 1949 Civil War, when the Communist Party came to the helm of the country. The removal from power of the Kuomintang national forces would considerably augment emigration fluxes as people tried to escape persecutions in Communist China. This move would dynamise the Japanese economy and contribute decisively to the other emerging economies in South-East Asia (Singapore, South Korea, Malaysia, Indonesia, Thailand and Brunei). Simultaneously, migrational flows to the Western states would increase along three directions: to America (particularly the USA, Canada, Brazil and Peru); Western Europe (especially to Germany and France), Australia and New Zealand. Emigration targeted also the Communist Bloc, e.g. on the one hand, the Russian Far East and South Siberia (Buryatia, Tuva, Altai, etc.) and, on the other hand, Vietnam, where the Chinese minority is known by the name of *hoa*.

The 1989 events in Tienanmen Squere, followed by the transfer to China of the British and Portuguese sovereignty over the cities of Hongkong (1997) and Macao (1999), increased emigration waves, many of their citizens holding double citizenship. These events marked a turning-point in the Chinese economic policy, engendering new special economic zones[1].

Chinese emigration to Africa got momentum largely after 2000, when economic agreements with the raw-material exporting countries were signed (South-Africa, Angola, Zambia, Namibia, Nigeria, Chad, Algeria, etc.). Chinese exports to Africa consisted in both infrastructure exploitation technique, with the corresponding workforce, and an entrepreneurial culture, which was distinctively different from what existed in the host countries. As a result, the Chinese communities would in time acquire privileged places in the economic and social hierarchy of the host-countries. This situation has often generated resentments among the population of the poor countries in particular, incidentally turning into social tension and conflicts (e.g. the 1969 anti-Chinese revolts in Malaysia, 1965–66 and 1988 in Indonesia, and 2006 in Tonga).

At present, the largest Chinese communities live in South-East Asia, representing the majority in Singapore (74.1% of the total population), holding an important share in Malaysia (24.6%; 6,960,900 pers.) and Thailand (14.0%; 9,392,900 pers., the largest Chinese community in South-East Asia). As a matter of fact, nearly half (ca. 22 million) of the overall Chinese diaspora live in Thailand, Malaysia, Indonesia and Singapore (Fig. 1).

[1] Shenzen zone in the proximity of KongKong, and Zhuhai zone established close to Macao.

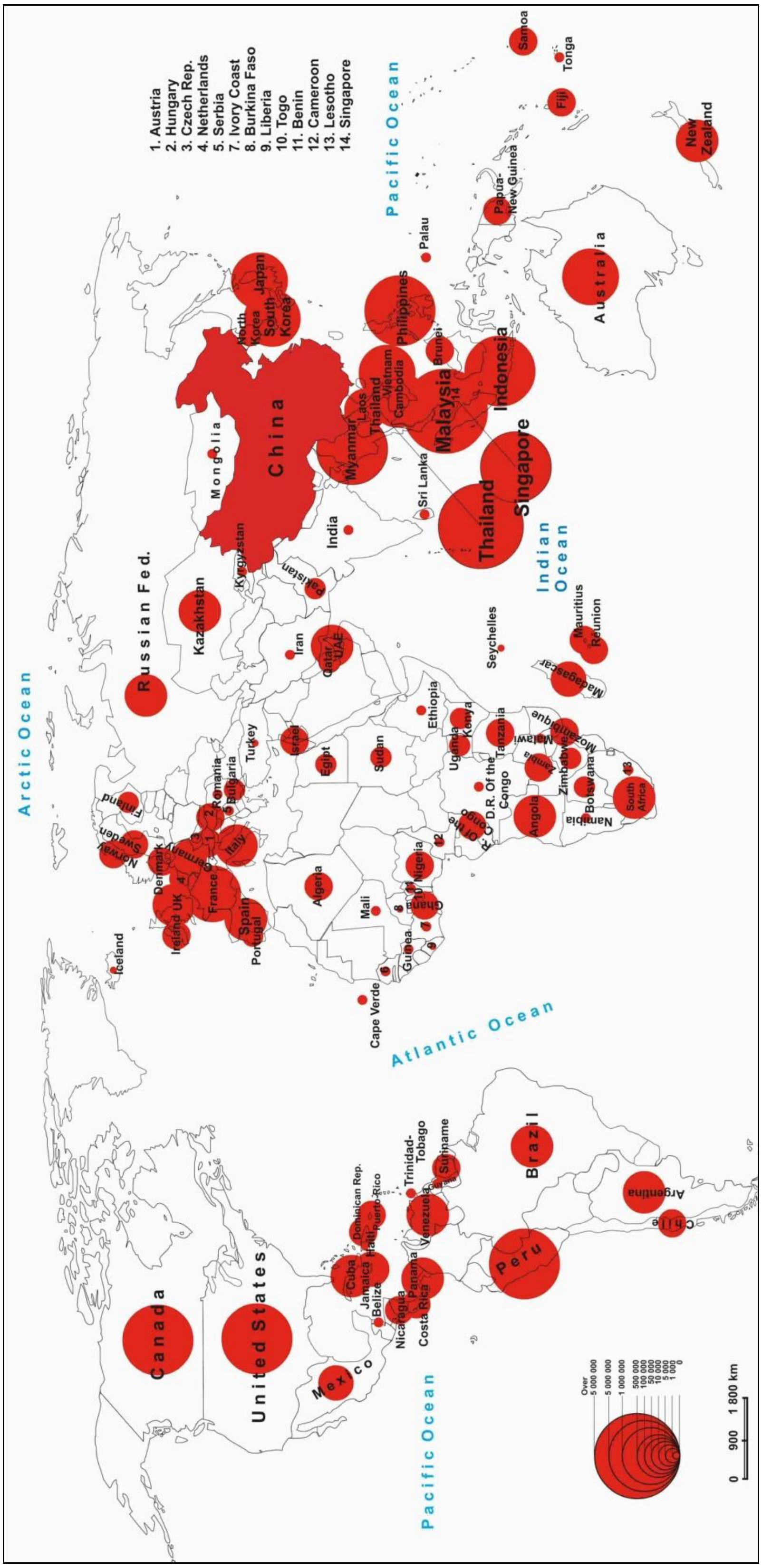

Fig. 1 – Chinese emigration in the world (2015).
Data sources: Calendario Atlante de Agostini, Instituto Geografico de Agostini, Novarra, 2014.

Some of the towns (China Towns) in the above-mentioned states also have the largest Chinese communities: Bangkok (2,900,000), Singapore (2,800,000), Penang (650,000), Kuala Lumpur (612,300) and Jakarta (528,000) (Table 1).

The south of Siberia is perhaps the most characteristic demographic discontinuity worldwide. Despite ancient exchanges of population, the Sino-Soviet ideological gap (1956–1985)[2] affected also this segment as the northern Chinese border became relatively closed[3]. In this way, the area was subjected to a strong demographic pressure between the Chinese ethnical bloc in the south (average density 145 inh./km^2, often 1,000 inh./km^2 in the vast plains of Huang He and Yangtze) and the Siberian peoples in the north (average density under 1 inh./km^2).

Table 1

The largest Chinese communities in South-East Asia (2015)

Host-country	**Total number of Chinese**	**Ratio of Chinese / total population of host-country**	**Cities hosting important Chinese communities**		
			City name	**Total number of Chinese**	**Ratio of Chinese / total city population**
Thailand	9,392,900	14.0	Bangkok	2,900,000	35.0
Malaysia	6,960,900	24.6	Penang Kuala Lumpur	650,000 612,300	39.1 34.6
Singapore	2,808,300	74.1	Singapore	2,808,300	74.1
Indonesia	2,832,510	1.2	Jakarta	528,000	5.5
Myanmar	1,637,500	3.2			
The Philippines	1,350,000	1.3			
Vietnam	970,900	1.1			
Cambodia	800,000	6.0			
Korea Rep.	800,000	1.6			
Japan	674,900	0.5			

Data sources: Calendario Atlante de Agostini, Instituto Geografico de Agostini, Novarra, 2014.

As the ideological blockage was lifted, the demographic flows northward got momentum, the share and influence of the Chinese communities from south and east Siberia in the local economy growing. The number of Chinese living in the Russian Federation is estimated at 200,000 – 400,000 people, diffusely distributed, being concentrated especially in the south of Siberia autonomous republics and in the big urban centres.

The Chinese communities living in the USA and Canada (ca. 5.3 million people) are the followers of the economic immigrants who began arriving especially in the latter half of the 19th century. They would concentrate in five areas of big urban agglomerations: New York, San Jose – San Francisco – Oakland, Los Angeles, Toronto and Vancouver.

Latin America hosts over 2.6 million Chinese people, half of them living in Peru (1.3 mill., 4.1% of the country's population). They are known by the name of tusán, derived from Taishan (Toishan) city, Guangdong Province (China), the first Chinese emigrants to Peru having originated therefrom. Beginning with the 16th – 17th cc, they had been brought as slaves by Spanish and Portuguese navigators (Look, 2010).

For all the significant cultural differences, the Chinese immigration to Australia and New Zealand has never ceased, currently representing some 4% of the overall population in each of these countries (i.e. 12 mill. people).

[2] A Sino-Soviet ideological gap, begun in 1956, became known only after 1961, when the Chinese communists officially denounced the "band of Soviet leadership traitors"; things would smooth down in 1985, when Mikhail Sergeyevich Gorbachev and Deng Xiaoping came to rule Russia and China, respectively.

[3] Mongolia growing into Moscow's ideological satellite.

Obviously, in most cases, migrational flows were generated by economic factors, being facilitated through the intermediacy of the powerful South-East Asian Chinese communities. According to statistical data, about 866,500 Chinese live in Australia[4] and some 180,000 in New Zealand[5].

Chinese migration to Africa is a recent, exclusively economic, demographic phenomenon that got momentum after the year 2000. The agreements concluded between Chinese investors and their African partners have in view industrial and infrastructural co-operation projects to be implemented with Chinese management and workforce, local labour being hired only on condition that they should observe certain quality standards imposed by the Chinese managers. As a result, Chinese specialists and workers, most of them together with their families, came to work in the African states, forming gated communities.

The host-countries, China has trade relations with, have a relative political stability and important mineral resources. About 50% of the Chinese residents in Africa are found in two southern African states: the South-African Republic (ca. 350,000 pers.) (Rahimy, 2009) and Angola (259,000 pers.), being employed mainly in the extractive industry.

Massive Chinese immigration to Western Europe occurred after 1950, when political opening began, the EEC came into being, and post-war economic development was short of labour force. The EU Chinese communities are put to some 2 million people.

Most of them live in France (700,000 pers.), basically one-third (1%) of that country's population. The explanation would be that Indochina, a former French colony, triggered emigration flows to the colonial metropole. A second destination for the Chinese emigration was the United Kingdom of Great Britain and Northern Ireland (over 450,000 Chinese settlers, 0.7% of the country's population). Italy has the third largest Chinese community in the EU (320,794 pers.)[6], migrants coming at a faster rate in the last 15 years. Next in line stands Spain (166,223 pers.)[7], the Chinese immigration also dating from colonial times, a massive move beginning in the years 1920–1930, and especially after 1990, people being tempted by economic opportunities. The other countries hosting Chinese communities on their territory are Holland (80,198 pers., 0.5% of that country's population)[8], Germany (56,000 pers.)[9], Sweden, Austria, Ireland, Norway and Denmark (between 10,000 and 40,000 pers. each).

3. CHINESE EMIGRATION TO ROMANIA. CONSEQUENCES. CHINESE INVESTMENTS

China's economic opening promoted by Deng Xiaoping[10] after 1985, associated with the collapse of the communist political system in Central and Eastern Europe, triggered a strong Chinese immigration in this part of the Continent, too. The Chinese community in Romania, established in the 1990s, would evolve at a fast pace, setting in the North-Eastern part of Bucharest, the country's capital.

According to official statistics (October, 20, 2011 Census data), 2,017 Chinese live in Romania, but their real number is by far greater, given that many of them dwell here without legal forms. The Romanian Office for Immigration advances the figure of 8,253 persons[11], that is four times more (Wundrak, 2010).

[4] Cultural Diversity in Australia. Reflecting a Nation: Stories from the 2011 Census, Australian Bureau of Statistics, https://www.abs.gov.au, Nov. 2015.

[5] Statistics New Zealand, 2013 Census QuickStats about culture and identity, https://www.stats.govt.nz, Nov. 2015.

[6] https://en.wikipedia.org/wiki/Chinese_people_in_Italy, Nov. 2015.

[7] Under Spanish Census, Jan. 1, 2009.

[8] In 2012.

[9] In 2010.

[10] Deng Xiaoping (1904–1997), the third President of the Chinese People's Political Consultative Conference, and of the Central Military Commission of China, was the founder of the "Chinese type of socialism" and of the "socialist market economy".

[11] Source: stirileprotv./stiri/Romania-te-iubesc-intre-doua-luni-romano-chinezii.html., Dec. 2015.

In terms of territorial distribution, large numbers are registered in Bucharest city, Romania's capital and in Ilfov County (1,032 and 681 people, respectively), accounting for 85% of all Chinese nationals who live in Romania. In Ilfov County, most of them are found in Voluntari town (359 pers.), in Dobroeşti (210 pers.) and Ştefăneştii de Jos (72 pers.) communes. Other nuclei of legal Chinese residents in Romania are the counties of Hunedoara (60 pers.) and Buzău (32 pers.), especially in Pârscov Commune (27 pers.) (Fig. 2).

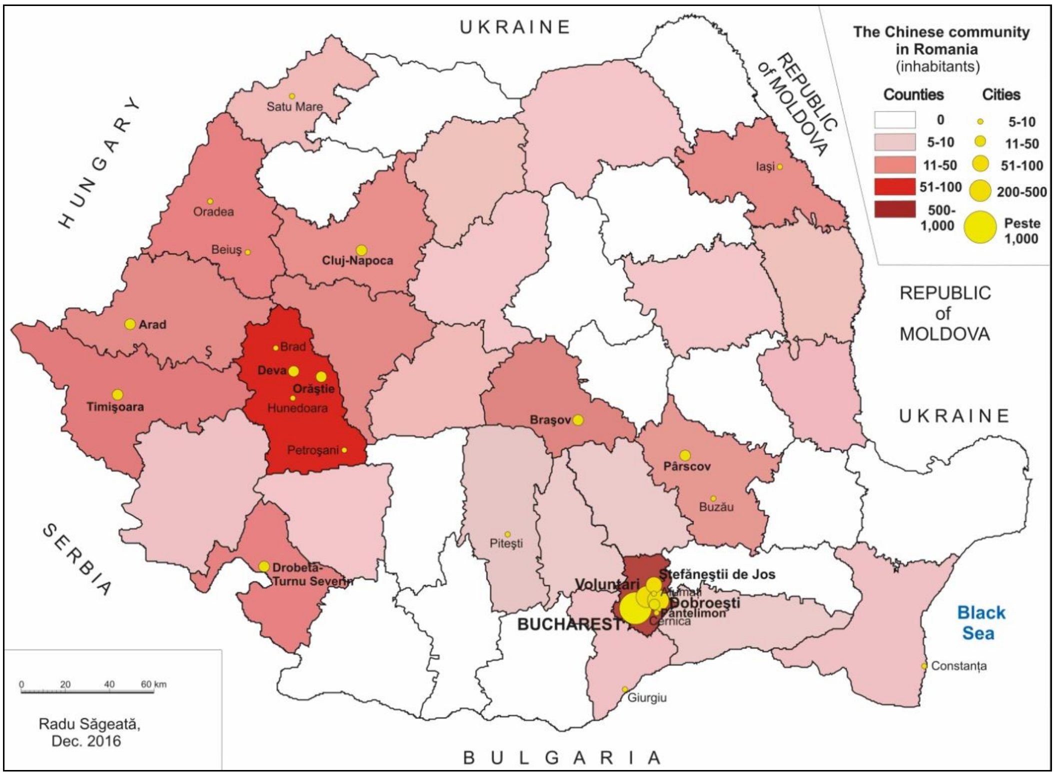

Fig. 2 – The Chinese community in Romania (2011 Population and Housing Census data).

In Bucharest, it is Sector II which registers 886 Chinese residents, out of the 1,032 hosted by the city, that is 85.8% of all those who live in it, and 43.9% of all those who reside in Romania (Fig. 3). There is territorial contiguity between the Chinese-inhabited area (China Town Romania) on the territory of Voluntari and Pantelimon towns, of Dobroeşti and Ştefăneştii de Jos communes.

Most of these people deal in trading and services (restaurants serving specific Chinese dishes), commercial complex units like *Europa* and *Niro*, developed in the 1990s, are located on the outskirts of Bucharest along the highway to Urziceni Town (Colentina – Voluntari route), and represent an agglomeration of retail stands belonging mainly to Turkish, Arab and Chinese investors. The *Dragonul Roşu* (Red Dragon) Company, set up in 2003 by the *Niro Investment Group* of firms, underlies the *China Town Romania* project, centred on Dragonul Roşu commercial area (142,570 m^2) which has 10 pavilions with 5,500 shops. Most commodities originate from China, but some one-third of the traders are Romanian nationals. *Dragonul Roşu* commercial complex, employing around 9,000 people (Mureşan, 2015), is visited by some 15,000 potential buyers daily. Beginning with 100% Chinese goods and traders, at present one sees by 30% fewer Chinese operators and only 60–70% goods from China[12].

[12] Idem.

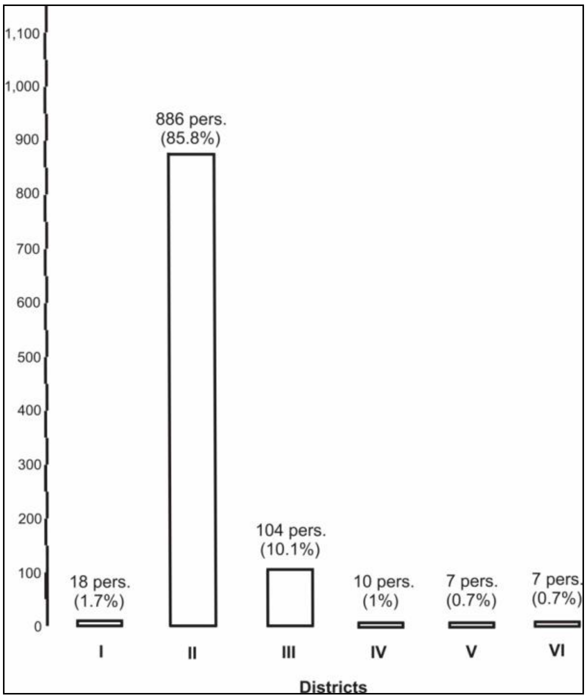

Fig. 3 – The Chinese Community in Bucharest (2011 Population and Housing Census data).

Dragonul Roşu (Fig. 4) commercial complex, the core of the China Town Romania Project, will be extended in the Bucharest – Dobroeşti – Voluntari – Afumaţi area, where China Business Centre Romania and a residential complex (China Towers), consisting of 12 blocs-of-flats with 600 apartments, are scheduled to be built[13].

Fig. 4 – "Dragonul Roşu" (*Red Dragon*) Complex (interior) preserves influences of Chinese architecture (Photo Radu Săgeată, June 2015).

[13] *China vrea în UE cu escală prin România* [China wants to be in the UE with a stoper in Romania], by Adrian Mihai, National Journal Magazine, http://www. media.imopedia.ro/stiri-imobiliare/china-vrea-in-ue-cu-escala-prin-romania-1370.print.html, Dec. 2015.

Chinese investment in Romania was a slow-going process, with only ten more important investments having been reported until the second semester of 2001 (Fig. 5).

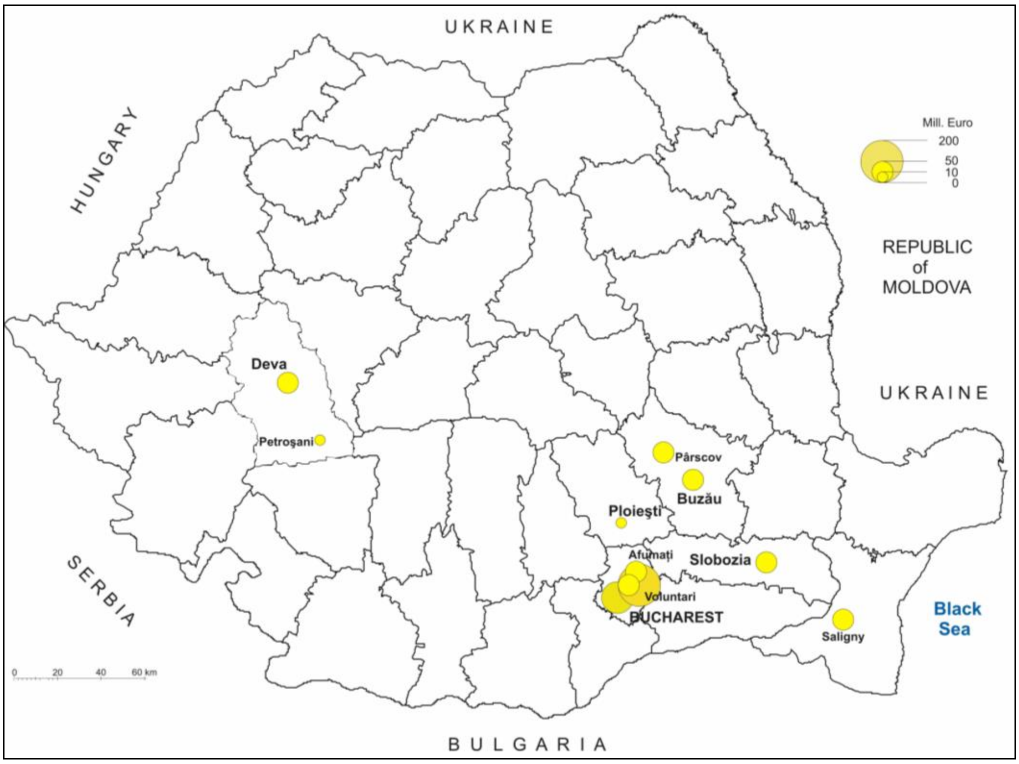

Fig. 5 – The main investments of Chinese capital in Romania (2015).
1. Counties with Chinese investments, 2. The value of vested capital (mill. euro).
Data source: Cireaşă, 2011.

In addition to the Chinese investment made in the north-east of Bucharest, a few others, yet not that big (under 50 mill. euro), were placed in the countries of Buzău, Prahova, Constanţa, Ialomiţa and Hunedoara some of them being located in the country-side as well.

In 2011, the value of Romanian – Chinese exchanges amounted to 14 billion USD, out of which only 544 mill. represented Romania's exports to China, a negative trade balance, while imports from China would double compared to 2005 (Tiron, 2012).

At the end of 2014, ZTE Company, one of the biggest producers of telecommunication networks in China, opened a services centre in Romania which provided 250 new jobs[14]. This comes besides a new major investment in mobile telecommunications from the Huawei Technologies which, in 2012, had opened a regional centre in Bucharest, providing technical assistance to Central and Eastern Europe, to Northern and Western countries. The Chinese investment for this development was of 6 million euro, with the intention of raising it to 100 million euro until 2018, in addition to the 90 million euro of Chinese investment over 2007–2012[15]. At the end of 2014, Huawei Romania numbered about 1,200 employees, over 70% of them Romanian nationals, it also supplying some 2,500 temporary jobs in the operational units of Romania[16].

[14] Source: http://ziare.com/afaceri/investitii-straine/chinezii-de-la-zte-vor-investi-in-romania-veste-buna-pentru-vestul-tarii-1290232, Mar., 27, 2014; Dec. 2015.

[15] Source: http://www.capital.ro/seful-huawei-romania-avem-in-plan-investitii-de-100-mil-euro.html, Sept. 12, 2014.

[16] Idem.

China's investment is placed also in the energy sector, especially in building sectors 3 and 4 at the Cernavodă Nuclear Station[17], as well as in the Rovinari and Mintia–Deva energy estates, in aeolian centrals projects, and in the construction of the Tarniţa–Lăpuşeşti water-power plant on the Someşul Cald River (1,000 MW installed power; a 1.16 billion euro investment that will create nearly 1,000 new jobs)[18].

Also attractive to Chinese investment is the transport infrastructure, with a high-speed railway to be built on the Vienna–Bucharest–Constanţa line[19].

The Chinese interest in agriculture covers the import of food products (mainly meet, wine, cereals and bee honey), and industrial equipments. Food exports to China will grow to ca. 1 billion euro/year, that country's total investments in Romania reaching up to 8.5 billion euro[20].

However, the main problem facing the authorities is connected with the extent to which the Chinese can integrate, they often stating that, not being familiar with Romanian, they do not understand the rules of this country.

4. CONCLUSIONS

The biggest diaspora worldwide is not only demographic, but also economic. The post-war economic progress made by the South-East Asian states is largely due to the Chinese communities. The cheap labour-force that came from China, Taiwan or from South-East Asia has stimulated the economic development of Western Europe and North America.

On the other hand, implementing liberal-type reforms in the Chinese economy, encouraged migrational fluxes and the establishment of a powerful Chinese diaspora that contributed to improving international relations, creating new commodity markets and implicitly infusing foreign capital in the Chinese economy. As a result, the Chinese economy has constantly developed over the last three decades, surpassing the phase of a poverty-stricken economy and succeeding in solving major problems of food and clothing for millions of people, while creating important export availabilities. The former Chinese emigrants, or their followers, actual millionaires, started coming back to their homeland and provide new jobs.

However, despite the strong Chinese community existing in Romania, the Chinese presence is still below the possibilities offered by the Romanian market, what they are dealing in is mostly the import of goods and making small investments in family business (trade, services and the small industry).

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[18] Source: http://evz.ro/investitiile-chineze-in-romania-intra-in-faza-galopanta-1069580.html, Jan. 4, 2014.

[19] Idem.

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POPULATION LIFESTYLE AND HEALTH IN IALOMIŢA COUNTY (ROMANIA)

ANA-MARIA TALOŞ *

Key-words: population lifestyle, health, lifestyle components, Ialomiţa County, Romania.

Abstract: L'état de santé de la population est influencé par divers facteurs tels les facteurs socio-économiques, les facteurs liés au niveau de vie ou à l'organisation des services de santé. De plus, de nombreuses études ont également souligné le rôle joué par le mode de vie; un mode de vie sain est souvent associé à une bonne santé. Les composantes de mode de vie tels la structure de la consommation alimentaire, l'activité physique, certains comportements nocifs sont étroitement liés au niveau de l'éducation, lieu de résidence, l'âge ou aux traditions familiales. L'objectif de l'étude est d'explorer d'une part la relation entre le mode de vie et l'état de santé de la population du département Ialomiţa et, d'autre part, la manière dans laquelle certains éléments du mode de vie peuvent largement contribuer à une croissance de la fréquence de certaines maladies. Suivant un cadrage méthodologique spécifique, notamment pour le tri de localités envisagées dans l'étude, on a analysé les changements de l'habitude alimentaire, l'activité physique, les comportements nocifs (tabagisme et consommation d'alcool) et le comportement sanitaire de la population. Les données ont été recueillies dans l'enquête menée dans les localités Slobozia, Bărbuleşti, Balaciu et Drăgoeşti et qui présentent d'ailleurs un état de santé variée (très bonne, bonne et précaire/mauvaise). Les résultats préliminaires de l'étude ont montré que le mode de vie est un facteur déterminant pour l'état de santé de la population en cause, mais il y a également d'autres facteurs à prendre en compte afin d'évaluer la santé de la population. Ainsi, les femmes, les personnes âgées ou aisées semblent être plus adaptées aux modes de consommation alimentaire équilibrée et à une activité physique soutenue; en plus, elles prouvent des comportements moins nocifs et acquirent un comportement sanitaire approprié.

1. INTRODUCTION

It is well known that health status varies according to several determinants as health services, sociodemographic factors and lifestyle. Several researches investigate the relationship between lifestyle and population health status.

According to World Health Organisation, lifestyles are "*patterns of (behavioral) choices from the alternatives that are available to people according to their socio-economic circumstances and the ease with which they are able to choose certain ones over others*" (WHO, 1986).

Previous studies undertook a comprehensive investigation of the association between sociodemographic components, lifestyle factors and health status (Li *et al.*, 2017), while others have shown a close epidemiological association between fruit and vegetable consumption and health (both illness and wellbeing) (Stranges, 2014).

A healthy lifestyle can be defined by a combination of modifiable factors: healthy diets (Martinez-Gonzalez, 2014), physical activity, low adiposity, nonsmoking, moderate alcohol consumption (Ronksley, 2011). Still, lifestyle components varied according to different opinions. In epidemiological studies, these modifiable lifestyle factors have been consistently linked to a reduced heart disease risk, up to 80% reduction in coronary heart disease incidence and 50% reduction in ischemic heart incidence (Chiuve, 2008).

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There are strong theoretical reasons to believe that healthy lifestyle practices, which aim to increase physical activity and improve diet, could contribute to a better mental well-being. In the same study, significant improvements among participants were found directly after the intervention which was sustained at the 3-month follow-up (Johnson et al, 2017).

Moreover, physical activity has been shown to improve mental health in general (Fox, 1999).

Some of the lifestyle behaviors (non-smoking, light to moderate alcohol intake, high physical activity, diet rich in vegetables and fruits, and low adiposity) were independently associated with reduced cardiovascular disease events (Gaziano, 2017).

Six components were considered to define a low risk lifestyle: smoking, alcohol consumption, physical activity, dietary habit, body mass index (BMI) and waist to hip ratio (WHR) (Dam, 2008)

Lifestyle behaviors were found to be related to age, education level, place of residence and family traditions (Blaxter, 1990). Past studies results show that females smoke more than males, they are overweight, and they reported at least one lifestyle risk factor compared to males (Jarbol *et al.*, 2017). People with lower-income were more active and have healthier diets than people with higher-income (Katzmarzyk, 2009).

Smokers and overweight participants and those with increased sedentary behavior rated their health status worse than average. There were more smokers and non-active people among respondents with low income. Additionally, more smokers and overweight people had a low education level and the frequency of smoking was highest among the unemployed participants (Jarbol *et al.*, 2017).

The main objective of this study is to investigate the relationship between population lifestyle and health in Ialomita County, and the way in which certain lifestyle components can increase the frequency of certain diseases. The study area is Ialomiţa County, located in the south-east part of Romania, in the Romanian Plain, close to Bucharest area. In 2011, the rural population share was 53.9%.

In a previous study (Taloş, 2016), after analyzing several health indicators (general mortality, infant mortality, mortality and morbidity by specific causes), one can notice numerous health inequalities among Ialomiţa County localities (Fig. 1).

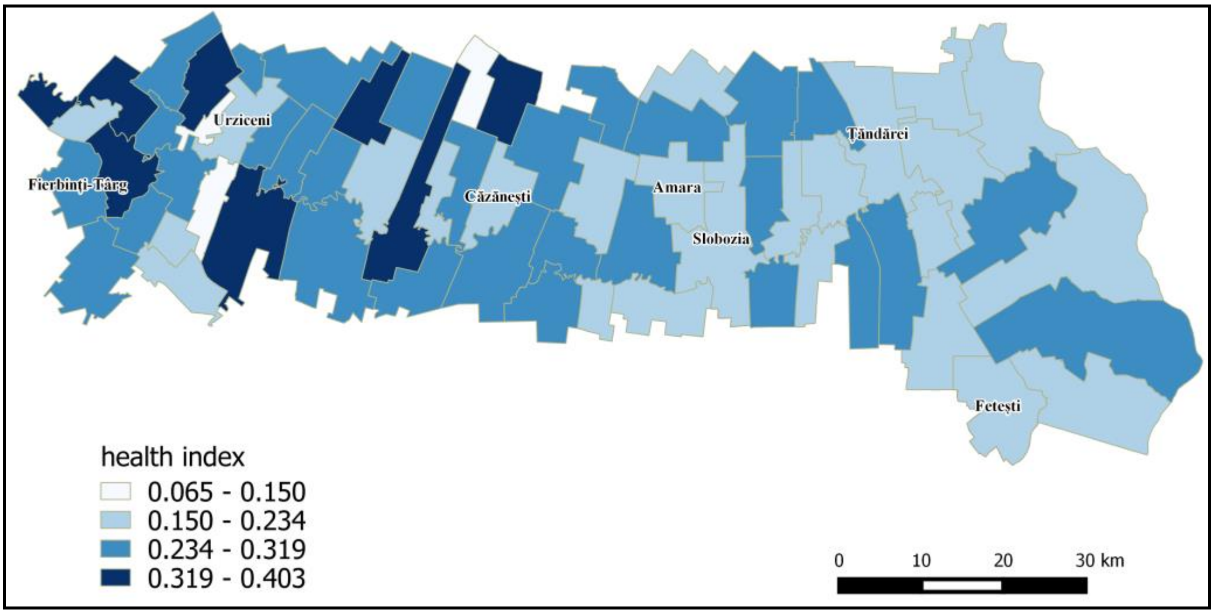

Fig. 1 – Inequalities in population health status
in Ialomiţa County (2012).

The health index is an aggregated index that highlights a precarious health status when is values are close to 1 and a good health status when the values are close to 0 (Dumitrache, 2004).

According to the health index, population from urban area has a better health status compared to population from rural area. These inequalities can be explained by different factors: age, medical resources, medical education and different lifestyle behaviors (Taloş, 2016).

The population health status in Ialomiţa County is precarious due to the high share of the rural population, which presents a number of characteristics as ageing, low incomes, low education level and a lifestyle behavior appreciated as unhealthy.

2. METHODOLOGY

Five lifestyle components: food consumption structure, physical activity, stress level, unhealthy behaviors (smoking and alcohol consumption) and medical behavior have been analyzed in sample localities (Slobozia, Bărbuleşti, Balaciu and Drăgoeşti).

A health survey was utilized as the data collection tool for this study.

In order to investigate the relationship between lifestyle and population health status among different categories of population in Ialomiţa County, independent variables like age, gender, marital status, education level, individual monthly income, working place (whether it implied regular physical activities or if it was a sedentary type of job like working in an office for example) were considered. Moreover, information about the respondent's food consumption structure, physical activity evaluation, presence of unhealthy behaviors (smoking and alcohol consumption), presence of chronic diseases and family history of chronic diseases were collected.

A total of 212 eligible participants were part of this health survey.

The respondents are from both from urban and rural areas (the sample localities were 1 city and 3 rural communities), women slightly outnumbered men with a total of 55.2%. The majority of respondents were married (67.5%), 71.7% had between 25 and 65 years old, 37.3% had graduated high school and the majority had an individual monthly income under 1000 LEI/ 222 EURO (60.4%). Nearly 40% of respondents worked in an office, 30% had no job and 30% were employed in a high physical work type of activity.

Analyses were carried out using the IBM SPSS version 21. Descriptive statistics, including standard deviations, frequency, crosstabs and percentage, were used to summarize the participant's socio-demographic data and healthy lifestyle behaviors. A multiple regression was used to reveal the main predictors of lifestyle (a p-value of <0.05 was considered significant for all analyses), and correlations were used to examine the link between health behaviors and socio-demographic characteristics.

3. RESULTS AND DISCUSSION

In order to assess different lifestyle behaviors, independent variables (age, gender, marital status, education level, individual monthly income, type of working place) were associated with the results of the health survey, and they are presented in Table 1 as percentages.

- *health status*

Health status can be evaluated using health indicators or using health survey. There are major differences between the outcomes, but there are better results when the two methods are used together. Usually, field research issues complete statistic data, as they report the realistic situation.

Table 1

Categories of lifestyle behaviors

Socio-demographic characteristics	Health status		Food consumption structure		Physical activity		Unhealthy behavior	
	very good	very bad	fruit diet	meat diet	active	inactive	binge drinker	current smoker
Rezidence								
urban	9.6%	0%	26%	23%	31%	33%	8%	12%
rural	9.9%	3.5%	26%	29%	61%	20%	6%	23%
Age								
under 25 years	32%	0%	19%	23%	58%	29%	3%	23%
25-45 years old	12%	0%	12%	31%	46%	27%	2%	24%
45-65 years old	1.50%	3%	20%	36%	57%	13%	13%	18%
over 65 years old	0%	0%	31%	21%	62%	20%	7%	7%
Educational level								
primary school	4%	3%	17%	26%	63%	22%	9%	19%
highschool	14%	0%	19%	29%	48%	24%	5%	27%
university	13%	0%	18%	38%	49%	22%	6%	11%
Family history of chronic diseases								
yes	8%	1%	15%	33%	60%	17%	7%	19%
no	12%	1%	22%	27%	46%	29%	6%	21%
Prezence of chronic diseases								
yes	10%	20%	22%	40%	60%	18%	15%	11%
no	16%	0%	17%	30%	48%	30%	5%	26%

Self-reported heath is an indicator of health status used in survey research, recommended by World Health Organization. It can be influenced by behavioral factors, social and demographic factors. Self-reported health can be a predictor of mortality and morbidity.

In this study, was considered necessary a field research to complete the assessed health status based on the health index. Only 10% of respondents (both rural and urban) appreciated their personal health status as being very good. Compared with participants from urban areas, those from rural areas reported very bad health status (3.5%).

Population age and education level ware important elements for evaluating personal health status, as younger respondents were convinced that they have a very good health status (32%) and the adults over 45 years old were pessimist about their health. Moreover, a higher educational level was related to a good appreciation of personal health status. People with higher education level evaluated their personal health status as being very good (13%), while only 4% of those with a lower education level said they have a very good health status.

Participants with chronic diseases reported a very bad health status, while the absence of chronic diseases in the family history made them optimistic about personal health appreciation.

One can notice that the profile of the respondent with a very good health status can be define by age, education level and the absence of chronic diseases.

- *food consumption structure*

It is a lifestyle component that can be influenced by various factors as age, income, education level and family background, so the food consumption structure may vary among population of different age, personal monthly income, education level and preferences.

There are contrasting views regarding the ideal food consumption structure, but the majority of them highlight the importance of fruit and vegetables consumption. Block et al. (1992) demonstrated based on 132 studies that fruit and vegetables provide protection against cancer, and Ness and Powles

(1997) that it prevent heart disease. The defense mechanism is unclear, but there is certain the high fiber intake and low fat and sugar share.

In the present study, it was considered the share of fruit and meat consumption from different categories. The participants from rural area reported an increased frequency of meat consumption (29%) compared to respondents from urban areas (23%), while the fruit diet was similar in both areas (26%).

An increased frequency of fruit and vegetable consumption was reported by elderly people (31%) and adults between 45–65 years old have a meat based diet (36%).

Participants with higher education level and those with chronic diseases prefer meat instead of fruit diet (38% and 40%), thinking about the benefits of proteins and neglecting the vitamins and minerals.

In case of food consumption structure, age is an important determinant, as individuals are more likely to choose a healthy behavior when they become ill and perceive the risks and consequences associated with those risks, rather than adopt health promotion behaviors to remain healthy.

- *physical activity*

Caspersen *et al.* (1985) defined physical activity as something "*planned, structured, and repetitive. Physical fitness is a set of attributes that are either health- or skill-related*".

World Health Organisation reported inactivity as one of the 10 main death cause, and if the physical activity is constant, the death risk is reduced with 50% (Pierce et al, 2007). It is recommended to have a daily physical activity of 30 minutes, and the benefits are also physical and intellectual. Still, there are diverse restrictive elements for accomplish this recommendation like age, free time, income, education level and self-motivation.

Participants from this study appreciated their physical activity as being active or inactive, thinking about their daily routine and activity.

Elderly people evaluated their activity as intense and active (62%) compared to young participants (58%), and the latter were more likely to be inactive (29%) as they not prefer to walk and spend time in parks and nature, in contrast with population over 65 years old (20%).

People from rural areas reported a more intense physical lifestyle (61%) compared to participants from urban areas (31%). In addition, education level was found to be associated with an intense physical behavior. Participants with a higher education level were significantly less physically active than those with a lower education level (49% compared to 63%). The reason can be related to the fact that respondents with lower education level were mostly from rural areas and they use frequently the bicycle and they have more outdoor activities (gardening, farming).

Also, the presence of chronic diseases and family background were reasons to have an intense daily activity (60%), as they received medical recommendation.

- *unhealthy behaviors*

Unhealthy behaviors have been studied and they are related to illness, health problems and addiction: skipping meals, eating fast food, smoking, drinking sweetened beverages, heavy alcohol drinking, use of drugs (Mozaffarian, 2011).

For this study have been chosen two unhealthy behaviors: smoking and alcohol consumption, considering them adequate for the study area – Ialomiţa County.

An assumption can be that an individual who smokes and drinks heavily is leading a generally unhealthy life, for which other forms of health behavior is unlikely to compensate (Blaxter, 1990).

Plant and Plant (2006) stated in a personal report, that people are optimistic about lifestyle behaviors, and they underestimate personal alcohol consumption, and overestimate the consumption of fruit and vegetables.

In this study, smoking was found to be associated with age and living area. Important associations were detected between respondents who smoke at the age of 25–45 years and the participants from rural area. There was a statistically compelling difference found in age groups ($p < 0.001$) and residence ($p < 0.001$). Respondents from the 25–45 age group (24%) were current smokers, while only 12% from urban area are smoking.

There were moderate alcohol consumers among participants from rural and urban areas (6% and 8%), also non-drinkers or moderate drinkers among participants belonging to the 25–45 age group compared to those in the 45–65 age groups (2% compared to 13%, $p < 0.001$).

Adequate lifestyle behaviors were confirm by those who presented a chronic disease, were over 65 years old and had a higher education level: less of them smoke, more were physically active and had healthier food consumption structure. This fact is indicating that people become more responsible with their health after having problems or being ill.

In order to expose more aspects regarding lifestyle behaviors in case of illness, lifestyle components and chronic diseases were associated and the results are summarized in Table 2.

Table 2

Lifestyle behaviors in case of chronic disease

Chronic diseases	Health status		Food consumption structure		Physical activity		Unhealthy behavior	
	very good	very bad	fruit diet	meat diet	active	inactive	binge drinker	current smoker
arterial hypertension	0%	0%	10%	45%	69%	14%	10%	10%
heart diseases	8%	0%	31%	31%	61%	15%	0%	15%
asthma	0%	0%	20%	0%	100%	0%	0%	0%
diabetes	0%	13%	13%	0%	75%	12%	12%	0%
arthrosis	0%	0%	60%	0%	60%	20%	20%	20%
ulcer	0%	0%	0%	50%	0%	50%	0%	0%
tuberculosis	0%	50%	0%	50%	50%	0%	50%	50%
respiratory diseases	0%	0%	33%	0%	33%	33%	0%	33%
digestive diseases	0%	0%	33%	67%	33%	0%	17%	17%
endocrine diseases	0%	0%	0%	0%	0%	33%	0%	0%
nervous diseases	25%	0%	25%	25%	75%	0%	0%	25%
infectious diseases	0%	0%	20%	20%	60%	20%	0%	0%
other diseases	0%	0%	0%	0%	0%	0%	0%	0%

Health-related lifestyle behaviors are important determinants of disease and mortality.

The differences in lifestyle behaviors between disease groups are striking. There were statistically significant differences in evaluating personal health status among different categories of chronic diseases: in case of tuberculosis and diabetes the health status was appreciated as very bad (50% and 13%). Such differences were also found when analyzing diet, physical activity and presence of unhealthy behaviors. Generally, respondents with chronic diseases exhibited a healthier lifestyle, including an increased fruit and vegetable consumption, intense physical activity, less alcohol and tobacco consumption.

Participants with arthrosis, respiratory diseases and digestive diseases eat more fruits compared to those with tuberculosis and ulcer who prefer a meat based diet. Those who were diagnosed with heart diseases, asthma, diabetes, arthrosis and tuberculosis have a more intense physical lifestyle.

Respondents with arterial hypertension, diabetes, arthrosis, tuberculosis and digestive diseases were significantly more likely to consume alcohol daily and to be current smokers than their counterparts.

To capture the share of components in determining lifestyle for the present study, multiple regression was used. This admit that the most significant lifestyle's predictors are medical behavior and physical activity, as together they explain 48% of lifestyle's variance: $R^2 = 0.33$, $F = 97.14$, $p < 0.001$ (medical behavior), and $R^2 = 0.48$, $F = 55.22$, $p < 0.001$ (physical activity) (Fig. 2).

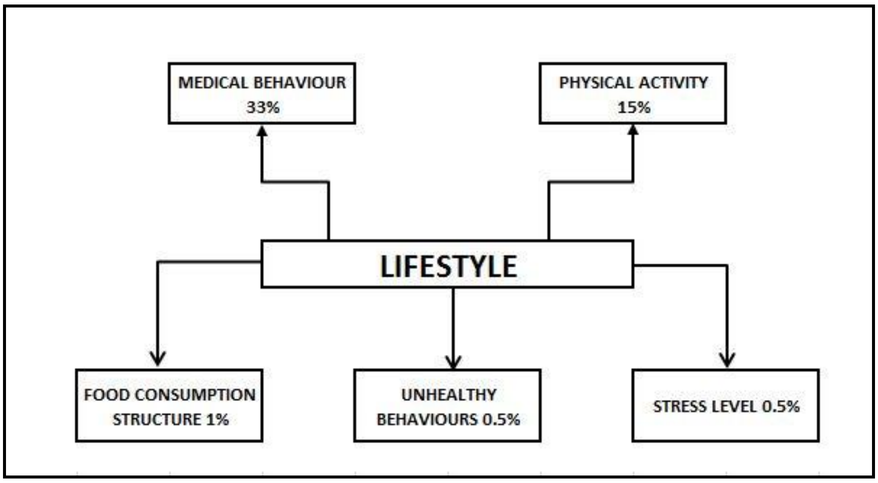

Fig. 2 – Lifestyle predictors.

4. CONCLUSIONS

The study focused on investigating lifestyle behaviors (food consumption structure, level of physical activity, smoking, alcohol consumption, medical behavior, and stress level) among Ialomiţa County population, in relation with health status.

Assessing population lifestyle behaviors is important in order to identify the determinants of choosing the correct health related actions. According to this study there are lifestyle differences between genders, education level, occupation, age and social status in Ialomiţa County. Moreover, it is possible to identify the groups with unhealthy behaviors and start a local research that can minimize health inequalities and prevent future health problems among population.

Preliminary results of this study showed that lifestyle is an important factor in determining population health status, as two of the lifestyle components (medical behavior and physical activity) analyzed in the study have a major influence (48%). These components can prevent illness and determine a good health status among population.

Different categories of population have various health status and lifestyle behaviors. In Ialomiţa County, women, elderly people and population with higher levels of education have a balanced food consumption structure, maintain as intense physical life and adopt fewer harmful behaviors while also presenting an adequate sanitary behavior compared to men, young people and the lower level educated population.

Several lifestyle behaviors were associated with a good health status, but those components are also influenced by other factors like age, education level or place of residence. In order to improve lifestyle behaviors is important to know the context and a complex analysis is required.

Lifestyle is an important determinant of health status, but there are also other factors that should be considered in assessing population health: medical services, environment, and socio-economic factors.

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OIKONYMS IN THE CURVATURE CARPATHIAN RURAL AREA. POPULATION AND SOCIO-ECONOMIC DEVELOPMENT PROCESSES. ARGUMENTATION

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Key-words: population, village, oikonyms[1], Curvature Carpathian Mts.

Abstract. The Curvature Carpathians represent an important historical and geographical area, continuously populated since times immemorial. Humanisation of the area has been an ongoing process, as proven also by the horizontal and vertical expansion of settlements. The region has a remarkable demographic potential, its 840,000 inhabitants being disseminated in 271 villages grouped by 90 communes, as well as in 19 cities and towns. This mountainous zone is dominated by the village, a permanent settlement both in terms of number, distribution in the territory and economic activities (mainly agro-pastoral). Arguments in this respect are sustained by the wealth of settlements and the linguistic origin of most words. Inside the Curvature Carpathian area, toponymy stands proof, alongside other ancient Dacian and Daco-Roman names, also of many Slavic-rooted ones. The fact that few place-names are of Hungarian origin suggests the continuous habitation by Romanians of the area's settlements, even after the Szechlers had arrived. Oikonyms reflect the local relief, waters, vegetal cover, as well as the community's social and historical life.

1. THE CURVATURE CARPATHIANS – A REGION INTENSELY INHABITED SINCE ANCIENT TIMES

The name of any region is kind of a "spiritual cover" of both man's relation with nature and his social and economic activities. Of higher altitude than other landforms, the Romanian Carpathians, although apparently less populated than the other geographical regions (tablelands and lowlands), are dotted with numerous permanent and temporary settlements. A fragmented relief (valleys, corridors and depressions) and a variety of natural conditions have allowed the settlement of people from oldest times. The ancient writer Florus (A.D. 2nd cent.) used to write that "Daci montibus inhaerant" – The Dacians are stuck in the mountains.

Archaeological researches have shown that the oldest elements of human habitat in the Curvature Carpathians date back to the Palaeolithic Times and the Neolithic-Musterian period of transition (Fig. 1).

A defining trait of the Romanian people, transmitted from one generation to the next, both by word-stock and culture (material and spiritual) is the close link with his birth-place, that is with the Carpathian-Danubian-Pontic space.

The Carpathians have played a huge role in the history and life of the Romanian people. The mountains were a secure place of defence in times of adversity and, most importantly, a vital source of water, wood, animals, salt and metal (also gold).

The Curvature Carpathians cover over 10,000 km^2 (*Geografia României, III, Carpaţii Româneşti şi Depresiunea Transilvaniei*, 1987, p. 173) and are heavily populated (about 840,000 inhab. in 2011, average density 78 inhab. / km^2); there are 271 villages, grouped by 90 communes, and 19 urban centres (cities and towns) (Fig. 2); 59% of the population live in town, 41% in the countryside. The

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[1] **Oikonyms** designate **human settlements**: from simple forms of habitat (shelters, tourist chalets, forestry and hunting huts, stables, etc. ~ provided they have proper names) to villages, towns, cities, urban agglomerations, conurbations, megapolises, bodies, hamlets, as well as the names of settlements that no longer exist.

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spatial-temporal analysis of the national population structure shows that the Romanian ethnical bloc has been in the majority all along the time; according to people's declarations of ethnicity (made by ca. 800,000 persons) 74.5% are Romanians, 22.3% Hungarians, 12.8% Gypsies, 0.4% other nationals (2011).

In the Curvature Carpathians, the village is the dominant form of **permanent settlement**, both in regard of number, territorial distribution and economic impact in the mountain zone. The village is the expression of the Romanian population's sedentary life. It is a historical and ethnographic reality of the Romanian landscape, like "… the link of a chair that comes from the past …" (Conea, 1939, p. 54).

Humanisation of the region was a progressive process, as revealed by the horizontal and vertical expansion of settlements; the number and territorial distribution of settlers would steadily grow in the 8th – 18th centuries. New villages kept emerging and characteristic feudal social-political formations would come into being.

From the 17th-to-mid – 20th cc, the settlement network of the Curvature Carpathians underwent two main stages of evolution, connected with the development economic activities, namely, the expansion of agricultural lands and the beginning of subsoil exploitations (salt, coal, oil, etc.).

The stage of rural expansion (17th – 18th cc) relates to the agro-pastoral activity, the region's main economic sector. According to historical documents it was pastoral swarming and transhumance that contributed to the emergence of new villages in the Curvature area. Some shepherds from over the mountains (Covasna and Bârsa Land), who had crossed the region along the old transhumance routes, would settle down in the already existing settlements, or would found new villages or hamlets at the southern foot of the Outer Carpathian Curvature (at the contact between the Teleajen, Buzău and Vrancea mountains with the Subcarpathians).

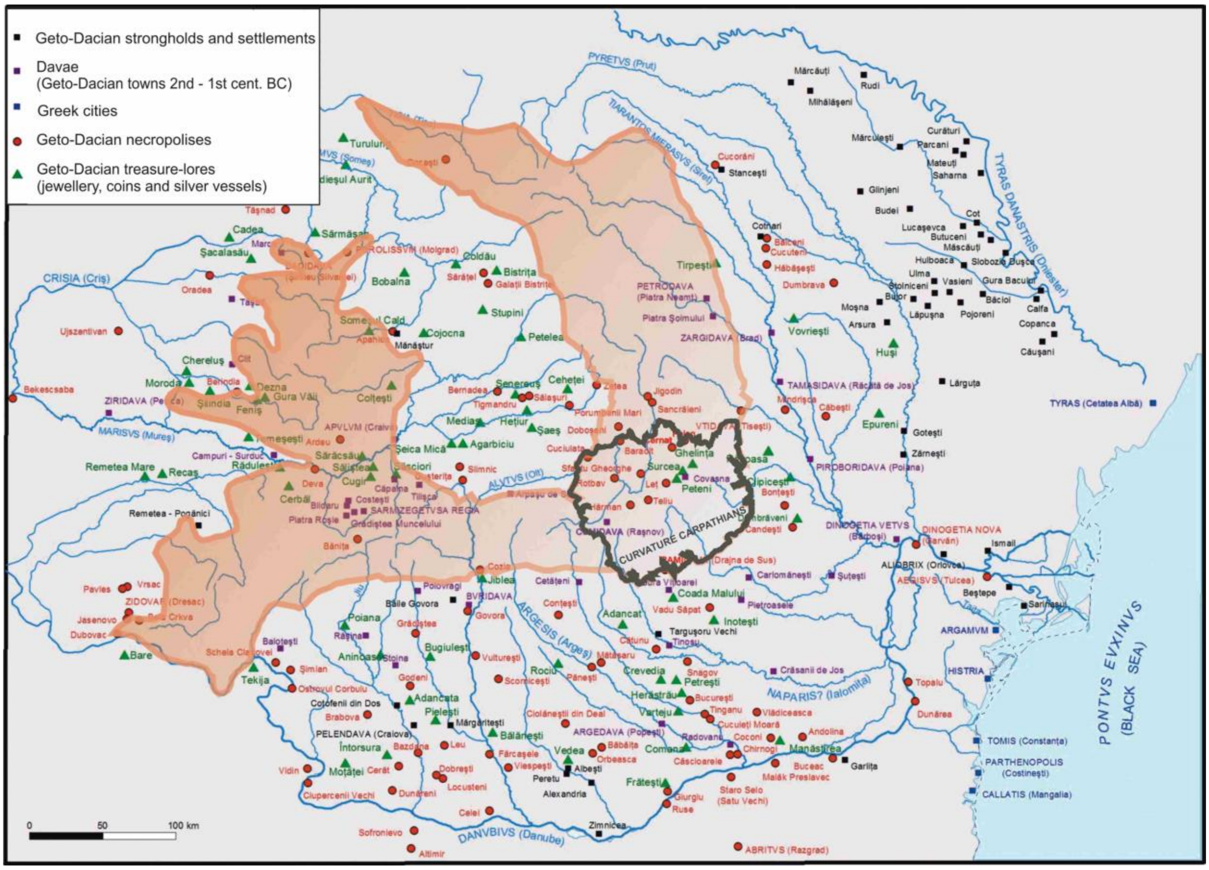

Fig. 1 – Archaeological attestations of ancient habitation (4th cent. BC – 1st cent. AD) (processed after the Historical-Geographical Atlas, plate 9, 2007).

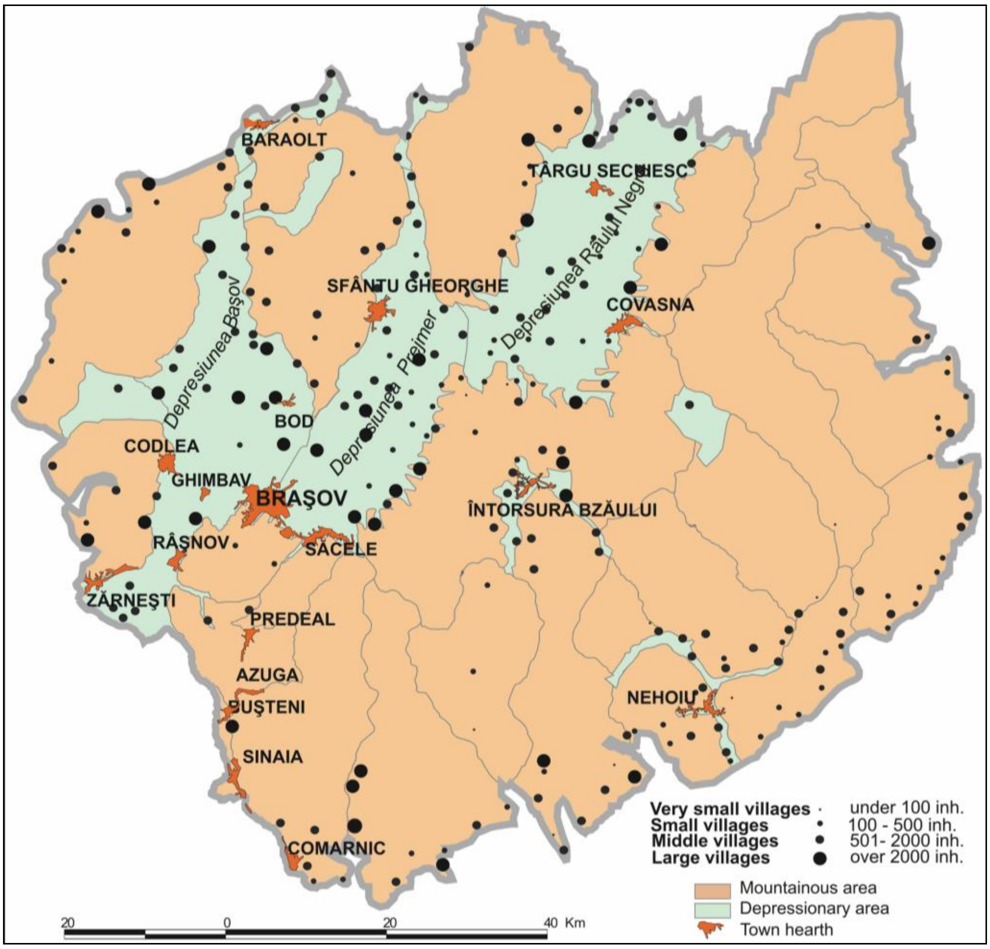

Fig. 2 – The village territorial spread by demographic magnitude (2011).

A sedentary pastoral activity contributed to the formation of permanent settlements, particularly of villages originating in temporary places of habitation (sheepfolds – Rom. *stâne*; cattle or sheep farms – Rom. *odăi*; sheep enclosure – Rom. *târle*). Wherever temporary settlements were in place, this process went hand in hand with the expansion of arable lands instead of pastureland, as confirmed by toponyms (e.g. village named like Poieniţele (Chiojdu commune), Odăile (Odăile commune), Târleşti (Poseşti commune), etc.

The stage of concluding the settlement network and the penetration of industrial activities. In the first half of the 19th century, village hearths would develop in terms of the local economy, the second half being marked by the numerical increase of settlements and their growing space expansion. Beginning with 20th century, small villages and hamlets kept "maturing", subsequently acceding to the village-type category. The hearths of most old villages used to extend, englobing many neighbouring hamlets, or small villages even. The first forms of industrial activity in the Curvature Carpathians would develop in the latter half of the 19th century (extractive industry), the beginnings of the processing sector dating to the early 20th century.

With the expansion and intensification of industrial activities, a part of the Carpathian rural settlements, especially those located in the intramontane depressions, would gradually change their economic function, also improving urbanistic endowments, and becoming more viable demographically, some of them meeting the conditions for acceeding to an urban settlement status. In effect, the current stage of permanent settlements is the last link in a long chain of transformations.

Temporary dwelling-places and rural households in the Curvature Carpathians had emerged centuries ago, in the time of cohabitation between the Daco-Roman autochthonous population and the Petcheneg-Cuman elements (11–12 cc BC), a reality confirmed by the toponyms "odaie", as an old element in Romanian (Giurescu, 1957, pp. 149–150).

In his work *Descriptio Moldaviae*, the great Romanian scholar Dimitrie Cantemir (1716) tells us that the Vrancea mountainous landscape shows scattered "*odăi*" considered to be *reliable households of the then Vrancea popolation*.

In terms of location, physiognomy, economic and social importance, it is mainly *the more numerous sheepfolds* at over 900–1,000 m alt. and next the "*odăi*" that discharge the functions of temporary dwellings and households in the Curvature Carpathians.

At present, "*odăile*" are only temporary dwelling annexes of the permanent valley household, their number and spread over the past few decades having significantly decreased. The "*Odăi*", locally named also "*târle*", have all but disappeared from the hillsides, yet still surviving in a few small areas of the upper Şuşiţa Basin, towards the contact with the mountain, being often located near the villages. A few "*odăi*" have still remained along the Slănic Valley at the foot of the Buzău Mts., most such structures having grown into permanent households, first into hamlets, then turned into villages (Târleşti, Odăile, etc.). However, the temporary form of habitation continues to exist at the contact between the mountain and the Prahova Subcarpathians in the valleys of the Ialomiţa, Prahova and Teleajen rivers.

Oikonyms (Greek oikos = house, dwelling), standing for human settlements, could be assigned to the broader class of **Toponyms**, the latter designating names of mountains and waters.

Oikonyms contain a series of particularities relating to the historical and social conditions specific to the respective territory. For example, somewhere in time, a conquering population would settle alongside the native one, hence the names of some localities originating from the language of the conquerors to sanction their conquered territory, while geographical names throughout each locality estate are derived from the language of the conquered / native population (Meyer-Lübke, 1901, p. 209).

Toponymy inside the Curvature Carpathians are of Slavic origin. Since many locality names are not of Hungarian extraction indicates that the Romanians continued to live there even after the Szecklers had arrived. It is the case of *Covasna, Ghelinţa, Zăbala, Pava, Ojdula, Baraolt,* and *Cernat.*

Two waternames in this area are known to be of Dacian origin (the *Buzău* and the *Olt* rivers), preserved as such for over two thousand years, while the Dacian oikonym *Cumidava* has been replaced by the Slavic *Râşnov* (first mention *Rosnou* in 1331, later *Roşnow*); *Angustia*, a Roman military stronghold and ("narrow") mountain pass was associated with the Slavic *Breţcu*, mentioned for the first time in a papal document (1332) as *Bzevilla*, later forms being *Beebcuk* and *Bereckfalva* standing for a settlement intended to secure the protection of the land.

Also of Slavic origin in the Curvature Carpathian area are *Baraolt* (swamp), *Căpeni* – Kopec (elevation), *Boroşneu Mare, Boroşneu Mic* (birch groove), *Lemnia,* through Hungarian route *Lehmény* (*Lemnia)*, *Ojdula* (from *Oszdola* – turnip-rooted cabbage place), *Moacşa* (*moksha* –spiritual freedom, unchained) (see Drăganu, 1933 and Iordan, 1963).

The grouping or classifications of oikonyms in terms of the significations of the origin of their names is due to geographers (Conea, 1960), language specialists (Iordan, 1963) and to sociologists in particular (Craiu, 2012). In the present study on the Curvature Carpathian oikonyms we used Conea's classification (p. 171), the founder of the Romanian geographical toponymy, who established a total of six categories of oikonyms, some structured by sub-categories: **1.** Oikonyms of *landform* and of some *relief particularities*; **2**. Oikonyms of *running or stagnant waters* close to which they were formed; **3**. Oikonyms designating *vegetation*; **4**. Oikonyms referring to *faunistic elements*; **5**. Oikonyms recalling *historical or social life testimonies*; **6**. Oikonyms rooted in *anthroponyms* and originating in the name of a former owner, or of a whole village community.

2. OIKONYMS OF SETTLEMENT LOCATIONS, FORMS AND SOME LANDFORM PARTICULARITIES, OIKONYMS OF RUNNING AND STAGNANT WATERS CLOSE TO WHICH THE HAD FORMED

Most settlements would develop along valley-sides or at the foot of slopes, on the outskirts of the forest or in glades. Such physical-geographical components used to have a 50% influence on name-giving to human settlements.

An important role in naming some villages has their position in the valley, eg: *Timişu de Sus* (Upper Timiş) and *Timişu de Jos* (Lower Timiş) on the Timiş Valley, Braşov County; *Sibiciu de Sus* (Upper Sibiciu) on the Buzău Valley, Buzău County; *Drajna de Sus* (Upper Drajna), *Drajna de Jos* (Lower Drajna) on the Teleajen Valley, Prahova County and exemples might continue; *Racoşul de Sus* (Upper Racoş) on the righthandside of the Cormoş River (670 m alt.), Covasna County; *Colţii de Sus* (Buzău County) and *Comana de Sus* (Braşov County) (Fig. 3).

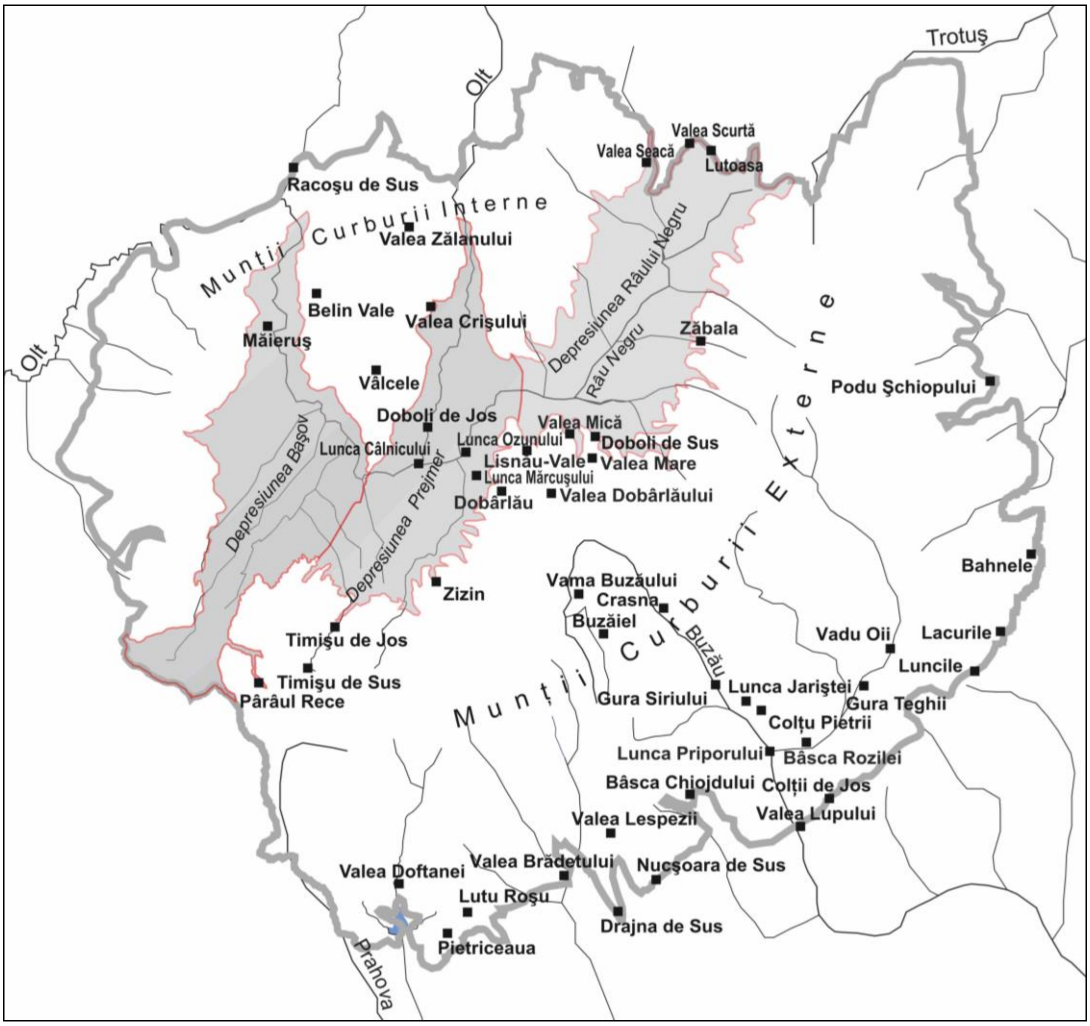

Fig. 3 – Territorial distribution of oikonyms by landform and some relief particularities.

There are quite many place-names that include the word ***vale*** (valley) e.g. *Belin Vale*, *Lisnău-Vale*, *Valea Mare*, *Valea Scurtă, Valea Seacă, Valea Brădetului*, *Valea Borului, Valea Crişului, Valea Dobârlăului, Valea Doftanei, Valea Lespezii*, *Valea Lupului*, etc.

Another name is "***luncă***" (river meadow, floodplain): *Lunca Câlnicului* (Braşov County), *Lunca Jariştei, Lunca Priporului* and *Luncile* (Buzău County), *Lunca Mărcuşului* and *Lunca Ozunului* (Covasna County).

Careful observers of their living environment, our forefathers used to name many settlements after ***landforms***, e.g. the villages of *Colţii de Jos*, *Colţu Pietrii* and *Curmătura* (Buzău County); *Gresia*, *Lutu Roşu*, *Pietriceaua*, *Podurile* and *Podu Lung* (Prahova County); *Lutoasa* and *Pietriceni* (Covasna County) and *Podu Oltului* (Braşov County).

The close connection between the settlement and a water source also reflects in the name assigned to communes and villages e.g. the communes of *Izvoarele* (the Springs), Prahova County; *Pârâu* (Brook), Braşov County; the villages of *Gura Teghii* (the Teghii Mouth), *Vadu Oii* (Sheep Ford); *Gura Siriului* (the Siriu Mouth), Buzău County; *Lacurile* (the Lakes) in Bisoca Commune, Buzău County. Often enough, village names derive directly from the name of the valley they are lying in, of the brook or river crossing them: *Bâsca Rozilei* and *Bâsca Chiojdu* (in the Bâsca Chiojdului Valley); *Buzăiel* village (in the Buzăiel Brook Valley, a tributary of the Buzău River); *Vama Buzăului* Commune (in the Buzău Valley); *Dobârlău* in the Dobârlău Valley – a tributary of the Râul Negru River; *Măieruş* (in the Măieruş Brook, a tributary of the Olt River); *Zizin* (in the Zizin Valley, a tributary of the Tărlung River) and examples are numerous.

2.1. Vegetation-related oikonyms

The vegetal cover, represented largely by forestland, has been gradually replaced by pastures and small arable areas, a reality reflected in the Curvature Carpathian region by the name of some localities – oikonyms – recalling various plant species, e.g.: *Aluniş* (Harzel Wood), *Brăduţ*, *Brădet* (Fir Wood), *Valea Brădetului* (Fir Wood Valley), *Arini* (Alder Trees), *Nucu* (Nut Tree), *Plaiu Nucului* (Flat Mountain Nut Realm), *Merişor* (Cowberry), *Nucşoara de Sus* (The Upper Nutmeg), *Paltin* (Sycamore Maple), *Păltiniş, Păltineni* (Maple Grove), *Cireşu* (Cherry-Tree) (Fig. 4).

A significant number of village names contain the word "***poiană***" (glade), e.g.: *Poiana*, *Poiana Mare* (Large Glade) and *Poiana Ţapului* (Billy Goat Glade) in Prahova County; *Poiana Mărului* (Apple Glade) in Braşov County.

2.2 Fauna-related oikonyms

There are fewer villages bearing the region's ***fauna*** names, e.g. *Valea Lupului* (Wolf's Valley), *Vadu Oii* (Sheep's Ford) and *Poiana Ţapului* (Billy Goat Glade).

2.3. Social life-related oikonyms and oikonyms originating in anthroponyms.

Oikonyms which have preserved in time aspects of a ***community's social and historical life*** represent some 40% of the settlement names, most of them deriving from individuals names.

Anthroponyms seldom remain unchanged. As a rule, a village name derives from that of a common ancestor plus the suffix *-eşti* and *-eni* / *ani*, the plural of *-escu* and (*e*) *anu* intended to designate the inhabitants' personal origin, basically of descendants of the village founder, or of its owner in a certain period of time. Both suffixes indicate the origin of people in a given village: the former refers to the place one comes from, the latter to one's ancestor.

It is from that ancestor's name that the village name is formed: 1) suffix *-eşti* to indicate the followers of the village ruler (or founder) and 2) suffix *-ani* (*-eni*) to designate the inhabitants that originate from the village with a common ancestor.

In the Curvature Carpathians, most village names contain the suffix -eşti (*Brătileşti*, *Chirileşti*, *Mânzăleşti*, *Furtuneşti*, *Poseşti*, *Păuleşti*, *Nistoreşti*, *Romaneşti*, *Ştefeşti*); suffix -eni (*Olteni*, *Ungureni*, *Ilieni*, *Vlădeni*, *Cozmeni*, *Mărtineni*, *Petriceni*), only a few have the suffix -ani (*Perşani*, *Chiricani*) (Fig. 5).

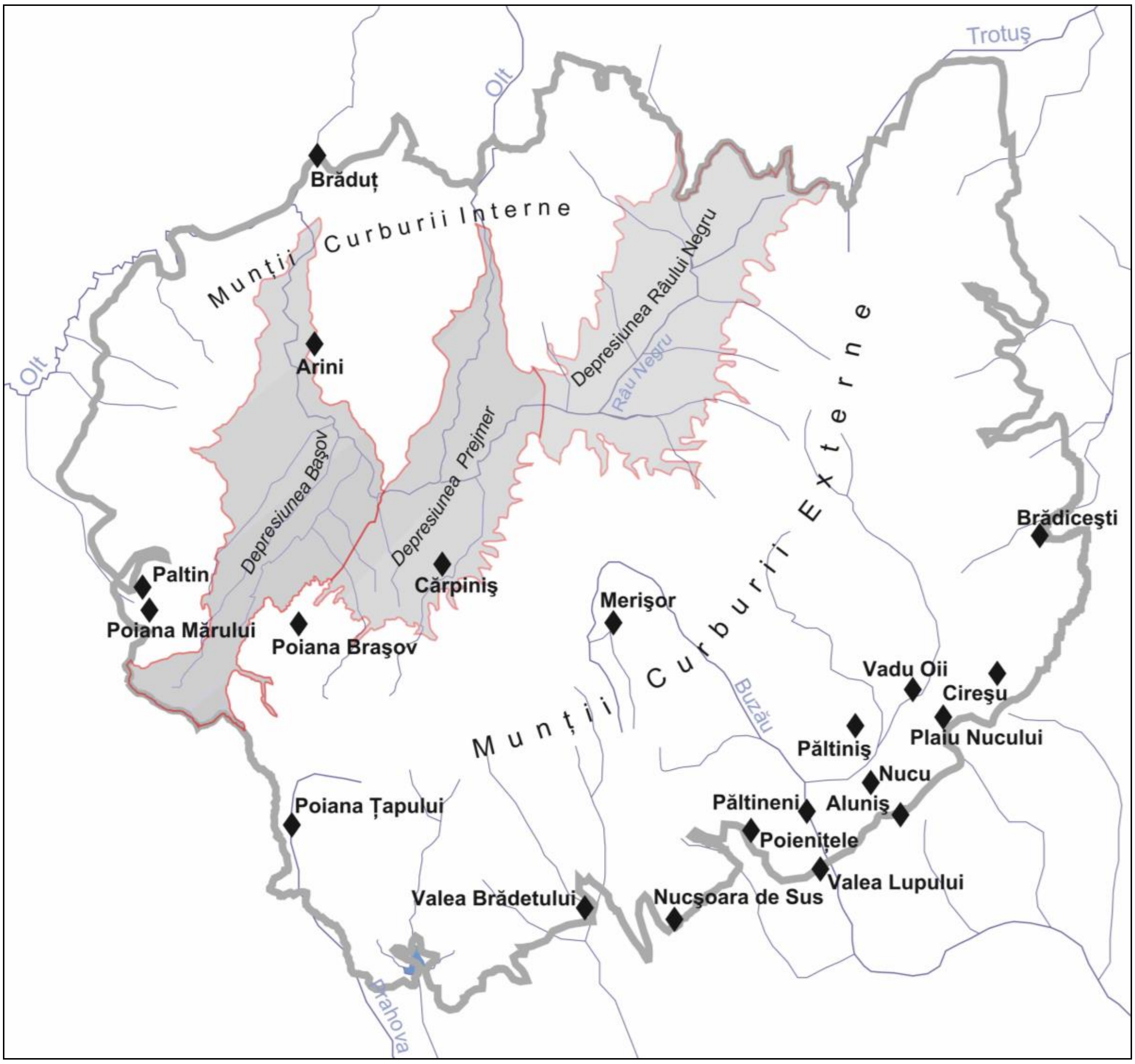

Fig. 4 – Territorial distribution of phyto- and zoo- toponymic origin.

It is also customary for a village to be given an anthroponymic name, without any ultimate modifications. This procedure is meant to honour a family member, who under certain circumstances, proved to be a valliant man, or was a thrifty man and good manager; the name may also commemorate a historical event, or an important character, e.g. *Angheluş, Augustin, Herculian* and *Sânpetru*. There are situations when several villages bear the same name, and in this case an adjective is attached lest they be confused. This happens when a village estate had innitially only one master, but would, in time, become the property of several owners. The original village acquires the attribute “Mare” (Large, Big) or “Vechi” (Old), the newly-formed ones being “Nou” (New), or “Mic” (Small): *Boroşneu Mare* –

Boroşneu Mic, *Valea Mare – Valea Mică*, *Aita Mare – Aita Medie, Satu Nou*, *Şinca Nouă*, *Tohanu Nou*, *Caşinu Nou*; other villages have religious denominations, e.g. *Mănăstirea Caşin*, *Mănăstirea Suzana*, *Sânpetru*, *Sânmartin*.

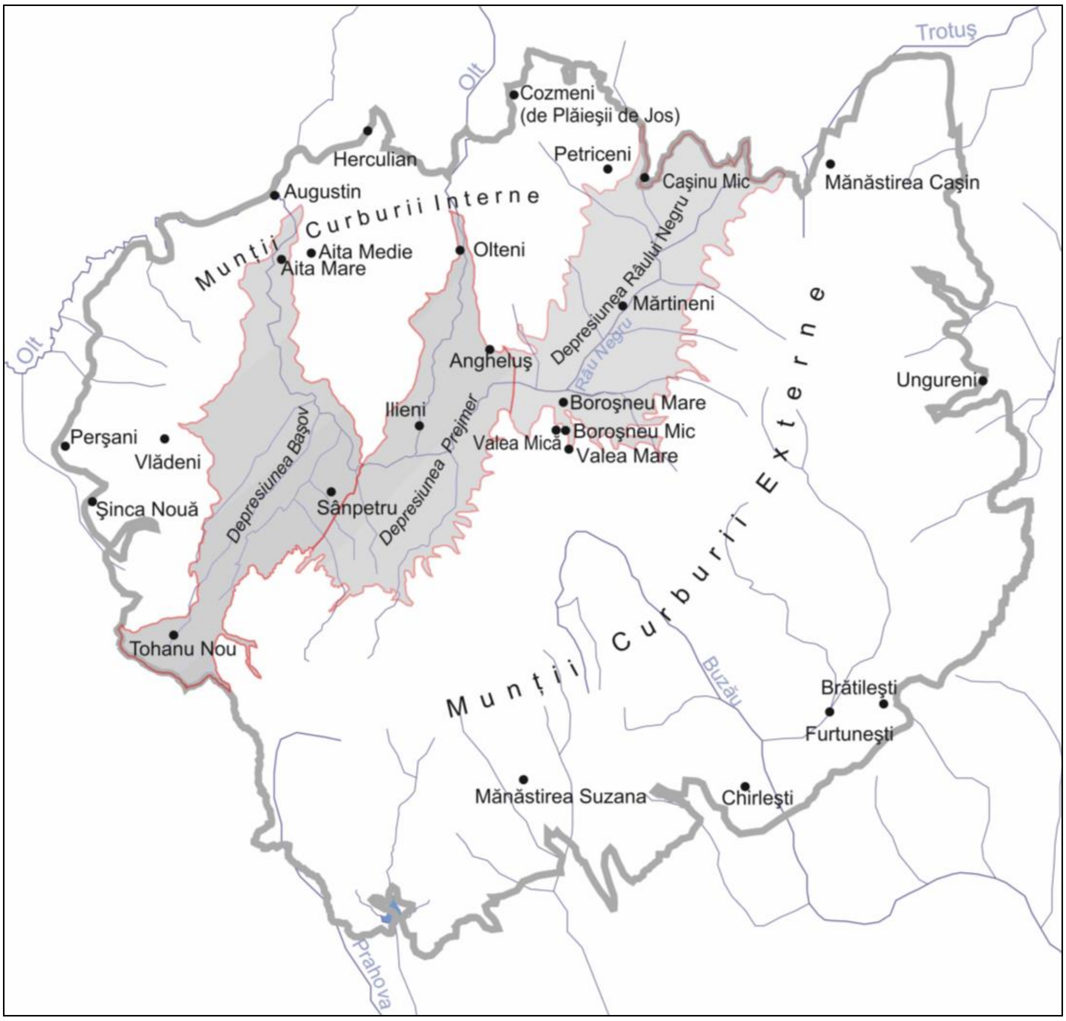

Fig. 5 – Territorial distribution of social life-related oikonyms and oikonyms originating in anthroponyms.

3. CONCLUSIONS

We consider that this brief analysis of settlement names in the Curvature Carpathians has succeeded in presenting, the wide range of categories they belong to, highlighting the natives' remarkable capacity of name assignment inspired from the environment, from historical facts and from the socio-economic reality; as well as the wealth of oikonyms and their linguistic diversity in this region, underlining the oldness and continuity of habitation.

Acknowledgments. Research-work for this paper was conducted under the Institute of Geography research plan (Research Project: "Geographical Studies on Rural Development in the Romanian Carpathians").

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"NEW IDEAS AND NEW GENERATIONS OF REGIONAL POLICY IN EASTERN EUROPE" CONFERENCE,

APRIL 7–8, 2016, PÉCS, HUNGARY

Between April 7–8, 2016, the Hungarian city of Pécs hosted the Regional Geography Conference on *New Ideas and New Generations of Regional Policy in Eastern Europe*, organised by the Institute for Regional Studies, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

In the opening session, the Director of the Institute for Regional Studies, Mrs. Ilona Pálné Kovács, and the Secretary General of the Hungarian Academy of Sciences, Mr. Ádám Török, extended a wellcome address to the participants.

The Conference proceedings, attended by 110 researchers and professorial staff from the universities of Albania, Bulgaria, Croatia, Hungary, Italy, Poland, Romania, Serbia, and Turkey, were held in the former Conference Hall of the Palatinus Hotel in Pécs, the city with the oldest University in Hungary.

A Primary Session of Communications was scheduled in the first part of the Conference, in which four papers on issues of resilience, governance, territorial cohesion and social polarisation were presented: *Resilient territories and territorial cohesion: different origins, same destination* (Simin Davoudi); *Territorial governance in Europe: Same policy issues, different instruments* (Dominic Stead); *Democratic citizenship and social polarization: evidence from mezo-level contexts and policy implications* (Gabriel Bădescu) and *European Union territorial governance: understanding Europeanization* (Giancarlo Cotella).

The second part of the Conference dwelt largely on such aspects as: From globally-ranked metropolises to rural ghettoes: the changing patterns of socio-spatial inequalities across East Central Europe; Challenges and specialties of the cohesion policy in Eastern Europe; Regional aspects of the new environmental paradigm; Borders and mental spaces; Smart City, the liveable city; Economic competitivness, industrialisation, growth; International migration processes and migrant trajectories in Eastern-Central Europe; Human capital, creativity, social innovations in rural areas; Different forms of capital in regional development. Representing the Institute of Geography of the Romanian Academy, Mr. Radu Săgeată and Miss Mihaela Persu delivered their paper on *Cross-Border Euro-Regions in the Lower Danube Basin*.

Discussions focussed on the results of scientific research, the papers speaking of inequalities as challenges of space-related policies; sustainable urban development; European Energy policies; cross-border co-operation programmes; changes of the mental space; polarisation structures; social exclusion; multi-functional agriculture versus ecosystem services; the new industrial revolution, etc.

Mihaela Persu

EUROPEAN GEOSCIENCES UNION – GENERAL ASSEMBLY

APRIL 17–22, 2016, VIENNA, AUSTRIA

The European Geosciences Union (EGU) is a non-profit union of scientists from all over the world, which is promoting excellence and networking in geosciences, planetary and space sciences. EGU was established in September 2002 as a merger of the European Geophysical Society (EGS) and the European Union of Geosciences (EUG) and currently has over 12,500 members, including professionally engaged individuals (researchers, students, retired seniors) with interests and activity in or related to geoscience, planetary and space sciences. Nowadays, the annual assembly of EGU is the largest geosciences conference in Europe with more than 500 sessions and various side events dedicated to a wide range of topics, which attracts on average over 11,000 scientists each year.

In 2016, the EGU General Assembly was attended by 13,650 scientists from 109 countries. The Conference program scheduled 601 scientific sessions organized under 23 disciplinary divisions: e.g. Atmospheric Sciences (AS), Biogeosciences (BG), Climate: Past, Present and Future (CL), Cryospheric Sciences (CR), Natural Hazards (NH), Energy, Resources and the Environment (ERE), Earth and Space Science Informatics (ESSI), Geodesy (G), Geomorphology (GM), Planetary and Solar System Sciences (PS), Seismology (SM), Soil System Sciences (SSS), Tectonics and Structural Geology (TS). The conference program also included numerous special side events like: five union symposia (e.g. NASA-ESA-EGU joint union session; Geosciences in Anthropocene; EGU award ceremony), 34 medal lectures (e.g. Sergey Soloviev medal lecture by Irasema Alcántara-Ayala), five theme lectures on active planet (e.g. *Solid Earth; Liquid Earth; Solar system*), four great debates (e.g. *Plan it Earth: is there enough resource for all? Is it just a matter of planning for the future?*; *Is global economic growth compatible with a habitable climate?*), eight townhall meetings (e.g. *European Research Council (ERC) funding opportunities*; *The Science of Climate Change Communication: Engaging the Public, Policymakers, and Journalists*), 65 short courses particularly addressing to early career scientists and students (e,g. *Practical tips for applying to the EU Marie Skłodowska-Curie Individual Fellowships program*; *Modelling soil water time series data using R program*), 22 division meetings, union meeting, editorial board meetings of the 17 journals included in the EGU portofolio, 69 splinter meetings (and other 47 only by invitation), movies in the GeoCinema (e.g. the asteroid impact missions; 365 days under Antarctic ice), a photo competition, as well as other various exhibitions in booths (e.g. companies, publishers, research facilities, scientific organisations).

The 2016 EGU General Assembly was the largest EGU meeting to date. The number of submitted abstracts was of 16,500 for: 4,863 oral presentations, 10,320 posters and 947 PICO presentations. The conference attracted a lower number of students than in the previous years, which counted for 25% of the total number of attendees, but a greater number of early career scientists (under the age of 35), namely 53%. The wide spectrum of scientific sessions and side events included in the program of EGU assembly in 2016 have reflected core theme of the conference (*Active Planet*). The contributions highlighted unique and outstanding scientific insights and discoveries in the fields of geosciences and space sciences, technological and methodological advances, (re-)evaluations of established paradigms, as well as the ongoing and future challenges and opportunities in these sciences, for a better understanding of the Earth as an integrated system, as well as of the impact that human activity and climate change is having on natural Earth processes.

The number of the Romanian scientists attending EGU Conference was the greatest over the last five years (82), showing a constant increase of the overall interest (a 22% increase relative to 2015). The Institute of Geography of the Romanian Academy was represented by four researchers who gave presentations in six scientific sessions of four EGU disciplinary divisions, as follows:

– Natural Hazards Division: Session NH3.2/SSS2.26 (Mechanisms and processes of landslides in seismically or volcanically active environments): *Distant, delayed and ancient earthquake-induced landslides* (Havenith H-B., Torgoev A., Braun A., Schlögel R., Micu M.); Session NH3.9 (Uncertainty and quality evaluation in landslide hazard and risk assessment (including Sergey Soloviev Medal Lecture): *Challenges and limitations of a statistical Pan-European landslide susceptibility evaluation* (Jurchescu M., Günther A., Malet J-P., Reichenbach P., Micu M.); Session NH9.6 (Resilience and vulnerability assessments in natural hazards and risk analysis): *Assessing public flood risk perception for understanding the level of risk preparedness – Evidence* *from a community-based survey (the Bend Subcarpathians, Romania)* (Bălteanu D., Micu D., Dumitraşcu M., Chendeş V., Dragotă C., Kucsicsa Gh., Grigorescu I., Persu M., Costache A.);

– Climate: Past, Present and Future Division: Session CL4.08/AS1.13/BG4.14/CR1.12/HS11.5 (Mountain climates: processes, change and related impacts): *Changes in the distribution of isotherms across the Carpathian Mountains in response to climate warming* (Micu D., Dumitrescu A., Cheval S., Birsan M-V.).

– Geomorphology Division: Session GM3.1/SSP3.22/SSS2.19 (Erosion and sedimentation processes in the high mountains): Linking landslide susceptibility to sediment yield in the Romanian Carpathians (Broeckx J., Vanmaercke M., Bălteanu D., Chendeş V., Sima M., Enciu P., Poesen J.).

– Soil System Science Division: Session SSS10.1/HS5-12 (Irrigated agriculture: Natural Resources Management for the sustainability of the terrestrial ecosystem maintaining productivity): *Crop water productivity under increasing irrigation capacities in Romania. A spatially-explicit assessment of winter wheat and maize cropping systems in the southern lowlands of the country* (Dogaru D.).

The next EGU General Assembly will take place in Vienna (Austria) from 23 to 28 April, 2017.

Dana Micu

THE INTERNATIONAL CONFERENCE “DENDROLOGICAL DAYS AT ARBORETUM MLYŇANY 2016”,

SEPTEMBER 5–6, 2016, NITRA, SLOVAKIA

The International Conference *Dendrological Days at Arboretum Mlyňany 2016* was held from 5 to 6 September 2016 in Nitra, Slovakia. The event was hosted by the Institute of Forest Ecology – Arboretum Mlyňany, Slovak Academy of Sciences.

This scientific meeting gathered over 20 scientists from various research institutions and universities in Slovakia, the Czech Republic and Romania. The conference addressed issues related to the relationship between invasive terrestrial plant species and the environmental conditions, modeling the distribution potential of invasive terrestrial plant species, the ecological characteristics of the various plants that populate the Mlyňany Arboretum Park, the morphological plasticity of plants, the impact climatic factors on plant phenology etc.

On behalf of the Institute of Geography, Romanian Academy one paper was presented: *Assessing invasive terrestrial plant species in selected protected areas in Romania. A geographical approach*” (I. Grigorescu, Gh. Kucsicsa, M. Dumitraşcu, M. Doroftei) which synthesised the scientific results achieved within FP7 enviroGRIDS project. The participation to this event was made in the framework of the inter-academic exchange between the Romanian Academy and the Slovak Academy of Sciences through the project “*Assessing invasive terrestrial plant species in the natural ecosystems along the Danube River. Case-studies from Romania and Slovakia”*.

After the conference, a study visit to Mlyňany Arboretum Dendrological Park, which owns the largest collection of exotic evergreen wood species in Slovakia and one of the biggest in Central Europe, was conducted by the organisers.

Furthermore, within the inter-academic exchange, the Mlyňany Arboretum Forest Ecology Institute organized a series of scientific field trips aimed at assessing and mapping *Amorpha fruticosa L*. species in the Danube Alluvium protected area and in the urban area of Nitra. In addition, two medieval towns, whose historical centres are listed as UNESCO World Heritage, were visited: Banska Bystrica and Banska Stiavnica.

Ines Grigorescu, Gheorghe Kucsicsa

INTERNATIONAL WORKSHOP "CURRENT ENVIRONMENTAL THREATS AND THEIR IMPACT IN THE LANSCAPE"

OCTOBER 25–26, 2016, BRNO, CZECH REPUBLIC

On the 26th–27th of October, 2016 the city of Brno (Czech Republic) played host to the International Workshop on "Current environmental threats and their impact in the lanscape", organised under the aegis of the Czech Academy of Sciences. The event enjoyed the the participation of teachers and researches from Belarus, Bulgaria, the Czech Republic, Hungary, Nepal, Poland, Romania and Slovakia.

This event, part of the "Natural Threat" AU 21 Research Programme Strategy, focused on two main issues:

– Natural threats (slope deformations, floods and drought), their impact on the lanscape, and the possibility of appraising them);

– Social and economic consequences of natural and man-made disasters.

A number of 27 papers were presented in the Plenary Sesion, discussions being further continued in seven sections with focus on problems of arctic zone pollution, global climate change and its impact at local level, natural disasters as tourism constraints, methods of cartographic representation of natural and technological hazards, global climate change-induced modification in the river discharge regime, in animal behaviour and in man – protected fauna relations, soil changes, the management of some polluting industries, or of household wastes.

The Workshop concluded with a field survey in the surroundings of Brno, the biggest city in Czech Moravia. On that occasion, they would underline the city's territorial and functional evolution, the changes occurred in its relationship with the influence area, the post-communist economic decline and the challanges posed by EU integration, urban metabolism and physiognomy intra- and- inter-urban flows, projects and opportunities for sustainable urban development.

The purpose of this Workshop was to strengthen scientific co-operation in order to cope with the threats of global environmental impact on the Central and Eastern Europe, at regional and local scale. The aim was on the one hand, to sanction some theoretical-methodological concepts regarding local and regional development, recently launched in the academic circles and to bridge relationships among the academic, economic, entrepreneurial and decision-making millieus, on the other hand.

Radu Săgeată

Dan Bălteanu, Monica Dumitraşcu, Sorin Geacu, Bianca Mitrică, Mihaela Sima (Eds.), (2016), *România. Natură şi societate* (România: Nature and Society), Bucureşti, 2016, Edit. Academiei Române, 685p., 260 figs., graphs, 59 tables.

This original approach brings up into discussion a series of complex and very topical problems, also ingeniously combining the text with the maps. This work is a continuation of fundamental productions on the relations between the Romanian land and its people (Revue Roumaine de Geographie/Romanian Journal of Géography, A Geographical Monograph of Romania, The Natural Geographical Atlas, A Geographical Treatise of Romania).

It is an update of the volume *Romania. Spaţiu, Societate, Mediu* (2005), with its English version *Romania. Space, Society, Environment*, (2006), and synthesis of current geographical research into the Romania territory. It contains numerous theoretical-applied aspects derived from the national and international projects of the Institute of Geography. Recent data and information on the natural background, the society, the economy, environmental change and regional development, are also included.

The focus of this work is the post-EU accession period, with its common social, economic, political, and environmental evolution, but with regional differentiations, as well.

This five-part volume highlights the complexity of Romania as a Central-European country, with spatial, historical and geopolitical traits intimately connected with the Carpathian-Danubian-Pontic space.

The first part introduces the reader to such topics as Romania's geographical position and borders, Romania and the new architecture of Europe, historical landmarks and the development of Geography in Romania. Being situated at the Eastern end of the European Union, Romania's strategical position is of special interest, this country being an active factor of stability between the West and the East.

The second part covers the natural background and all its components: territorial built-up, geological structure and mineral resources, landform units, the climate, the waters resources, plant cover, animal world, and the soils. The natural backround is depicted in all its complexity, with emphasis on the habitation potential of landforms, the climate change, sustainable use of water resources, soil diversity and protection of biodiversity.

The third part presents the Romanian society and its economy, population-dynamics and demographic structures, urban development and metropolitan areas, the village: territorial development and socio-demographic trends, land-use and the present development of agriculture, Romania's industry: from deindustrialisation to reindustrialisation, communication network and transport means, foreign economic relations, clements of social geography, ethnographic landscapes and tourism.

The socio-economic approach offers recent data on population, the urbanisation process within the context of the Europen Strategy and of town-village particularities.

An important chapter is devoted to the millenary-old traditional Romanian village and the types of rural habitants on various relief steps (plains, hills, tablelands, mountains, intra-montane and Subcarpathian depressions, as well as major valleys).

The fourth part enlarges upon the environment an its characteristic features within the context of climate change and intensification of extreme phenomena with major effects on society, regarding the quality of the environment, protected natural areas, natural and technological hazards, man-induced climate change and climate scenarios.

The fifth part which covers regional development, presents a synthesis of the eight development regions and of Cross-border Co-operation Euroregions which Romania is a part to. Some sustainable development prospects are also put forward. After 1990, Regional development has became a main study matter of scientific research for the authorities, entrepreneurs and public opinion alike. Assessing disparities in the socio-economic development at nation level became a priority issue, transition and the economoc crisis that followed, stressing inter- and intra-regional disparities, regional polarisation being still very strong in Romania.

The elaboration of this volume benefitted from the contribution of many institutions, primarily The Publishing House of the Romanian Academy and The National Institute of Statistics.

In view of its theoretical-methodological characteristies, the information provided, the interdisciplinary character and the distinctive different analysis approach as well as the impressive graphic material, makes this work a reference for the study of the man-environment relations, a valuable landmark for tackling the problems of the present geographical situation.

Dragoş Baroiu

Vasile Cucu, Ion Velcea (coord.) (2013), *Satul şi oraşul în strategiile de dezvoltare regională* (The village and town in regional development policies and strategies), Edit. Universităţii „Lucian Blaga", Sibiu, 474 pages.

The present volume includes the works of the 16th National Colloquium of Geography of Population and Human Settlements, held in Bucharest and Sinaia during 6th–8th June 2012 through 35 scientific papers, structured into 5 themes covering several topics of the regional development strategies.

The first part, *Socioeconomic implications on the population and human settlements*, includes various aspects related to socioeconomic components such as: migration, social and economic inequality, poverty, urbanization, tourism in the rural area. Special attention is paid to the regional development with a focus on the issues of village and town population (V. Cucu), but also to the interdisciplinary analysis focused on some aspects concerning demographic, morphostructural, functional and regional typology of rural settlements.

In order to evaluate the interdisciplinary proposals concerning environmental protection and risks, socioeconomic vulnerability, scientific services for the decision-making process and integrated systems of data for research applications, the section was centered on particular case-studies concerning environmental pollution, related with population aging, poverty, unemployment, deindustrialization, lower living standards, rural-urban migration. Part of the analyses were realized in view of the specific methodologies using GIS (Geographical Information Systems) applications for mapping and spatial modeling.

The last section of the volume follows on the same line of regional development with highlight on tourism in the rural area and geopolitical implications, identifying tourist areas hierarchy approaches related to global sustainable development. This chapter deal with the complex analysis of the tourism potential of rural areas in Romania in accordance with some aspects: villages tourist attractions, policy structure for rural development, specific activities of certain components, diversification of the touristic services, improvement regarding the natural touristic resources, involvement in a main tourist activity (Ielenicz, M., Simoni, S.).

The importance of this volume is twofold: scientific and practical, with a strong interdisciplinary character and reflect the current orientation in human geography using a modern methodology of spatial analysis regarding regional development in line with international research.

Laura Lepădatu

Elena Teodoreanu, Ovidiu Gaceu (2013), *Turismul balneo-climatic în România* (Spa-and-health tourism in Romania), Ed. Univ. din Oradea, 228 p., 10 chaps., 58 figs., 15 tables, 165 refs.

Spa-and-health, basically therapeutic tourism, is a new interdisciplinary research field which associates climatic and spa conditions, particularly wide-ranging in Romania, as an opportunity for spending one's leisure time as agreeably as possible and recover the physical availabilities of the human body.

Although practiced in this country since historical times, first with a view to spatial movement in a variety of ways, and later as a means to recover one's physical capacity through a spa-and-health climatic cure, yet this activity did not go by this name. Spa-and-health tourism is a new applied research trend developed in the late 20th century, then a mass-practice, and in the early decades of the 21st century, when several other types of tourism business, cultural, history-related, hunting, sporting, etc.) fell into this sphere of interest.

As a new research direction, spa-and-health tourism benefits from a wide variety of natural cure factors (natural or anthropic salt-or-fresh-water lakes, mineral springs, therapeutic muds, mineral waters, aerosols, UV rays, and a moderate climate, natural, and very picturesque multicolour landscapes at different altitude steps), that contributed to making treatment and tourism in Romania a very attractive experience.

The genetic diversity of Romania's relief account for the wide and varied range of natural cure factors (systematically presented in this volume) and offer huge possibilities for using them in spa-and-health cure and tourism.

The present volume is authored by two highly professionally qualified people: Mrs. Elena Teodoreanu Ph.D., geographical background, balneoclimatology specialist at the Institute of Balneology, long-standing research practice, Assoc. Prof. at the Ecological University, and a young geographer Ovidiu Gaceu, Ph.D., Professor at the University of Oradea, a disciple of Mrs. Elena Teodoreanu, who has enlarged his scientific preoccupations to the spa-and-health area as well.

This work is actually a small encyclopaedia of tourism-associated bioclimate, and a study-book for the formation of new generations choosing to work in this domain. The wealth of scientific information on the *climate*, a basic natural factor for spa-related tourism (and all the climatic elements involved in both treatment and tourism), *aeroionisation* (a physical-therapeutic factor influencing man's health condition) and the *bioclimates* of Romania, never ever presented before as specific bioclimatic indices in connection with landform particularities, as well as some spa therapeutical procedures, e.g. *aerotherapy*, *heliotherapy*, *salt-mine therapy*, etc., *spa waters* (*mineral springs, salt lakes, muds, gases, marine waters* used in *hydrotherapy*, *talasotherapy* and *psammotherapy*. All these aspects are brought to the reader's attention by Mrs. Teodoreanu's rich experience in this research field.

The final part of this volume presents the spa-and-health resorts of Romania by steps of relief and their specific natural cure factors, which is a particularly useful guide for the specialist medical staff, as well as for everyone interested in choosing the desired resort.

The present work is the fruit of an assiduous activity of applied research, the first of its kind in the Romanian specialist geographical literature, as underscored by the appended bibliography. The message covered is to fully evaluate the country's spa-and-health potential, to present a model of approaching it by the specialist geographical literature and, last but not least, to meet some of the specific teaching demands of higher education, especially of tourism geography, of M.A. and Ph.D. candidates and initiation in scientific research.

A well-conceived work, with logical demonstrations, conclusions and an exceptional graphical illustration will undoubtedly arouse the reader's interest, and our well-deserved appreciation.

Octavia Bogdan

Lucian Badea, *Dicţionarul unităţilor de relief din România* (Le Dictionnaire des unités de relief de la Roumanie), Editions de l'Université de Craiova, 2014, 181 p.

Après 60 ans dédiés à la recherche du relief de la Roumanie dans l'Institut de Géographie de l'Académie Roumaine, période dans laquelle il a collaboré ou a coordinnée maints travaux de valeur de la géographie roumaine, le dr. Lucian Badea accomplit le projet d'âme de l'ancienne équipe de géomorphologues de l'Institut, conduite par lui, à savoir *Les unités de relief de la Roumanie*.

Comme part et but final de le projet de recherche, le dictionnaire se propose, selon le témoignage de l'auteur dans son avant-propos, la découpage du relief de la Roumanie, si varié et complexe, dans la support des particularités morphométriques et morphographiques, de la constitution, de l'évolution et de la dynamique actuelle, y compris des possibilités de valorisation, sous-divisions identifiables par les dénominations recommandées.

Ce volume se présente comme une finalisation des huit volumes antérieurs donc est considèré comme le neuvième de ce sériel de présentation unitaire de toutes les unités et sous-unités du relief de la Roumanie, dans les volumes parus entre 2001 et 2014. Il est, en quelque sorte, par les noms, des vrais noms-clés, un sommaire de tous les volumes parus.

Le volume offre, d'une manière succinte, en ordre alphabétique, selon un schéma unitaire, qui indique l'individualité topographique, physiographique et socio-humaine de tantes les unités et sous-unités du relief complexe de la Roumanie. Il s'agit de 1.280 entrées pour des noms de sous-unités jusqu'un cinquième ordre. Ce schéma unitaire suivi avec rigueur assure une facile comparaison de toutes des sous-divisions.

La parution de ce volume a été devancée par l'inclusion de toutes ces dénominations dans le sommaire du *Dictionnaire géographique de la Roumanie* (2 volumes, 2008–2009, environ 1400 pages, avec plus de 40.000 termes), redigées selon les recommandations des conférences des Nations-Unies pour la nominalisation des noms géographiques.

La nécessité de compter sur une forme unitaire des noms géographiques de toutes les unités et sous-unités de relief a été ressentie non seulement dans la littérature géographique roumaine. Répondant à cette exigence, l'auteur, Lucian Badea, a essayé d'illustrer de manière cartographique ce thème, avec le professeur Grigore Posea, en 1994, sous la forme d'une carte murale, à l'échelle 1:400.000e.

Dans le volume que nous commentons, l'auteur utilise de suite la forme génitivale des noms, parfaitement légitime dans les textes, mais moins acceptée par les cartographes, obligés d'inscrire dans un espace limité, une dénomination plus longue avec quatre littres. Dans le passé, l'originalité des contributions scientifiques géomorphologiques était parfois jugée, aussi par l'utilisation de nouvelles dénominations des sous-unités, différentes par rapport aux précedesseurs. Pour les dénominations doubles en usage, par exemple Monts de Gârbova (de Baiu), le Balta de Ialomiţa (de Borcea), l'auteur, d'une manière sage, les inscrit, toutes les deux, laissant la communauté scientifique, aussi bien que celle locale, de décider. Les exigences lexicographiques auraient imposées l'inscription dans le Dictionnaire aussi du deuxième nom, entre parenthèses, avec renvoi au premier nom.

Le niveau différent de connaissance des sous-unités de degré inférieur, consacré par des thèses de doctorat, a obligé, bien sûr, l'auteur de recourir, pour des lieux moins connus, à des noms repris de la toponymie locale. Le temps va prouver en quelle mesure ceux-ci vont s'imposer.

Un parcours soigné de l'entier fichier permettra l'auteur l'introduira des corrections à une prochaine édition. Par exemple, les monts Vlădeasa ne pourront pas être inclus, de manière topographique, dans les Monts d'Arieş. On va se dédire du principe, très rationnel, d'intégrer la dénomination au bassin hydrographique afférent.

60 ans se sont écoulés depuis la parution de la carte de la régionalisation géomorphologique du territoire de la Roumanie dressée par le Professeur Vintilă Mihăilescu, une borne difficilement à atteindre. Une riche expérience de terrain, ainsi qu'une approfondie analyse cartographique et de la riche littérature géomorphologique plus récente ont autorisé le Dr. Lucian Badea d'offrir un nouveau découpage, plus détaillé à cette préoccupation permanente, de deux générations de géographes, liée au relief de la Roumanie.

Şerban Dragomirescu