CZECHIA: CHANGES IN LANDSCAPE USE IN THE TRANSFORMATION PERIOD

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Key-words: land use of Czechia, driving forces, transformational period, methods of evaluation.

Abstract. This article analyzes processes of land use changes realized in transformational period after 1990 in Czechia. Land use Czechia database is a source having six time horizons for almost 9000 cadasters or joined cadasters covering all territory of Czechia. Time horizons give us chance to compare trends of land use changes among them – 1845, 1896, 1948, 1990, 2000 and 2010. This article uses mainly data form 1990 and 2010. In this period we observed relatively huge increase of grassland (meadows and pastures) influenced by abolishing of socialist support of agriculture shortly after 1990 and following decrease of agricultural intensity. We are concerned also on the regional trends in land use structure changes in Czechia. We used special methods (index of change, typology of change, main landscape change prepared earlier by Slovenian authors: Kladnik, Gabrovec, Petek). Transformational changes in land use show continuation of earlier started trends but in different intensity and shorter time. Main driving forces are differential land rent I, II. Main regional differences are visible between lowlands and regions of higher altitude, in lower level plays important role distance from main core regions and main axis of social economic development. There is important long term creation of special typological regions of specific land use structure and also its development. This process is influenced by new functions given to different parts of landscape in modernization of Society in last two centuries.

1. INTRODUCTION

Recently, the landscape in Central Europe has featured as a very frequent research topic. This covers not only geographical works, but also a wide array of further branches that examine the landscape and its dynamism. Hampl (2000) presents three main stages in the development of interaction: determination, competition and cooperation. On the basis of the three cited stages, the present-day Central Europe may be finding itself at the beginning of the third stage. In fact, the countries here are among the richer ones for which the efforts at cooperation of the functions between nature and society have been visible, especially after the change in the political and economic situation that started after 1990. The research into the interaction "nature vs society" by means of the data on land use/land cover is a very frequent topic, with an accelerated focus in the past 30 years (see Table 1). One should consider this not only evidence of the growing problems of this interaction, but also of an increased interest expressed by geographers and furthers specialists.

In the geographical research into landscape changes, a major role is played by maps of various scales, by the data derived from the maps of land use/land cover as well as the data from cadastral registration of land use. Our approach to the assessment of long-term landscape changes is based just on the latter data, derived from the cadastral mapping within the territory of Czechia in 1824–1843. By means of the data, one can analyse the situation in individual localities and microregions from the viewpoint of land use structure (dated uniformly as of 1845). If there are a number of time horizons,

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one can evaluate the development of land use as well as changes between the individual time horizons and one can speak about a dynamic or historical land use (Jeleček, 1985; Worster, 1987, 1990; Bičík, Jeleček, Štěpánek, 2001; Bičík *et al.*, 2010). In the course of time, land use structure changes in the individual localities under the pressure of changing functions from the viewpoint of a modernising society. Just the land use data of a given locality/microregion reflect the functions that a specific society and local community (but the latter increasingly less) demand from the specific area in a given stage of development.

Table 1

The development of the number of articles with selected LUCC key-words at WoS and Scopus 1970–2010

		1970	1980	1990	2000	2005	2010
	key words						
Web of Science	landscape ecology			21	114	119	177
	landscape metrics				15	57	74
	land use	65	132	228	1350	2653	4335
	land cover		3	28	361	810	1267
Scopus	landscape ecology			15	159	174	408
	landscape metrics				13	60	73
	land use	19	48	256	1456	2373	4102
	land cover		1	9	295	603	1119

Source: Balej (2012).

The land use data provide information on the current state of the interaction "nature vs society" in the form of numerical information on the individual land plots, cadastral units, and administrative units (districts, regions, and states). This means that the land use data make it possible to evaluate the state of interaction on the varying order level of territorial units in various time horizons. Obviously, the smaller the territorial units in which the land use is evaluated in an area, the bigger the differences in the state of and changes in the individual categories and the total land use structure. Given the character of this contribution, we consider this explanation necessary. We will adopt a geographical approach with a focus on changes in the interaction "nature vs society" in the regional impact in Czechia's transformation period. The first part presents a discussion of the selected literature on the broad topic of dynamism of land use, with a focus on the transformation period of post-Communist society (since 1990). The second part tries to present an attempt at a detailed look at regional differentiation of the development of the interaction "nature vs society" by means of land use data according to Czechia's cadastre units.

2. DISCUSSION OF LITERATURE AND OBJECTIVES OF THE ANALYSIS

Out of the quantity of literature published on the topic, we will primarily deal with the authors who characterise the social and economic development and its most important processes with an impact on new functions of certain parts of the landscape and on land use changes. From the viewpoint of land use changes, the work by Worster (1987, 1990) is crucial for the study of the interaction of nature and society. Worster has analysed man's long-standing impact on landscape by various ways of its (agricultural) use.

Turner II and Meyer 1994, Turner II (1995, 1997) characterised the driving forces as the causes underlying changes in the functions of certain areas. He distinguished the natural, economic, political, social and other forces. Along with a change in the function, there is a gradual land use change. Hampl and Müller (2011, p. 211–212) studied the uneven speed of transition in different structures triggered by the post-1989 transformation. "They argue that political and economic structures have changed quite fast (within days, weeks, or months). Social, cultural, and demographic changes are much slower and usually take years. Even analyses of land use driving forces (Hampl and Müller take land use as one of social-geographical structures) show that within all examined periods land use changes have been somewhat slower than changes of other social-geographical structures. The increase in regional differences of land use types, resulting in new typological regions with similar land use patterns, was the slowest process of all. To sum it up, the uneven speed of changes mentioned by Hampl and Müller applies also to land use changes that have been always slower since the beginning of Industrial Revolution" (Bičík *et al.*, 2015, in print).

The relationship between the development of society and landscape changes was examined by Mather (2002). With the forest transition theory, he pointed out the transformation of the function and change in forest areas in developed countries. Thanks to the modernisation of these countries, forest areas have acquired new functions. This, along with the prevailing intensification of the development of agricultural production, became a cause of the growth in their area in a certain stage of Industrial Revolution as well as subsequent changes in the form of a Technological and Scientific Revolution, and Scientific and Technological Revolution (Purš, 1973, 1980). Along with traditional, primarily productive functions of the forests, modernising society gives them further functions: water management, recreational, environmental, housing, and other ones. With the process that was started locally, but acquired general dimensions in the 1890s, it was possible to produce, by means of intensification measures, higher volumes of agricultural production. This released the return of a part of farmed land for other purposes (back to forest areas or to built-up and other areas). The process of forest transition provides an explanation of the growth in forest areas in most advanced European states.

In Czechia, the topic of landscape use changes was examined by Häufler (1953, 1960), undoubtedly influenced by the contemporary interest in land use mapping (Stamp, 1948). Häufler analysed the upper limit of agricultural management and the decreases in arable and agricultural land of the mountainous areas of the former Czechoslovakia, strongly affected both by the deportation of Czech Germans and forced collectivisation of agriculture. Jeleček (1985) examined agriculture in the 19th century in Bohemia and the impact of Industrial Revolution on the state and development of agriculture and land use. Jeleček and Bičík published analyses of social economic and political influences on the development of Czechia's land use (2009). Lipský (2001, 1998) has analysed land use changes of Czechia. In this country, he is one of the leading authors with strong geoecological approaches applied on minor model areas. Important author from point of view of evaluation of physical geographic components in landscape is Kolejka (2013), who prepared many maps into the Landscape Atlas of the Czech Republic.

Hampl and Müller (2011) have defined the delays in the individual social economic processes. Among others, their approach explains the slow changes in land use structure and increase in its regional differentiation. The long-term development of land use is heading for a formation of typological regions composed of stable territorial units (STU) with a similar structure of areas and also of their development. There is the question of whether the found trends of a gradual formation of certain types of land use structure, as documented by Bičík *et al.* (2012), will be permanent. Lipský (1995) has noted that in the past, there was an oscillation of the growth and decrease in agricultural land.

One has to point out also other concepts analysing landscape changes such as that of driving forces and the DPSIR concept. They are important both for the local and microregional analyses and rather general deliberations on the level of regions and states. The DPSIR concept was established at the turn of the millennium. Its elaboration for Central Europe was conducted, e.g., by Feranec *et al.*

(2001, 2010) and Kupková (2001). Social metabolism is a very interesting concept of the study of landscape changes, developed by Austrian environmentalists. It documents the transformation of energy demands in agriculture during more than one century on the basis of energy inputs/outputs both on the local level in selected municipalities and in the whole of Austria (Haberl *et al.*, 2001, 2003; Kušková *et al.*, 2008).

Our research focuses on the development of land use in the long run, based on the data of a special database that we prepared for the whole area of Czechia (for 1845, 1948, 1990) at the close of the previous century and later widened by the data from 2000 (see http://web.natur.cuni.cz/ksgrrsek/lucc/). Recently, the database was complemented by the time horizons of 1896 and 2010 (so far unpublished). A search for the trends in the development of LUCC within Czechia was one of the research questions of our efforts. It has turned out that in the individual periods (Bičík *et al.*, 2010; Bičík *et al.*, 2015), various processes were under way with a varying intensity and a specific regional impact. There is the question of whether similar trends are generally valid or are only specific for the post-Communist transformation period of European countries. As the social economic conditions were not quite equal and transformation was not equally triggered and implemented in the individual countries of post-Communist Europe, this question has remained the objective of further, perhaps internationally conceived research. These differences are analysed, e.g. by the studies performed in the late 1990s and early 2000s (Turnock, 1998, 2001; Banski, 2008; Bičík and Götz, 1998).

In the past decade, a number of studies using the land cover data according to CORINE from 1990, 2000 and 2006 appeared. They compare the general trends of landscape use changes in Central Europe or even in the whole of Europe (Feranec, Šúri *et al.*, 2001; Feranec, Jafrain *et al.*, 2010 etc.). A later study has documented regional differentiation of the changing area of agricultural land in the form of changes characterised as extensification or intensification. Similarly, there were analyses of changes in forest areas such as deforestation or reforestation as well as changes in the extent of urbanisation (increase or decrease in built-up and other areas; Krausmann *et al.*, 2001, 2003). A number of concrete results of an analysis of decreases/increases in specific categories of areas were also published in the Landscape Atlas of the Czech Republic (Hrnčiarová *et al.*, 2009), including a number of cartograms drawn up by the authors of this contribution.

3. LAND USE CHANGES IN CZECHIA 1990–2010

3.1. Political and economic changes in Czechia

While the change in natural conditions was small if any, political, economic and social changes were crucial driving forces of this period. After 1990, there was a property restitution and privatisation. The two processes have basically influenced the tenure and use of primarily agricultural land. Until 1990, agricultural land was de facto owned by the state. It was used by several thousands of agricultural cooperatives (2563) and state farms (174; average size 6259 ha), while there were only a few hundreds of individual farmers (some hundreds only; they only used approximately 1.5% of agricultural land resources). In the course of 1991–1995, agricultural land was returned to its original owners or their heirs in Czechia. The land was suddenly owned by approximately 3.5 million entitled people. The overwhelming majority of them only received a few hectares, mostly fragmented in a number of land plots (sometimes even tens of them), while only a tiny part of the owners started farming the land again. At that time, for the sake of profitability of farming, it was necessary to cultivate about 40–50 hectares of agricultural land. As a result, most of the entitled owners either leased the land or sold its minor parts to buyers. One part even did not take any care of the returned land. One of the reasons of the attitudes was the fact that most of the entitled owners had no experience with farming (even if they had worked in agriculture, this was in quite specialised branches of the Communist large-scale production) or often lived in very distant towns.

The process of property restitution, used by agricultural cooperatives and state farms until then, to the entitled owners, was very complicated. In the process, the obligations towards them had to be settled. Only afterwards it was possible, provided the general assembly of the remaining members of the cooperatives decided to continue working for them, to proceed to the transformation of the Communist-era agricultural cooperatives into a new type: the cooperative of owners. Given the difficult character of the task, it is interesting that the process of property restitution was completed in about 90% of the cases in the course of approximately two years. By 1995, the land tenure was quite different.

3.2. Database and methods of analysis

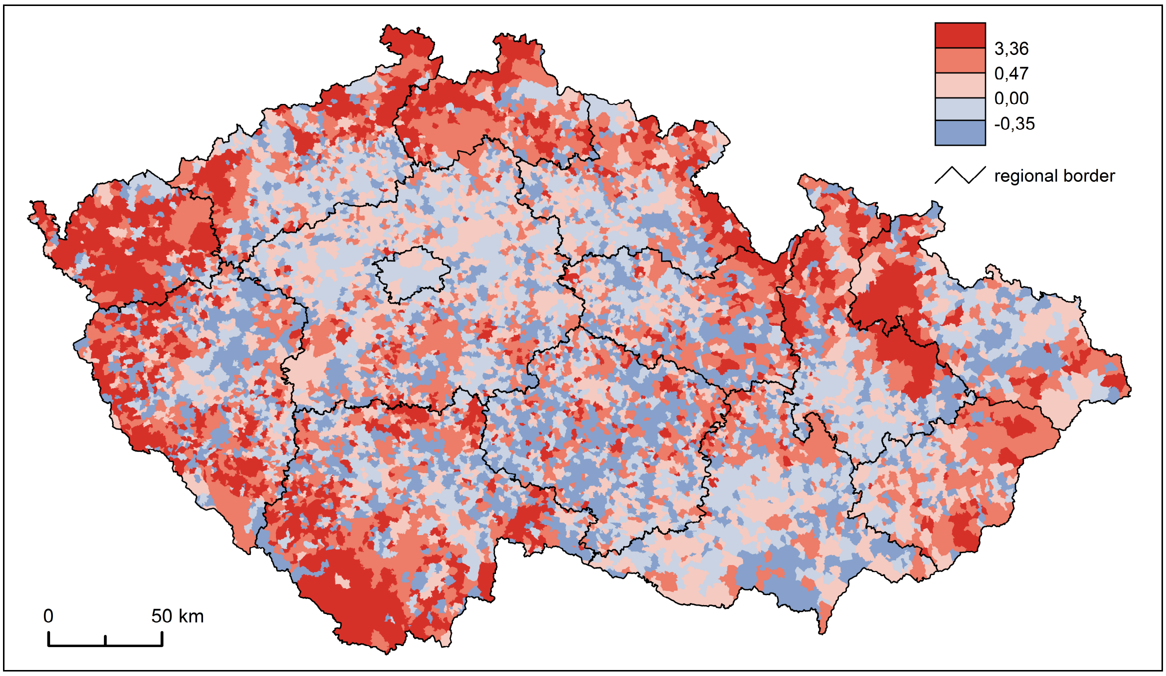
At present, a part of the data on which this contribution is based is available online (LUCC Czechia Database – http://web.natur.cuni.cz/ksgrrsek/lucc/) for the whole area of Czechia, specifically for 1845, 1948, 1990 and 2000, and for 8,903 stable territorial units (80% of them are comprised of a single cadastral unit, the rest of the two or more whose area changed). Taken together, one or more merged cadastral units created a sample of comparable stable territorial units (STUs) whose area was the same in the course of the observed years (the differences were smaller than 1% of their total area). This article mainly focuses on changes during the transformation period, as depicted on January 1, 1990 (in the cited public LUCC Czechia Database) and on December 31, 2010 (so far unpublished). The creation of this widened database was a difficult process because we had to modify:

1. The total number of stable territorial units (STU = 8,832) in order to ensure the same area of the analysed units;
2. It was necessary to simplify the observed structure because in 2010, there was no separate registration of meadows and pastures, but only their sum called permanent grassland;
3. For the given reasons, our original database and the new one, created after the data for 1896 and 2010 were added, are not fully comparable, unlike the previously published analyses. The new database analyses changes in the following seven categories: arable land, permanent cultures (gardens+orchards+vineyards+hopfields), permanent grassland (previously meadows and pastures), forest areas, built-up areas, water areas and remaining areas (taken together, the last three form an aggregate category of “other areas”);
4. In order to watch general trends, we also evaluate the macrostructure of land use or changes in the area of agricultural land, forest areas and other areas.

Along with an assessment of the state of and changes in regional differentiation of individual categories in 1990–2010, we also watch more general trends of changes in total land structure by means of index of change, the type of changes in landscape macrostructure and the main processes of landscape transformation.

3.3. Results of changes in land use of Czechia in 1990–2010

Unlike the previously published articles, we work here with a rather different methodology of depiction of land use changes by means of cartograms. We presume that it was crucial to depict regional differences in land use changes and, possibly, to try and interpret possible causes of these differences. While in the past most of our analyses were based on the index of development of individual categories between two particular years, we apply a different principle here. We assess the difference of a given category by its proportion in the size of a STU (= 100%). Moreover, we only work with five, equally numerous classes of the whole sample (8,832 STUs). This approach reflects better the size of the individual STUs on the one hand and there is no distortion in those with a small extent of the category in which a change by a few hectares was sufficient for a large value of the index, on the other. The first cartogram (Fig. 1) depicts change in the area of the category that is characteristic of the period: change in permanent grassland, primarily as a result of the cancelled Communist subsidies for agricultural cooperatives and state farms after 1990.



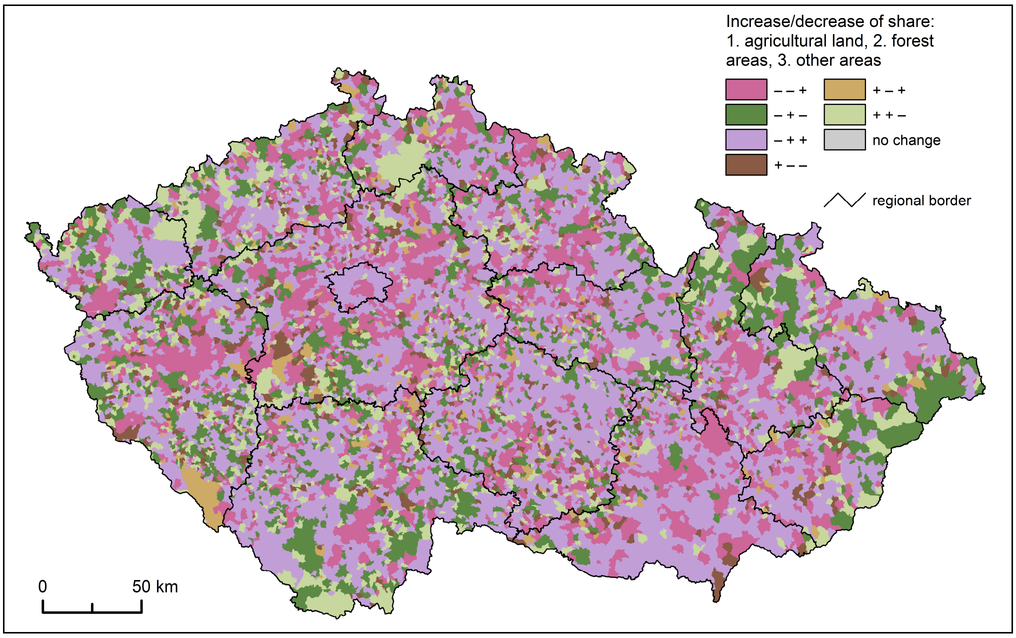
Source: LUCC Czechia Database.

Fig. 1 – Change in area of permanent grassland between 1990 and 2010 (percentage points of BTU area).

After 1990, a falling intensity of farming brought about changes in the structure of agricultural land. On the one hand, this was caused by the loss of Communist-era subsidies and by the property restitution and privatisation of state farms along with a transition to the market prices and a fall in the exports of agricultural products, on the other (Götz, Jančák, 1997; Bičík, Jančák, 2006). This has resulted in abandonment of arable land and a growth in permanent grassland recorded in the cadastre of real estates. Besides, at least 300,000 hectares of arable land (approximately 5% of the area of arable land in 2004, Bičík *et al.*, 2010) remained unused in the long run (fallow land). After Czechia joined the EU in 2004, it was partly ploughed up again. This was largely due to the chance of applying for subsidies for its cultivation after Czechia joined the EU. On the face of it, the regional pattern of decreases in arable land and its replacement with permanent grassland clearly points out a strong dependence on natural conditions: soil quality, altitude and slope of the abandoned arable land. However, there was the stronger impact of the reasons arising from differential rent II: if there is a falling volume of production and loss of Communist-era subsidies in Czechia, it is more profitable to invest in the fertile land in the lowlands, which also has a smaller environmental impact. The extent of permanent grassland is higher in the northern half of Bohemia. There was, in the long run, a relatively strong employment in industry, which gave a chance to the rural population to find jobs outside agriculture, while they could maintain additional small-scale cattle and pig breeding. This is why the process of abandonment of arable land and a transfer to permanent grassland was started here earlier and after 1990, it continued at an even faster pace.

We can similarly evaluate further observed categories, but the limited space of this contribution makes us pay attention rather to the more synthetic approaches in the assessment of land use change in Czechia after 1990.

The first method evaluating landscape change is based on an assessment of land use macrostructure. This is understood as an analysis of merely three elementary macrostructure categories: agricultural land, forest areas, and other areas. The analysis is based on the increase (including the same area), denoted by the sign " + ", or decrease (denoted " – ") of area of these three aggregate categories, thanks to which one can distinguish six types of the changes between 1990 and 2010 (Fig. 2).



Source: LUCC Czechia Database.

Fig. 2 – Types of macrostructural land use changes in Czechia in 1990–2010.

A comparison of the occurrence of the individual types of changes in the period under observation over the past 170 years is best shown by Table 2. It is obvious from it that in the transformation period of 1990–2010, over 80% of Czechia's area was characterised by the STUs with a decrease in agricultural land. The growth in forest areas was recorded in approximately 71% of the STUs, while the increase in other areas was recorded in the STUs covering about 67% of the national area.

Table 2

Typology of land use changes by STUs in Czechia in 1845–2010 (proportion of the national territory, %)

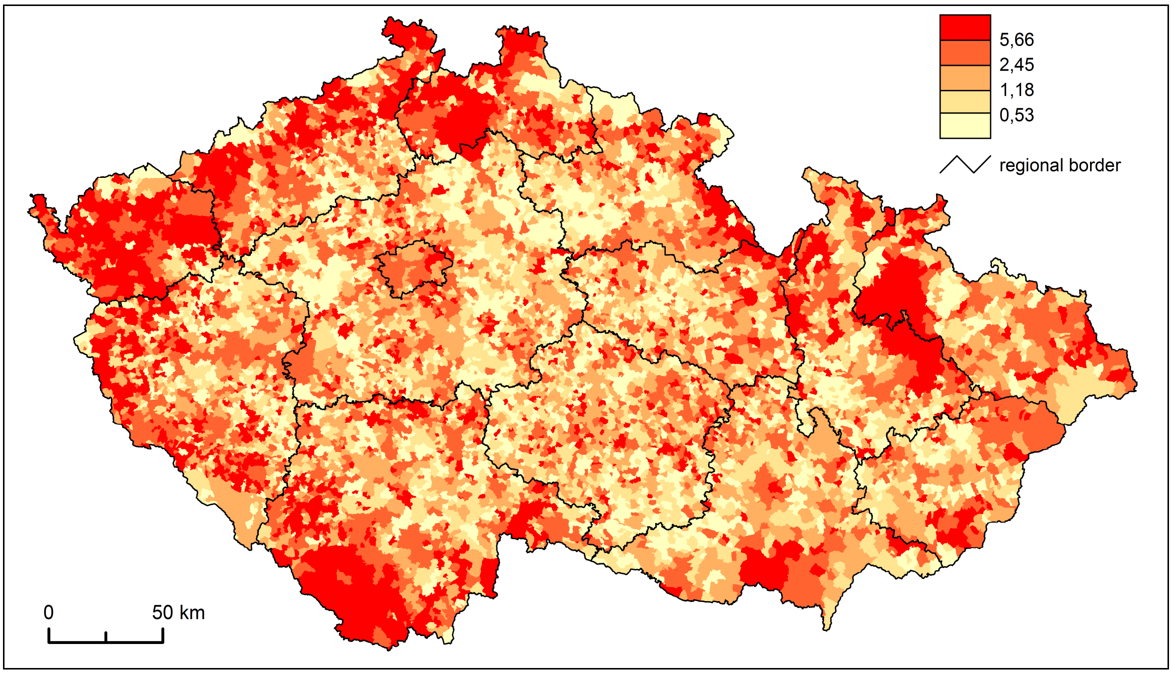
Type	Period				
	1845–1896	1896–1948	1948–1990	1990–2010	**1845–2010**
– – +	3.7	17.4	9.6	21.1	**16.5**
– + –	22.3	2.7	0.4	15.9	**0.9**
– + +	16.5	72.3	89.9	43.2	**79.3**
+ – –	32.7	0.6	0.0	5.0	**0.2**
+ – +	13.5	6.2	0.1	3.0	**2.6**
+ + –	10.9	0.4	0.0	11.7	**0.2**
no change	0.0	0.0	0.0	0.1	**–**
no data available	0.4[a]	0.4[a]	–	–	**0.3[a]**

Source: LUCC Czechia Database. Note: The first mark (+, –) indicates increase / decrease in agricultural land, the second forest areas, the third "other" areas (water, built-up, and remaining areas combined). [a] The regions of Hlučínsko and Valticko, plus České Velenice and its environs became part of the present-day territory of Czechia only after World War I.

We published the index of change in the analyses of development of landscape structure of Czechia in a number of previous studies (Bičík *et al.*, 2010). This indicator documents the total intensity of changes in the area of the observed seven categories (there were eight of them before 2000 because there were specific classes of meadows and pastures). In theory, it ranges between 0 and 100%, from localities with no movement between the areas of individual categories to the localities with a total transformation of land structure (IC = 100%). This is the mathematical expression of index of change (IC):

$$IC_{A-B} = 100 \cdot \frac{\sum_{i=1}^{n} \left| P_{iB} - P_{iA} \right|}{2}$$

IC_{A-B} means index of change between year A and year B; n indicates the number of land use classes; P_{iA} equals the proportion of relevant land use class at the beginning of the examined period and P_{iB} equals the same proportion in the end. In this publication, seven land use classes are taken into consideration (n = 7): arable land, permanent cultures, permanent grassland, forest areas, water, built-up and remaining areas. In some earlier publications and articles, calculations included all eight basic land use classes (Bičík *et al.*, 2001; Bičík *et al.*, 2010 etc.).



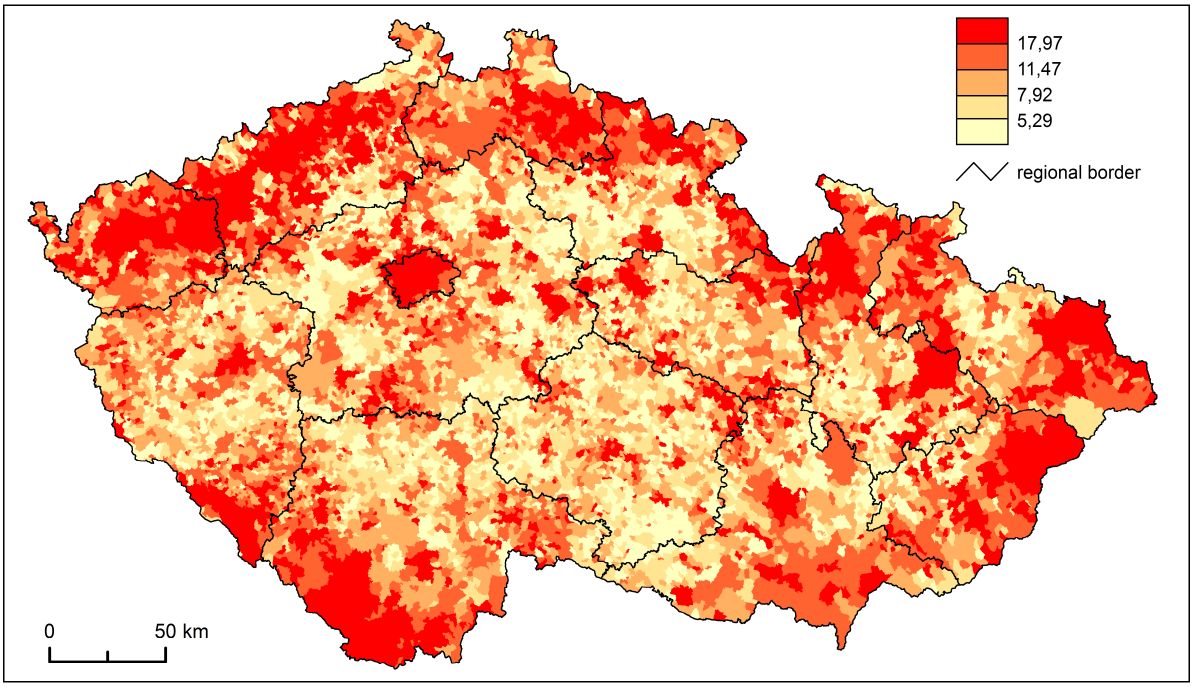
Source: LUCC Czechia Database.

Fig. 3 – Index of change between 1990 and 2010 (in %).

Cartogram 3 shows the index of change in five, equally numerous classes. The areas with the highest index of change (5.66% and more) were surprisingly not reached by the regions with large towns and their hinterland. Primarily thanks to the mining, built-up areas and abandonment of agricultural functions of landscape and increasing extent of other areas (mining, industrial and housing development, dumping sites, etc.), the whole Northwest Bohemia is the most important region with the highest values of index of change. Smaller regions with a high value of index of change can be found in the abandoned areas of military training grounds and of three newly established national parks

Šumava, Podyjí and České Švýcarsko (administrative reasons of shifts between categories). On the contrary, the smallest index of change characterises hinterland areas with good to average conditions for agriculture without major development tendencies, due to which they have a stabilised landscape structure.

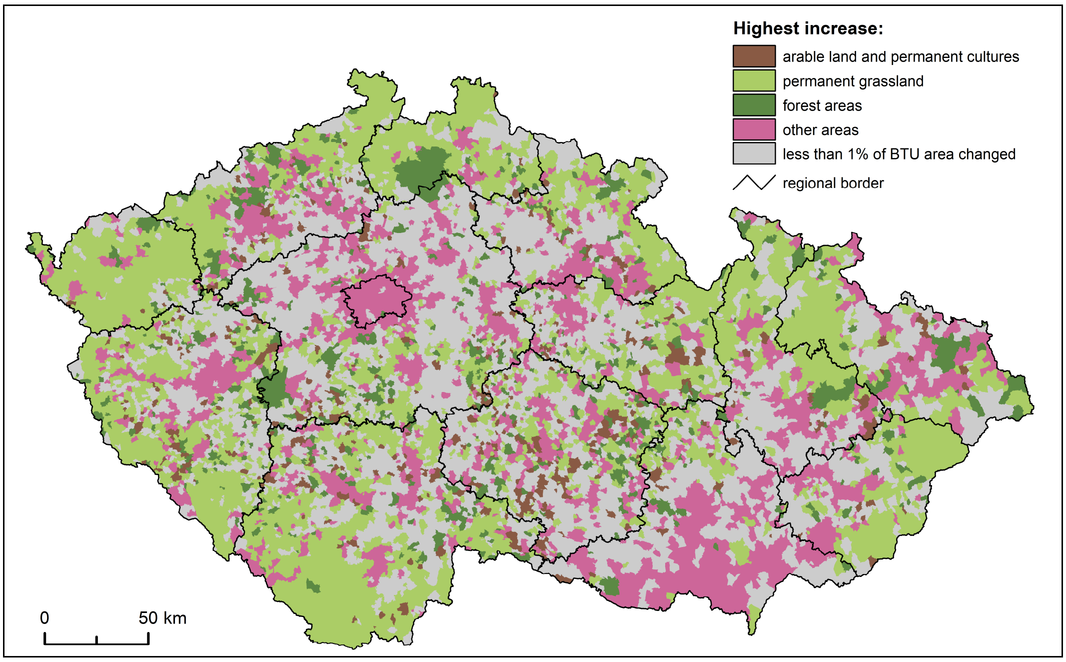
Unlike the previous period (see Fig. 4), we have to stress a substantially smaller movement between the individual categories of land use areas in 1990–2010, which caused a smaller index of change. This was largely due to the deportation of Czech Germans from the border regions after World War II (its consequences in the form of abandonment of agricultural and, specifically, arable land around the Iron Curtain could be felt as late as the 1950s) that were never fully resettled. In high and poorly accessible locations, agricultural land remained unused. Another reason was the transition from traditional family farms to primarily large-scale companies of the Communist-era type (agricultural cooperatives and state farms) that cultivated 98% of Czechia's agricultural land in 1989. Besides, the development of industrial projects and large housing estates from scratch and, last but not least, large-scale open cast mines along with large areas of overburden contributed to a high level of index of change in the totalitarian era. Large losses of agricultural land were also due to the insufficient legal protection as the first law on the protection of agricultural land resources was only enacted in 1965. Moreover, its efficiency was poor. It was only the law No. 65 from 1976 that ensured a much more efficient protection, although its application was limited by the sprawl of some towns surrounded by quality soils (Olomouc, Hradec Králové etc.). Nevertheless, about one-fifth of agricultural land resources were lost in 1948–1990. The main proportion of the loss was concentrated in 1948–1965. In 1948–1990, the main areas with the biggest index of change were primarily concentrated in the border regions and the regions with mining of raw materials (Northwest Bohemia, Ostrava region, Southeast Moravia).



Source: LUCC Czechia Database.

Fig. 4 – Index of change between 1948 and 1990 (in %).

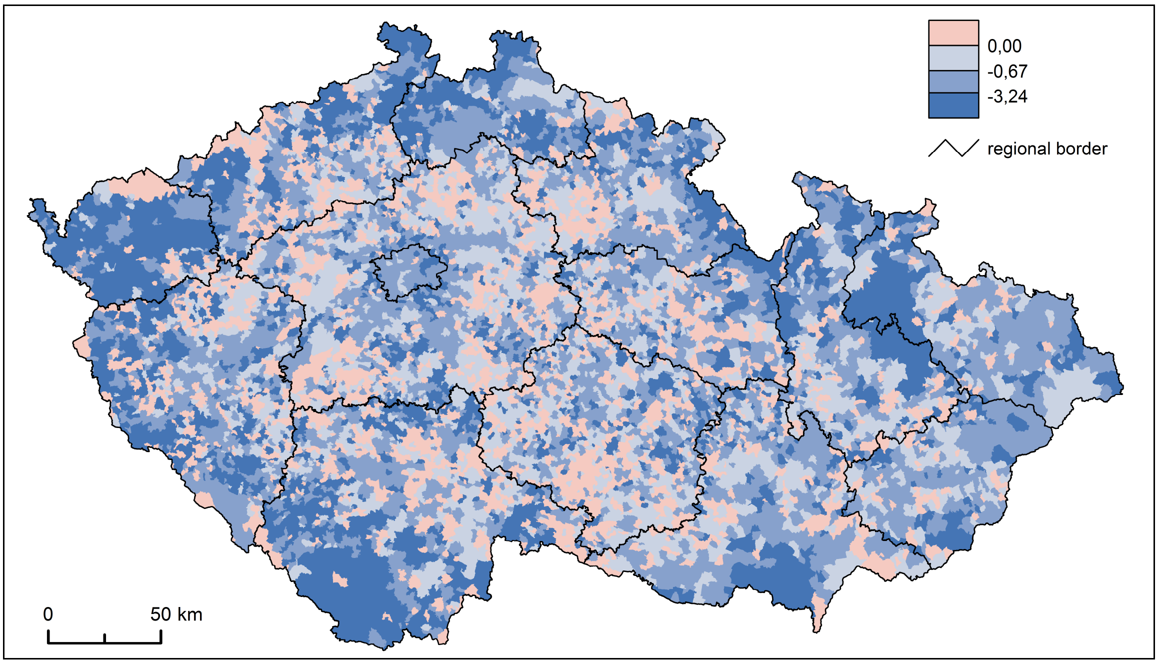
In the international context, further chances of using similar databases have been published. Here we use the indicator that was published by the colleagues from Slovenia who have access to a database similar to that we use for Czechia (Gabrovec, Kladnik, 1997; Gabrovec, Kladnik, Petek, 2001). This is an indicator assessing landscape changes by means of the main processes that occurred in territorial units between two time horizons. The method works with only five merged categories of areas expressing, with a certain inaccuracy, the pressure on specific function. These categories are as follows: arable land+permanent cultures; permanent grassland (=meadows+pastures); forest areas; built-up+other areas; water bodies. There is an assessment of increase between two time horizons. The merged category that records the biggest increase of all growing categories is denoted as the main landscape process. According to the proportion in the sum of all increases, they are evaluated as follows: a minor process (under 49.9% of all increases), a medium process (50.0–74.9%) and a strong process (75% and more) either as intensification of farming, covering with grass, reforestation or urbanisation. The water bodies virtually fall out from the evaluation because their extent does not much vary. Besides, their proportion in the land structure of each STU is almost invariably under 1%! For the period between 1990 and 2010, cartogram 5 clearly documents covering with grass as a dominant process of Czechia's landscape transformation, influencing about 33% of all STUs. Suburbanisation has turned out to be the second most frequent process, while the process of intensification of farming was all but negligible in this period.



Source: LUCC Czechia Database.

Fig. 5 – Main processes of landscape changes 1990–2010.

Figure 6 depicts changes in the area in the form of differences in the proportion with which arable land contributed to the area of individual territorial units (STU) between 1990 and 2010. This has revealed a continual decrease in arable land area, especially to the benefit of permanent grassland (in Czechia in this period by -220 000 hectares, which meant a fall in arable land by 7% as against 1990). As a result, regional differences are primarily important from the viewpoint of the degree of occurred losses. From this viewpoint, the biggest losses were recorded by the Karlovy Vary, Ústí and Liberec regions. These are the areas with a considerably industrial character, with a high proportion of immigrated population and, at present, with a high unemployment level. A similar situation is alongside the western border in the mountains and foothills of Šumava and Český les. The loss of arable land in southeastern Moravia is more influenced by the transfer of arable land to permanent cultures, orchards and gardens. In this period, only a tiny quantity of STUs recorded a growth in the area of arable land, but without a clear regional pattern. To some extent, this can be explained as a consequence of large-scale return of agricultural land in the early 1990s and many entitled owners' reluctance to farm the returned land (having to decide on its sale, their own farming, lease, development, etc.).



Source: LUCC Czechia Database.

Fig. 6 – Change in area of arable land between 1990 and 2010 (percentage points of BTU area).

Changes in land use in Czechia and perhaps also in other post-Communist countries after 1990 can be to some extent explained both as a continuation of the past long-term trends in the processes characterising all economically advanced countries of Europe (loss of agricultural land resources, growth in forest areas, suburbanisation, construction of transport corridors, etc.). On the other hand, in the post-Communist countries this has resulted from the efforts at putting right a number of the deformations caused by the central command economy and from their specificities and the extent of their application in these countries (elimination or new definition of subsidies in agriculture, the processes of property restitution and privatisation, the freezing of purchase of agricultural land resources to foreigners, etc.). These changes differed among the individual countries in the observed transformation period (Banski, Bednarek, 2008; Turnock, 1998, 2001 etc.). Changes in LUCC have been under way at a slower, more gradual pace and with a certain time lag after the creation of new social and economic conditions after 1990. According to the evaluation by Hampl and Müller (2011), this mostly only occurred after 2000. This delay in the processes of social and economic territorial restructuring has also resulted in the delayed entry of changes in the categories of cadastral registry within the agricultural land resources and their transfer to other, non-agricultural utilisation. Nevertheless, one can observe a gradual forming of typological regions composed of the STUs of a similar land structure and even of a similar development. Within the framework of the analyses of long-term land use changes in Czechia (Bičík *et al.*, 2010) evidenced a formation of minimally following types of landscape of Czechia with a similar structure of land in the STUs that shape them and different land structures of such formed typological regions.

Our analyses of long-term land use changes make it possible to delineate certain areas of similar functions and similar structures of land and their development in the landscape. These typological regions formed the STUs of a similar structure of land and its development, but they considerably differ from one another. We can distinguish the following typological regions created by long-term land use changes in Czechia (Bičík, Kupková, 2012; Bičík *et al.*, 2010), although their delineation is a question of the future. Moreover, they have not covered the whole territory of Czechia.

There are also certain transition zones between them:

– Urbanised regions of big towns;

– Hinterland of big and medium-sized towns with a transformation of agricultural function of a part of the hinterland to housing, servicing, storage and transport areas with a microregional environmental impact;

– Lowlands outside main settlement centres with good natural conditions for agriculture with a dominance of arable land, a minimum of forest areas and grassland;

– Areas of medium altitude (450–600 m) with average, sometimes slightly below-average natural conditions with a prevailing agricultural, housing and locally also recreational functions;

– Foothills and lower mountain areas with a restructuring and even loss of agricultural function and depopulation;

– Military training grounds, both abandoned and existing, with limited chances of development and a possible revitalisation of landscape use, search for new functions (most land use changes were caused by changes in categorisation);

– National parks and protected landscape areas with limited chances of change and a relatively stable structure along with a considerable proportion of forest areas and grassland;

– Areas of outer and inner periphery with a strong depopulation and long-term extensification of agricultural use of landscape, locally also with a recreational function;

– Mountain areas with specific functions and a high proportion of forest areas, that has been growing in the long run, and of a largely depopulation nature;

– Mining and industrial areas with a strong devastation of landscape and its revitalisation in the past 30 years;

– A new wilderness appears on the local level as a relatively new element in the landscape that was previously intensively used. Now, it is outside economic use for various reasons. These are primarily small areas, mostly on abandoned agricultural land, but also from the category "other areas" (quarries, abandoned field paths or previously built-up areas of agro-brownfields, etc.).

4. CONCLUSIONS

Like in other countries that bordered with the West by the Iron Curtain, in Czechia, too, its removal in the areas with quality natural conditions triggered a robust boom of tourism (the case of Šumava and Český les, the Harz area straddling the border between East Germany and West Germany, the Hungarian areas around Lake Neusiedl, etc.) and also a growth in the area of landscapes with specific protection (Chromý and Rašín 2010 – national parks, reserves, etc.).

One has to realise that the degree of centralisation in decision-making processes varied in the individual countries. When it comes to the impact on the landscape, changes in the land use structure after 1990 have been much bigger in the countries in which the number of small farmers had been reduced or even eliminated (Czechia, Slovakia, East Germany, and Hungary) and agricultural cooperatives and state farms cultivated almost all agricultural land. They were influenced by property restitution and privatisation of the land owned and used by the state, which had a serious impact on changes in functions, intensity of farming, etc. In addition, after 2000 Czechia was under the influence of its forthcoming entry to the EU whose agricultural policy (CAP) influenced changes in agriculture and its efficiency and, subsequently, in land use structure (Hampl, Müller, 2011).

The creation of large industrial brownfields was a typical process that influenced land use structure on the national level and even more on the regional level. The brownfields were partly redeveloped into servicing projects (shops, galleries, loft housing, etc.). Besides, there was the establishment of new industrial and storage zones on the fringes of towns and a gradual urban sprawl into the free landscape, often with an intensive agricultural use, by the development of suburbia, etc. (Kupková, 2001; Ouředníček, 2007; Grigorescu *et al.*, 2012). In Czechia, there was one negative aspect: "the postponement" of the transfer of unused arable land to the category of permanent grassland (under the law, fallow arable land had to be transferred to permanent grassland in the land registry within four years at the latest). A number of old-new owners of arable land were waiting for Czechia's joining the EU in order to be able to use it again with the help of European subsidies! Another example is posed by the growth in the area of vineyards in south Moravia. A few years before joining the EU (after it, the land could no longer be enlarged), it increased by approximately 2,000 hectares, or about one-sixth of its original area from 2000.

After 1990, Czechia's land use and its character were influenced by the fact that out of the 3.5 million people who received back their land, only a fraction decided to start farming it again. Most of the returned land was leased, a small part sold, and another small part was fallow. In fact, Czechia is an extreme country in the EU as there is a high proportion of agricultural land resources as leased! There is another characteristic feature: a general lowering of intensity of farming. Along with nature protection (foundation of new national parks, protected landscape areas and localities), this influenced the higher level of this care and its consciousness in the population. Moreover, about 57% of national area was classified as less favoured areas.

In addition, there were the processes of internationalisation and globalisation (construction of supranational transport corridors, construction of new border crossings and customs offices, that soon lost their function and transfers of a large number of agricultural products across Europe influenced the production and intensity of farming both on the national and regional levels, etc.).

Last but not least, one has to mention the impact of natural disasters on the landscape of these countries. These were primarily the floods that afflicted a part of the area in 1997, 2002, 2007 and 2013 and, to a smaller degree, the wind calamities that caused devastating damage especially in forest stands (Šumava). Naturally, this influenced the quality of the environment, but it did not change the classification or function of these forest areas.

The release of state ownership of land brought about changes in the functions in some returned or purchased plots by their new owners. There were also partial changes in the structure of their area. In the hinterland of towns, the old-new owners were interested in transferring agricultural land into building sites and then selling them. This phenomenon, of whose harmful consequences warned some "western" town planners, geographers and sociologists at the beginning of the 1990s already, caused the development of the suburbia whose urbanistic standard, the proportion of greenery and public space are mostly mediocre. The projects that lack any concept caused the creation of an "urban sprawl" (Kupková, 2001; Ouředníček, 2007; etc.). In Czechia, the end of centrally commanded construction, territorial planning and a certain chaos caused by the general process of property restitution and privatisation logically liberalised the protection of agricultural land and its transfer to non-agricultural functions and caused a belated compulsory registration of transfer of categories within agricultural land. Hence the unexpected changes in land use, such as the growth in the area of permanent grassland. In Czechia, an increase in registered areas was recorded in about 40% of STUs in 1990–2000. Another approximately 300,000 hectares of arable land were fallow for a number of years without being transferred to permanent grassland. The abandonment of agricultural land whose use did not bring the relevant economic effect to the owner brought about an increase in the area of "new wilderness". On the one hand, it has a revitalising function from the environmental viewpoint, but it has become a source of spread of weed and undesirable species to the surrounding, farmed land, on the other.

To conclude, we would like to express the belief that the development of land use (in particular long-term loss of agricultural and arable land along with a growth in built-up and other areas) constitutes an urgent and vital topic for further research in post-Communist countries. It may be interesting to compare both the driving forces that brought about the change and their regional impact to verify the processes that were described here, using the example of Czechia. In order to achieve such an objective, one can use not only a special project with the support by the EU, but also one of the further volumes of LUCC Atlas (Land use changes in selected regions in the world). The Volumes I –IX were published on the basis of a project prepared by (IGU vice-president) Himiyama in Japan as well as authors of this article in Prague. We consider it possible to use various data sources and various methods of their processing from the local up to the international levels. Given the urgent and rapid nature of landscape changes, we consider such a project very beneficial and usable in practice.

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PLANNING ECOLOGICAL CORRIDORS ON ARABLE LANDS IN NATURA 2000 SITES: CASE STUDY ROSCI0123 MĂCIN MOUNTAINS, ROMANIA

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Key-words: arable lands, ecological corridors, biodiversity, Natura 2000, Măcin Mountains, Romania.

La planification des corridors écologiques sur les terres arables dans le SITES NATURA 2000: étude de cas ROSCI0123 Măcin Montagnes, Roumanie. La planification de l'activité humaine dans les zones protégées est un enjeu important à l'échelle mondiale, due à l'augmentation de la perte de biodiversité. L'étude vise à évaluer si la mise en œuvre des corridors écologiques pourrait être un des outils pour diminuer l'impact environnemental des activités agricoles dans les sites Natura 2000. En utilisant une évaluation multicritère, nous évalué pour Măcin Montagnes Natura 2000 site, la morphologie, le sol et les critères écologiques afin d'identifier les domaines qui pourraient convenir pour les corridors écologiques. Nous avons obtenu 1 432 hectares des zones favorables pour le développement de corridors écologiques, ce qui signifie 62% dans la zone d'étude. Ainsi, les corridors écologiques pourraient être une solution viable à long terme, afin d'intégrer des pratiques agricoles avec des espèces et des besoins de conservation des habitats naturels.

1. INTRODUCTION

Conservation planning represents one of the main tools (Sarkar *et al.*, 2006) that contributes to biodiversity threats control (Margules and Pressey, 2000; Moilanen *et al.*, 2009, Pressey *et al.*, 2007). Among the biodiversity threats, agriculture contributes to the destruction, degradation and fragmentation of natural habitats (Lisec and Pintar, 2005), through habitats conversion, monocultures, chemical uses, aggressiveness of different practices, irrigation and others (Straus *et al.*, 2011; Firbank *et al.*, 2008; Primack *et al.*, 2008).

In the Natura 2000 Network, agriculture has "dual nature, being considered the main risk affecting biodiversity at global level, but also the support of sustaining biological communities" (Iojă *et al.*, 2010). Diminishing the agriculture environmental impact can be obtained through control instruments, which solve most of the short-term problems, or through interventionist measures. One interventionist instrument example is the ecological corridors – "vegetation strips which are different than the adjacent usage" (Hobbs, 1992) and which are contributors to an area's connectivity growth – either between natural habitats (Forman, 2006), or in the context of an agroecosystem (Beier and Noss, 1998).

The ecological corridors differ as structure, wildness, length or purpose, but all of them deliver ecological services, either of a structural order or of a functional one. The ecological corridors that give the structural connectivity can control the water flow, resulted from precipitation or nutrient flow applied on agricultural fields, increase productivity by diminishing the wind actions (Earnshaw, 2004) and allow abiotic process mobility like water, energy or matter (Meiklejohn *et al.*, 2009). Functional, they allow plant and animal species mobility, they can account for support-habitats for avifauna species or dispersion routes for mammal species (Hinsley and Bellamy, 2000; Forman, 2006; Groot *et al.*, 2009).

Nowadays, these limit-plantations are used on the agroecosystems' surface. The ecological corridors incorporated in agroecosystems are improving the structural connectivity level in an area and

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they have the capacity of improving agricultural productivity and conservation procedures (Hinsley and Bellamy, 2000).

By implementing ecological corridors, an agricultural system can be turned into an agroforestry system with biodiversity benefits and a large number of ecological and economic services (Wehling and Diekmann, 2009).

In the same matter, the European political framework is trying to promote a sustainable agriculture and to protect the environment for future generations, through the Common Agricultural Policy or to avoid actions that can lead to degrading the state of priority habitats (European Council, 1979, 1992; Iojă *et al.*, 2011). A number of objectives set out in the European Biodiversity Strategy are to integrate biodiversity protection objectives in the Common Agricultural Policy instruments by promoting sustainable farm practices to reduce the risk of pollution (European Commission, 2011).

Taking into account that most of the field owners wish for a bigger agricultural production and with the lack of an efficient control system regarding chemical fertilizer application, the ecological corridors can, on one side, help accomplish the conservation purpose in a protected area and on the other to support farmer's activities through European funds assimilation (the European Agricultural Fund for Rural Development, through Measure 112, the Rural Development Program through Measure 221 – First afforestation of agricultural land). So, the necessity of the study comes from the need of developing instruments that can improve the state on the agricultural fields and that can be easily interpreted by the decisional authorities.

The aim of the study is to identify the favourable areas for ecological corridors on the arable land in the Măcin Mountains Natura 2000 site.

The objectives of the paper are: (a) identifying criteria that allow separating the optimal routes for the ecological corridors and (b) building and applying a multicriteria assessment for an efficient selection of ecological corridors.

2. STUDY AREA

The Măcin Mountains Natura 2000 site (Fig. 1) is located in the Eastern part of Romania, Tulcea County, and has an area of **16 893** hectares (Ministry of Environment, 2011). This area is included in the Steppic biogeographic region, characterized by an arid climate and limited hydrological resources (European Environment Agency, 2006).

In the Măcin Mountains Natura 2000 site, agriculture has the advantage of a favourable climate, with a high number of sunny days in the summer season and some types of fertile soils (Doniţă *et al.*, 2007), conditions that determined the development of activities like grazing, vineyards, vegetables and cereal crops.

The Steppe and silvosteppe vegetation is dominating (Pătroescu, 1987) with a high floristic biodiversity given by the presence of rocky, riparian**,** steppe and forest habitats, endemic species (*Campanula romanica, Corydalis dobrogensis*), or by the important species at national or European level (*Moehringia jankae*) (Doniţă *et al.*, 2007). Regarding the fauna diversity, the protected area includes endemic vertebrates – *Polia cherrug* or protected species – nationally and internationally significant (invertebrates – *Morinus funereus, Cermabix cerdo*, birds – *Falco cherrug, Circus macrourus*, mammals – *Spermophilus citellus*), that can be affected by the aggressive agricultural practices (Ministry of Environment and Forests, 2011).

The protected area analysed belongs to the European Nature 2000 network and was designated as a site of community interest because of the presence of habitats and species listed in the Habitats Directive. ROSCI0123 Măcin Mountains tries to preserve the important biodiversity elements at a continental level and also to integrate and help develop the social component, through traditional activities.

The analysis takes into account the surface of the protected area under its limit in 2007 because of the expanded distribution of arable land at that time. Although in 2011 the protected area boundaries changed and its surface shrank, and much of the arable land is no longer part of a protection zone regime, they remain a threat to biodiversity resulting in true environmental conflicts (Tudor *et al.*, 2014). For that reason, planning the ecological corridors also on the fields nearby the protected area can contribute to a better accomplishment of conservation objectives.

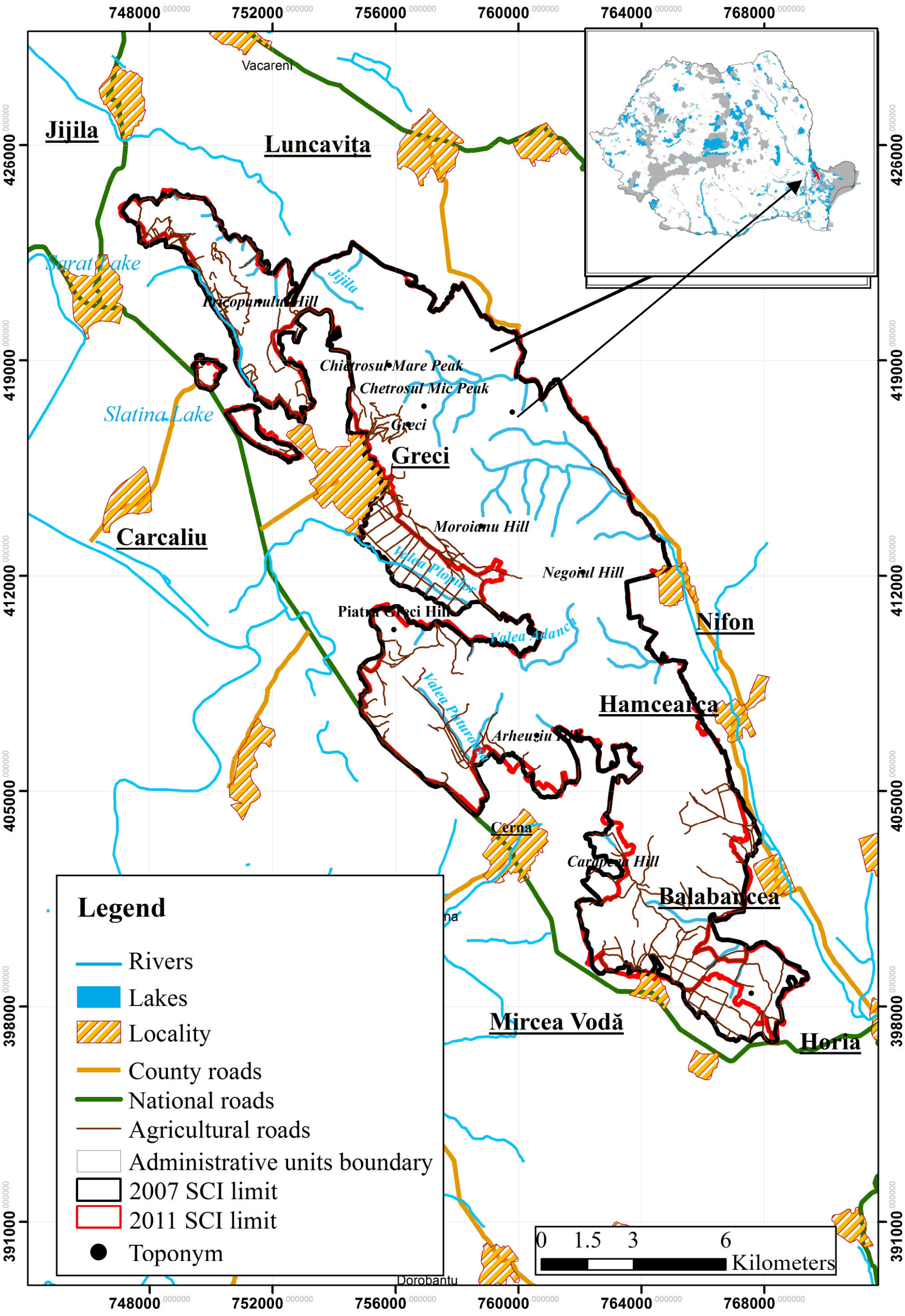

Fig. 1 – Study area ROSCI0123 Măcin Mountains.

3. DATA AND METHODS

For this study we used cartographic materials: the soil map at a scale of 1:200 000 (Geological Institute, 1971, updated in 2005), the topographic map at a scale of 1:25 000 (1980), ortophotoplans at a scale of 1:5 000 (2008), and the Digital Elevation Model with the resolution of 30 m – all used for elaborating the geodatabase and the Model Builder application used for the analysis.

Table 1

Reclassifying criteria according to their favourability for ecological corridors planning

No.	Spatial criteria	Criteria importance (from 1=low to 5=high)	Justification	Reclassifying and recoding the criteria	
				Code	Correspondence
1.	Patch surface	4	High favourability degree for patches with surfaces larger than 3 hectares since this area is established as favourable, relative to the ecological corridor width of 20 m (Earnshaw, 2004)	10	Patch < 3 hectares
				100	Patch > 3 hectares
2.	Flow accumulation areas	2	Higher values for those areas where water derived from rainfall could accumulate in the biologically active surface and could wash out farmland nitrogen chemical compounds and lead to diffuse pollution. These areas may be considered for ecological corridor implementing on one side to capture rich nutrients and to redistribute them on other arable lands and also to reduce surface runoff (Kovar *et al*., 2011)	10	High flow accumulation
				20	
				30	
				40	
				50	Medium flow accumulation
				60	
				70	
				80	
				90	Low flow accumulation
				100	
3.	Soil texture	3	Soil texture was classified according to its ability to retain water and can lead to areas of stagnation. A clay texture causes high water stagnation compared to the sandy texture. These areas show favourable conditions for implementation because of their capacity to retain water rich in nutrients (Burel and Baudry, 2005)	10	Varied texture
				20	Clay and sandy texture
				30	Clay and sandy texture, clay texture
				40	Clay texture
				50	Clay texture, Clay and argyle texture
				60	Clay and argyle texture
4.	Land-use	5	Areas occupied by arable land present the highest favourability given the need to diminish the anthropic impact on the structural connectivity (Groot *et al*., 2009)	500	Arable land
				400	Rivers, lakes, roads
				300	Pastures, orchards
				200	Construction sites, Unproductive land, Mining area
				100	Forest
5.	Roadside spaces	2	Proximity to roads is a significant criterion because of the existence of uncultivated land in their immediate neighbourhood. We considered a distance of 30 meters from the road as favourable (Earnshaw, 2004)	100	0-30 m
				0	>30 m
6.	Riverside spaces	4	An important criterion in identifying favourable areas for ecological corridor implementation was proximity to rivers in order to create a hydrographic network protection and reduce the possibility of eutrophication by nutrients effect from agricultural lands. We considered a distance of 30 m from the river as favourable (Earnshaw, 2004)	100	0-30 m
				0	>30 m

To separate the favourable areas for ecological corridors, we identify criteria with spatial distribution. Using ArcGIS 10.1, we obtained layers about: (a) land use and cover, vectored on the ortophotoplans (2008); (b) the hydrographical network vectored on the base of the topographic map; (c) soil texture distribution, using the soil map and (d) the road network). Using geoprocessing instruments from ArcMap and with the Model Builder application (ESRI, 2011) we delineated favourable areas for ecological corridor implementation. The criteria considered for our study are presented and justified in.

Table 2

Data and geoprocessing instruments used by the model in order to locate the favourable areas for ecological corridors implementation

No.	Input data	Geoprocessing instruments	Output data
1.	Land-use and cover type in Măcin Mountains Natura 2000 site	Polygon to Raster	Patch surface classification Land-use type classification
2.	Soil texture distribution in Măcin Mountains Natura 2000 site	Polygon to Raster	Soil permeability classification
3.	Hydrographic network	Euclidean Distance Reclassify	Distance to rivers classification
4.	Road network	Euclidean Distance Reclassify	Distance to roads classification
5.	Digital Elevation Model	Flow Direction Flow Accumulation Reclassify	Flow accumulation areas
6.	Output data 1–5	Weighted Sum	Potential areas with high favourability for ecological corridors application

4. RESULTS

The development and application of this model led to identifying the favourable fields for implementing ecological corridors. The selected criteria and their spatial distribution allowed a better visualisation of each type of corridor.

Within ROSCI0123 Măcin Mountains there resulted various spaces with a high level of favourability for implementing ecological corridors. This is based on the high number of criteria and the extensive distribution of each favourable class (Table 3). The extensive distribution of clay and argyle soil texture within the area, along with the large surfaces of arable land, a developed road network and a large number of patches with surfaces larger than 3 hectares projected a connected system of ecological corridors. The criteria with a low weight in the model – the distance to the hydrographical network and the flow accumulation areas – are explained by the reduced density of the hydrographical system and the low variability of altitudinal classes. Even with a poor spatial distribution of these criteria, the model considered them in the process because of their importance to conservation – the hydrological network that can be affected by the chemical fertilizer layer or areas where sediments rich in nutrients can be stored.

Table 3

Values obtained for each favourable class of the criterion in the model

No.	Criterion	The surface of the favourable class of the criterion within the study area hectares	The weight of the favourable class of the criterion within the study area (%)
1.	Distance to rivers	311	2
2.	Distance to roads	2,362	12
3.	Patch surface	3,460	18
4.	Flow accumulation areas	20	0.1
5.	Soil texture	1,083	6
6.	Land-use types	2,302	12

The spatial distribution of each favourable class of each criterion resulted in the following values: *Distance to rivers* criterion resulted in 2% of the total area of the study, *Distance to roads* approximately 12%, *Patch surface* 18%, *Flow accumulation areas* 0.1%, *Soil texture* 6% and *Land use type* 12% (Figs. 2, 3, 4, 5, 6, 7).

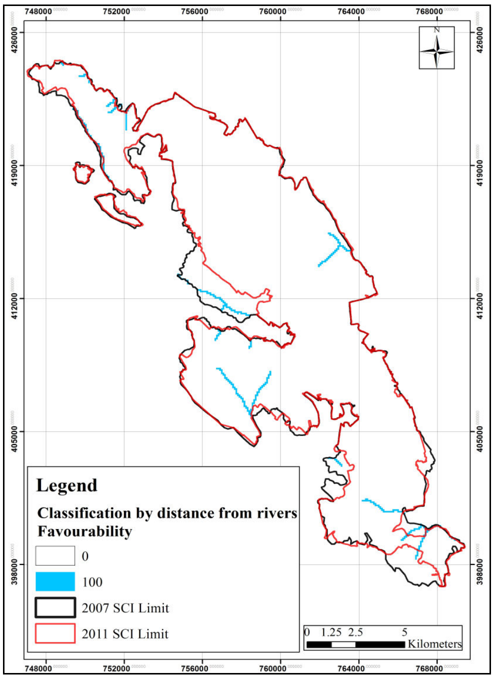

Fig. 2 – Distance to the hydrographical network.

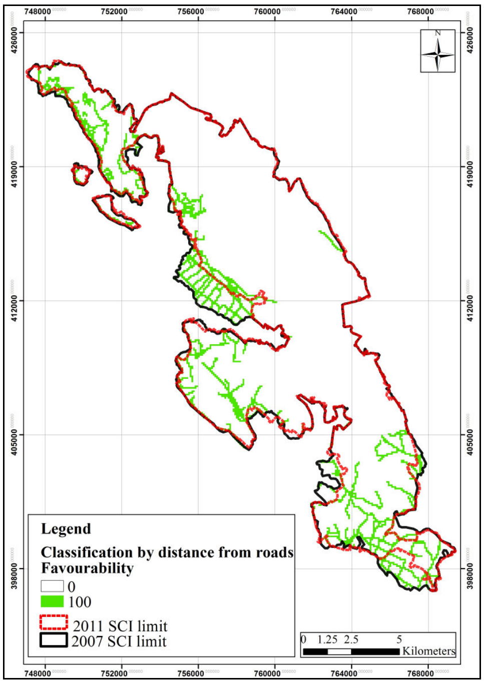

Fig. 3 – Distance to roads.

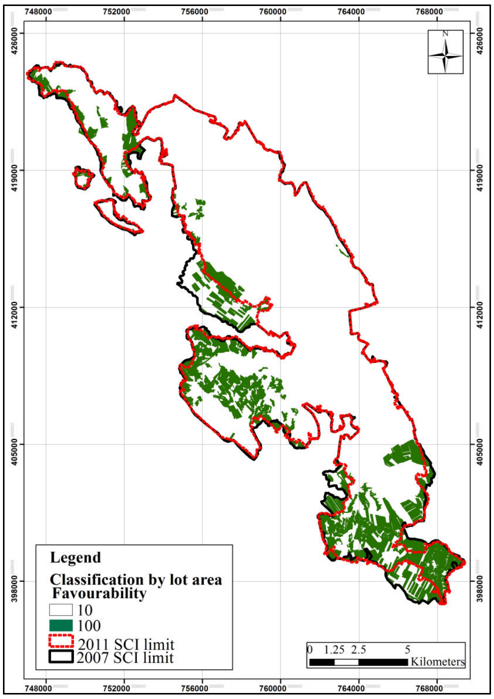

Fig. 4 – Patch surface.

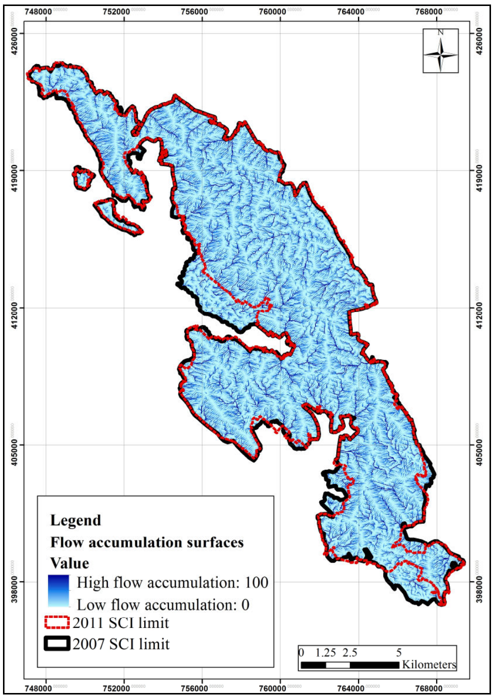

Fig. 5 – Flow accumulation areas.

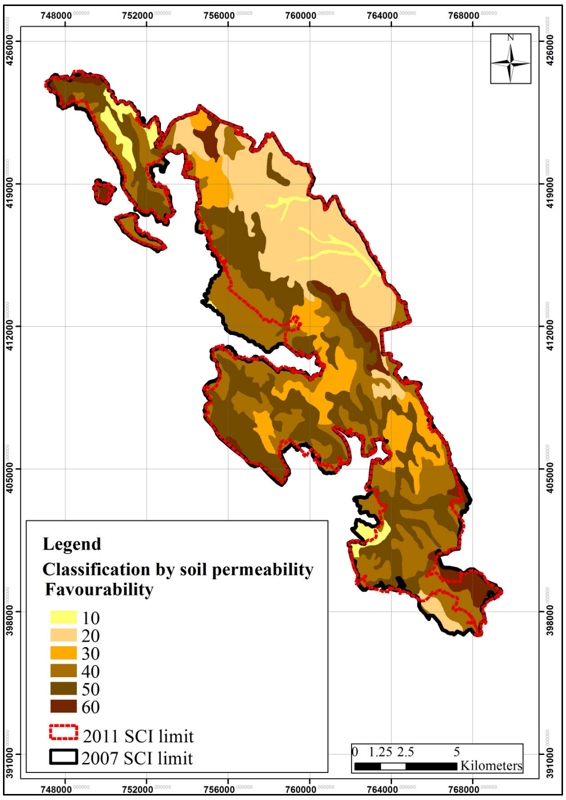

Fig. 6 – Soil texture.

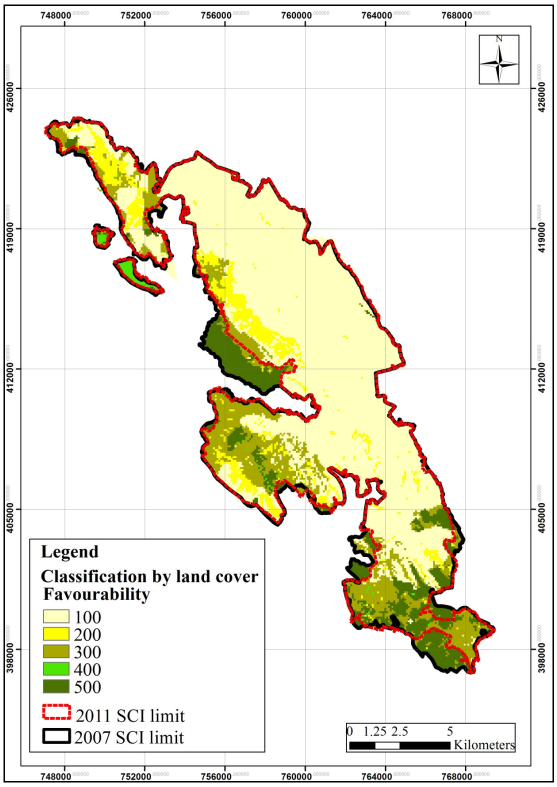

Fig. 7 – Land-use types.

All these criteria were overlapped and analysed within the model and reduced to a single class that represents the favourable areas for ecological corridors implementation.

According to the model results, within the total area of the study of **18,546** hectares and **2,302** hectares of arable land (National Institute of Statistics, 2012) we identified approximately **1,432** hectares with high favourability for ecological corridors planning (Fig. 8).

Considering the whole number of criteria in the model and overlapping them we were able to establish a connected network with multiple functions, an aspect that would have been overlooked in case the parameters were treated separately.

5. DISCUSSIONS

The arable land-use in the Măcin Mountains Natura 2000 site shows a high favourability for planning and implementing ecological corridors. Feasibility consists in the existence of various criteria of spatial distribution (Hobbs *et al.*, 1992; Forman, 2006).

The high number of patches of arable land of over **3** hectares allows the implementation of an ecological corridor approximately 20 meters wide which can also be economically efficient. This criterion, alongside surfaces with flow accumulation, the distribution of soils with clay and argyle texture and empty land near roads and rivers completed the model and helped develop a network that, in the end, through an active management can sustain species of community interest (Beier and Noss, 1998; Hinsley and Bellamy, 2000) and diminish the negative impact of agricultural practices (Groot *et al.*, 2009).

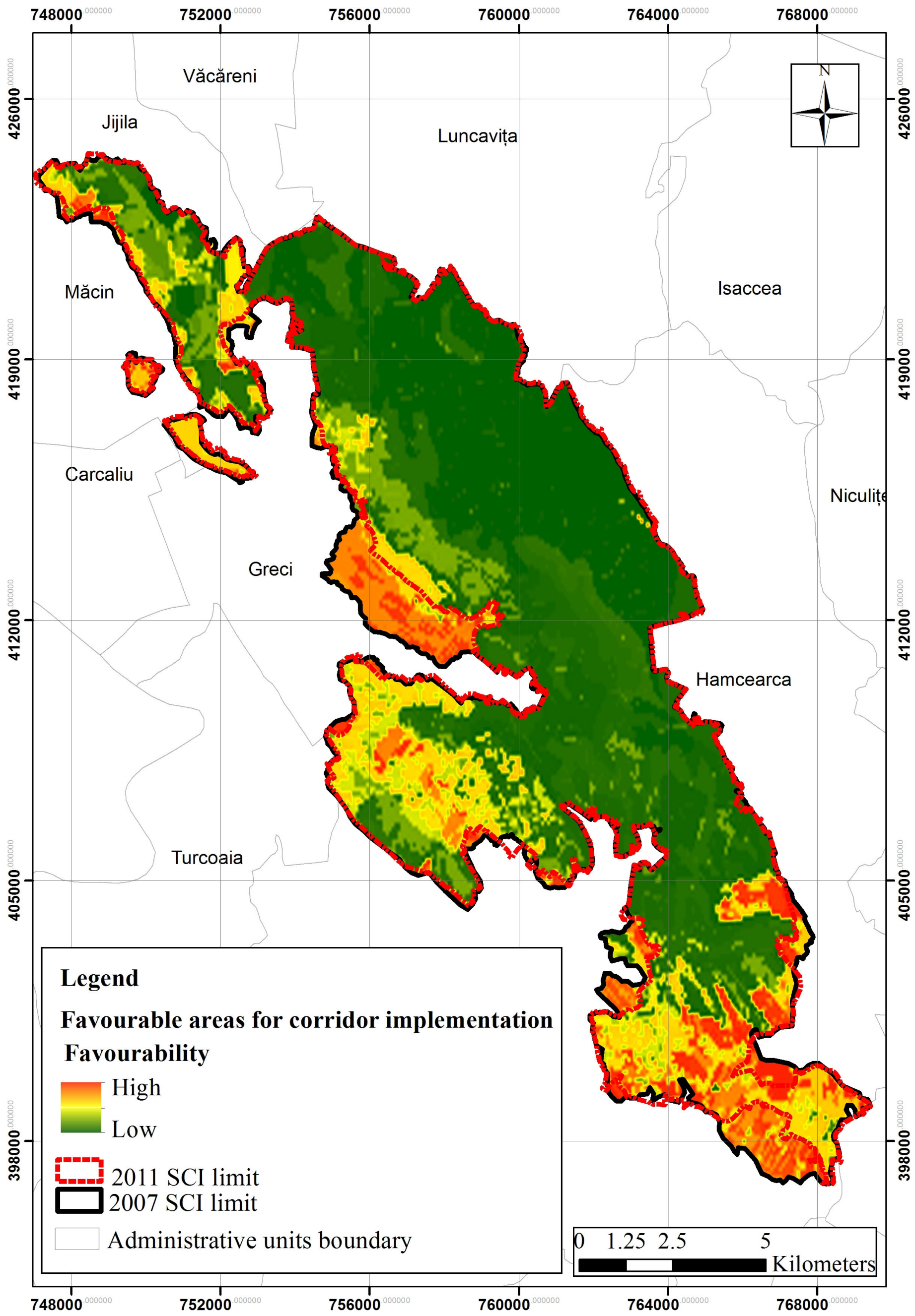

Fig. 8 – Spatial distribution of favourable areas for ecological corridor implementation in ROSCI0123 Măcin Mountains.

The economic component, the financial and legislative instruments of implementation (Bonnin, 2006) together with the social one – through the field owners' availability to develop these ecological corridors on their land – are elements that can dictate the ecological corridors' network complexity (Earnshaw, 2004). The existence of real financial resources, in the implementation and management process, together with possible compensations for farm owners can sustain the conservation objectives in the Măcin Mountains Natura 2000 site (Iojă *et al.*, 2010).

The presented method has the advantage of being applied to other areas and can be improved by adding more criteria, specific to each area. Also, by using this specific method we obtain quantitative results that can be easily interpreted by decisional authorities.

The importance of the study consists in its relevance during the administration process of the protected area, but also for the management of agricultural activities within the sit (Firbank *et al.*, 2008). From a conservation point of view, these ecological corridors can create habitats (Burel and Baudry, 2005; Wehling and Diekmann, 2009) and feeding spaces for species of community interest (Michel *et al.*, 2007), food resources for predators and can enhance the landscape's structural connectivity (Meiklejohn *et al.*, 2009).

The study shows the possibility of a landscape's structural connectivity improvement in a space of high conservative value, threatened by more and more aggressive agricultural practices (Primack *et al.*, 2008). Implementing the ecological corridors will lead to an improvement of arable fields state, through a careful management and by decreasing the negative effect of acidification or diffuse pollution on the soil's fertility level (European Commission, 2011). All of these outcomes can have a positive result on the biodiversity component of the SCI Măcin Mountains (Dallimer *et al.*, 2010; Iojă *et al.*, 2011).

6. CONCLUSION

The implementation of ecological corridors can be considered a proper instrument for conservation planning (Sarkar *et al.*, 2006) and the management of biodiversity threats caused by agricultural practices (Bayne and Hobson, 1998; Firbank *et al.*, 2008). The developed model is applicable to any study area with similar needs and characteristics if the data are available.

The landscape's structural connectivity is often ignored when we discuss the conversion from natural habitats to agroecosystems and it can lead to imbalances of physical and biological processes at an ecosystem level (Taylor *et al.*, 1993).

By developing a method that can locate an ecological corridor network the structural connectivity of an area can be restored, leading the way to improve the functional connectivity species' dispersion and mobility. Applying the method also demonstrates the feasibility of the area for ecological corridors, that take into consideration various criteria and has the advantage of performing numerous functions. The developed tool is applicable to any study area with similar needs and characteristics if the data are available.

For ROSCI0124 Măcin Mountains, creating a system with financial and legislative support that can ease the development of an ecological corridor network can lead to a balanced integration of human activities and conservation objectives of the protected area.

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LAND COVER AND LAND USE CHANGES REFLECTING THE ENVIRONMENTAL IMPACTS OF LOCAL DECLINING ECONOMIES. CASE-STUDY: SOUTH-WEST DEVELOPMENT REGION. ROMANIA

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Key-words: land cover and use changes, transitional dynamics, South-West Development Region, agriculture, deforestation.

Changements dans la couverture et l'utilisation du terrain réfléchissant impacts des pays en déclin économique local. Etude de cas: la Région Roumaine de Développement Sud-Ouest. Les changements dans la couverture et l'utilisation du terrain, les modifications des circuits de l'énergie et les changements climatiques sont constituants des «changements globaux», terme incluant tous les impacts humains sous les complexes des systèmes socio-écologiques. La plupart des auteurs faite une connexion entre la pression sous l'environnement et les forces socio-économiques, considérant que le processus de transition économique et la conscience environnementale réduite produisent problèmes environnementaux sérieux. Cette recherche s'agit de l'investigation des impacts environnementaux par les dynamiques de transition dans longues périodes réfléchies par des changements dans la couverture et utilisation du terrain dans la région de développement roumaine sud-ouest, en connexion avec le déclin post-socialiste de l'économie, aggravé par le fait que beaucoup des villes ont perdu leur fonction industrielle. La méthodologie est basée sur l'allocation de des changements dans la couverture et utilisation du terrain indiquées par les données CORINE entre 1990–2000 et 2000–2006 aux dynamiques de transition spécifique, calculant la surface affectée par chaque type, et utilisant le kriging commun pour trouvant les zones le plus affectées. Les résultats indiquent que le plus importantes dynamiques sont le forestage (afforestation ou reforestation), abandon et développement de l'agriculture, déforestation et urbanisation pour la première période, et le forestage (afforestation ou reforestation), déforestation, abandon de l'agriculture et urbanisation pendant la deuxième. Donné que la colonisation naturelle des parcelles agricoles abandonnées par la végétation forestière pourrait être erronément classifiée comme foretage, les causes majeurs peuvent être attribuées au déclin de l'économie, soutenant l'hypothèse de travail.

1. INTRODUCTION

A consistent part of the environmental literature is devoted to explaining environmental issues through poverty, or at least connecting them (Reichel-Dolmatoff, 1982; Rozelle *et al.*, 1997; Jehan, Umana, 2003), particularly in developing countries with low environmental awareness (Leonard, David, 1981; Ianoş *et al.*, 2009), or which do not use resources as sustainable means to reduce poverty (Hope *et al.*, 2005). However, a consistent part of these studies developed an in-depth conceptual refinement of the underlying causes of poverty and/or their relationship to the environmental issues. Some studies were focused on territorial disparities, which pinpointed problem areas (Ancuţa, 2010; Ianoş *et al.*, 2013). Many studies were devoted to mapping poverty (Sandu, 2003, 2005, 2011).

Other studies established typologies using different concepts; weak urban polarization areas were introduced by the National Spatial Plan of the settlement network, approved in 2001, and defined as "*areas distanced from cities at least 25–30 km., requiring priority actions for developing the settlements providing inter-communal services*"; the concept was rarely used in the literature (Ancuţa, 2010; Drăghici *et al.*, 2011; Soare, 2012; Vâlceanu, 2013). provided a first theoretical definition –

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"*areas characterized by economic and demographic stagnation or regress, which must be supporting by consolidating the territorial role and functions of human settlements with a favorable geographic position, a certain economic foundation, and well-developed administrative, cultural and education infrastructures*". Another concept is 'deeply disadvantaged area' (Braghină *et al*., 2008; Ianoş, 2001; Ianoş, Heller, 2006; Ianoş *et al*., 2009, 2010; Şerban, Ianoş, 2012; Turnock, 2005), defined by the Romanian Strategy for Territorial Development based on the spatial contiguity of at least 5 administrative units, an average development index at least 25% smaller than the one of the integrating area or 75% below the one of the region of development, values of core indicators close to the national or macro-regional minimum, and regional impact over all neighboring units. Four classes were identified using the criteria above: weakly polarized area without inner discontinuities, uni-polar rural area with slight inner discontinuities, bi- or multi-polar rural area with inner discontinuities, and deeply rural, not polarized area. The newest concept in this series, although insufficiently crystallized, is 'restrictive environment', the output of a joint action of natural and anthropogenic factors, impeding development and consequently calling for active spatial planning solutions aimed at boosting economic development and increasing life quality (Cocheci, 2014a, b); however, a set of criteria for individualizing such environments has not been developed so far.

Among the methods used to assess environmental changes, spatial analyses based on land cover and use data, particularly the CORINE Land Cover database provided by the European Agency, were preferred because of their association with other anthropogenic impacts forming the global changes (Dale, 1997; Dale *et al*., 2011), but also for the availability of data (Petrişor *et al*., 2010, 2014), despite of limitations including misclassification or changes of the classification schemes, or resolutions from one period to another (Jansen, 2007; Pelorosso *et al*., 2009; Verburg *et al*., 2011; Petrişor *et al*., 2014). Several studies used CORINE data to look at land cover and land use changes in Romania. The study by Petrişor (2012a) assessed all types of changes during the two periods covered by the data by transitional dynamic, using a different classification. The results underlined the importance of several antagonistic phenomena, affecting forests (afforestation and reforestation vs. deforestation), agriculture (agricultural development vs. agricultural abandonment) and urban areas (urbanization vs. urban restructuring), showing their connection with the economic transition lacking control over the development process (development and decline occurred in different places, instead of boosting development of a declining area). A similar study by Petrişor *et al*. (2014) covered, at a more detailed scale, the North-East Development Region, using a different classification; the findings, explained by socio-economic issues specific to the region, indicated urbanization, afforestation and reforestation vs. deforestation, and development vs. abandonment of agriculture as main drivers of change, reconfirming that spatial development was uncontrolled, as in other developing countries. Three studies were focused on urban processes: Petrişor *et al*. (2010) analyzed three phenomena affecting urban areas during 1990–2000 – urban development, restructuring, and de-urbanization, pinpointing areas mostly affected by each phenomenon individually. Ianoş *et al*. (2011) connected the urbanization process to a decrease in the level of primary eco-energy (*i.e.*, initial energy of a territorial system before the conscious intervention of man over its structures), at two spatial scales. Petrişor (2012b) carried out a national analysis aimed at assessing the extent of urbanization during 1990–2000 and 2000–2006 and found out that, given since the small share of urban settlements within the whole territory, the true extent of the phenomenon can be determined only comparing urban growth to the urban area. Overall, the three studies show that socio-economic drivers are the main drivers of land cover and use changes, especially in developing economies (Popovici *et al*., 2013).

The study area was constantly seen as one of the most disadvantaged Romanian regions from an economic standpoint. Some authors consider that the decline is due to the cities that lost their industrial function (Ianoş, 2000); particularly mining resulted into a loss of the environmental potential (Braghină *et al*., 2010, 2011) which could have been valued through tourism (Buhociu *et al*., 2013;

Stan *et al*., 2013). Among the phenomena that affect the environment and prevent the development of agriculture, the exposure of some areas to aridity and drought phenomena of the area seems to have the greatest impact (Marinică, Chimişliu, 2008; Vlăduţ, 2010; Corneanu *et al*., 2012; Bălteanu *et al*., 2013; Peptenatu *et al*., 2013; Prăvălie *et al*., 2013, 2014).

2. DATA AND METHODS

The methodology used in this study is an alteration of methodologies used in previous studies (Petrişor *et al*., 2010; Ianoş *et al*., 2011; Petrişor, 2012a, b; Petrişor *et al*., 2014). The method assigns changes to specific transitional dynamics. Several data sets, described in Table 1, were used for the analyses. Whenever needed, data were clipped by the Romanian boundaries and projected unto Stereo 1970 (EPSG 31700/ Dealul Piscului 1970 datum), the coordinate reference system used in Romania. For raster data, each cell was reduced to each geometrical center using the X-Tools extension of ArcView GIS 3.X, and centers were interpolated using the Geostatistical Analyst of ArcGIS 9.X via ordinary kriging.

Table 1

Data used in the study

Feature	Provider	Period, characteristics	URL
Land cover and use changes	European Environment Agency	1990–2000	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-changes-clc1990-clc2000-100-m-version-12-2009
Land cover and use changes	European Environment Agency	2000–2006	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-3
Elevation	Consultative Group on International Agricultural Research of the Consortium for Spatial Information	Raster cells of approximately 90 m × 90 m	http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp
Biogeographical regions	European Environment Agency		http://www.eea.europa.eu/data-and-maps/data/biogeographical-regions-europe-1
Ecological regions	European Environment Agency		http://www.eea.europa.eu/data-and-maps/data/digital-map-of-european-ecological-regions
Soil	European Soil Database (ESDB) (Panagos *et al*., 2012)	Food and Agriculture Organization of the United Nations 1990 classification – level 1	http://eusoils.jrc.ec.europa.eu/esdb_archive/ESDB/Index.htm
Natural protected areas	Ministry of the Environment and Climate Change	Only those of national and international interest - IUCN I-V, Natura 2000	http://www.mmediu.ro/beta/domenii/protectia-naturii-2/arii-naturale-protejate/

Transitional dynamics were assessed based on the status of each parcel in the beginning and ending period. Separate analyses were run for 1990–2000 and 2000–2006. Changes were classified as land cover changes (LC) if the level 1 class differs between the two periods and land use changes (LU) if only the third level changed. The main transitional dynamics were defined as:

1. Abandonment of agriculture: LU change of class 1 agricultural parcels into an inferior use (e.g., crops to agricultural land with significant areas of natural vegetation)

2. Development of agriculture: LU change of class 1 agricultural parcels into a better use (e.g., agricultural land with significant areas of natural vegetation to crops) or LC change of other class (except for forested or natural) into agricultural land (e.g., urban to agricultural)

3. Deforestation: LC transformation of forested parcels into other classes (e.g. forest to built up) or LU transformation to an inferior use (e.g. coniferous forest to transitional woodland/ shrubs)

4. Afforestation or reforestation: Dutcă and Abrudan (2010) define afforestation as change of other land uses into forest, or increase of the canopy coverage over 10% threshold through plantations or natural regeneration, and reforestation as re-establishment of forests after a temporary condition decreasing the canopy coverage below 10% due to an anthropogenic or natural phenomenon. In this study, afforestation and reforestation were defined as an LC transformation from other classes into forests or LU transformations within the forest/ natural class to a better use (e.g., transitional woodland/ shrubs to coniferous forest), including the colonization of abandoned agricultural land by forest vegetation (Petrişor *et al*., 2014).

5. Urbanization/suburbanization: LC change of other classes (not forest) into urban (e.g., agricultural to urban) and LU changes within the urban class

However, not all of these changes were considered. The analyses were confined to the most important types, which through the spatial distribution (number of parcels affected and their area) allowed for depicting a certain spatial distribution through spatial interpolation. The maps were obtained by: (1) overlaying the distribution of transitional dynamics against other layers of information (elevation, biogeographical and ecological regions, soils, natural protected areas); (2) using the Geostatistical Analyst of ArcGIS to interpolate via ordinary kriging the centers of parcels affected by each transitional dynamics category by their size. The centers were obtained using the X-Tools extension of ArcView 3.X. The resulting contours, reflecting the intensity of each transitional dynamic, were overlaid against other layers or information or simply mapped.

3. RESULTS AND DISCUSSION

The results are presented in two sets of maps. Figs. 1–6 display the transitional dynamics reflected by land cover and use within the South-West Development Region during 1990–2000 (figures labeled “a”) and 2000–2006 (labeled “b”), mapped against elevation (Fig. 1), natural protected areas (Fig. 2), biogeographical regions (Fig. 3), ecological regions (Fig. 4), soil types (Fig. 5) and types of human settlement (Fig. 6).

The first 4 groups of maps (Figs. 1–4) are easy to interpret if noticing that most changes occurred in the mountain areas, situated at higher elevations, in the alpine biogeographical region and ecological regions specific to the mountain areas, with large areas protected through inclusion in natural protected areas. In addition to them, the results show that urbanization occurs in the Sub-Carpathian hill region (average elevation), where most urban settlements are located, and the development of agriculture is characteristic of the plain area (low elevation), where the natural conditions favor it. When looking at the relationship with the natural protected areas, the results indicate a pressure of urbanization in the adjacent areas, evidence of deforestation and the abandonment of agriculture, most likely as a consequence of the protection status of some areas (Andam *et al*., 2010; Anthony, Szabo, 2011; Frys, Nienaber, 2011). The analysis of the location of transitional dynamics by the types of settlements reveals contradictory patterns; during 1990–2000, agricultural development characterizes the southern part of the region, and its north during the next period. Agricultural abandonment is characteristic of the south, most likely in relationship to the aridization process (Păltineanu *et al.*, 2007a, b, 2009; Marinică, Chimişliu, 2008; Vlăduţ, 2010; Dragotă *et al*., 2011; Corneanu *et al*., 2012; Bălteanu *et al*., 2013; Peptenatu *et al*., 2013; Prăvălie *et al*., 2013, 2014). Last but not least, while urban sprawl, through urbanization and suburbanization, is expected to occur close to the important urban centers (Grigorescu *et al*., 2012), it is not the only transitional impact in these areas; most likely, the others are a consequence of urbanization. Finally, when looking at the relationship with the soils, two phenomena are noticeable: the forestation of riverbeds and the abandonment of agriculture on soils prone to desertification, most likely as a consequence of aridization.

The magnitude of these phenomena is explained in Table 2. The table shows, for each transitional dynamic, the total area affected during the two periods, displaying the row values (in km^2) and the relative importance, as share of the total area affected by changes. The results show that for all periods the most important drivers of change were forestation, deforestation and urbanization, and during 1990–2000 the abandonment and development of agriculture. Overall, these results reconfirm the national findings (Petrişor, 2012a; Petrişor *et al*., 2010).

Table 2

Main transitional dynamics affecting South-West Development Region during 1990–2006 based on CORINE data on land cover and use

Transitional dynamics	**1990–2000**		**2000–2006**	
	Area (km^2)	**Area (% total)**	**Area (km^2)**	**Area (% total)**
Agricultural abandonment	59.21	19.36	3.25	7.87
Agricultural development	41.59	13.60	0.16	0.38
Aridization	4.75	1.55		
Deforestation	40.03	13.09	12.95	31.29
Floods	9.31	3.04		
Forestation	119.55	39.08	13.04	31.52
Unknown	0.55	0.18		
Urbanization/Suburbanization	30.89	10.10	11.97	28.94

The next set of maps displays the results of kriging-based analyses looking at the spatial distribution of the main transitional dynamics: agricultural abandonment (Fig. 7) and development (Fig. 8) during 1990–2000 and urbanization during the two periods, 1990–2000 (figures labeled “a”) and 2000–2006 (labeled “b”), mapped against natural protected areas (Fig. 9) and types of human settlement (Fig. 10). Fig. 7 and Fig. 8 provide evidence for the “compensatory development”, documented by previous studies (Petrişor, 2012a; Petrişor *et al*., 2010, 2014), meaning that the development of agriculture occurs through a land cover change indicating the expansion over other systems (natural), instead of boosting agricultural development of abandoned areas, which are declining. Also, the results provide additional evidence for the abandonment of agriculture in areas prone to aridity and drought phenomena. The analysis of urbanization shows that the process does not occur only around important settlements, and confirms an additional pressure against the mountain areas, which constitute a priority for European conservation policies due to their ecological vulnerability and fragility (Borsdorf, Braun, 2008), and against natural protected areas, rising questions on the effectiveness of their protection or declaration (Iojă *et al*., 2010; Knorn *et al*., 2012).

An important research question tackled with the relationship between socio-economic transformations and the main drivers of land cover and use changes – forestation, deforestation, urbanization, abandonment and development of agriculture. A first remark is that, except for urbanization, all the other drivers acted in pairs formed by opposing phenomena. This is a clear indication of the fact that switching from a centrally planned economy to a democratic, decentralized system resulted in uncorrelated actions with antagonistic effects. For example, agriculture could be developed, in theory, on the parcels that were abandoned. In reality, the explanation consists in the change of ownership; declining agriculture occurred on property restituted to the next generations of those who owned the land. As a consequence of forced urbanization during the communist time, one of the social transformations was a migration of young rural people towards the cities. Those who succeeded entering the possession of the land owned by their parents or grandparents lost the connection with agriculture, and were unable to use the land for agriculture. Similarly, many people who were restituted forested land did not have a use for it, but saw it as a possibility of obtaining rapidly a profit by cutting the forests off and selling the wood (Roman, 2009). In opposition to these changes, most of the ‘beneficial’ ones (i.e. forestation, development of agriculture) occurred on land owned by the local or central government.

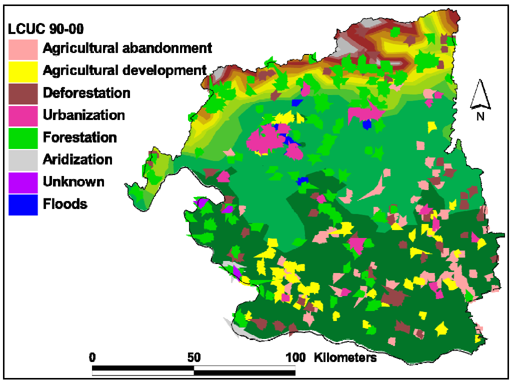

Fig. 1a – Main transitional dynamics by elevation in the South-West Development Region (1990–2000).

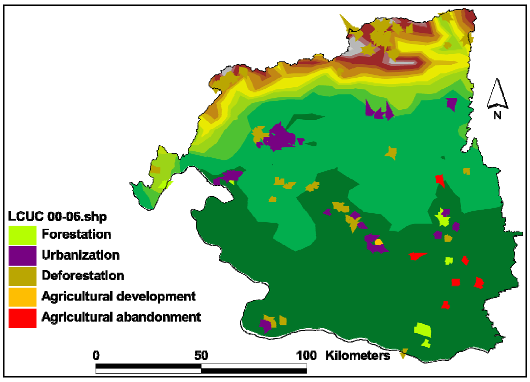

Fig. 1b – Main transitional dynamics by elevation in the South-West Development Region (2000–2006).

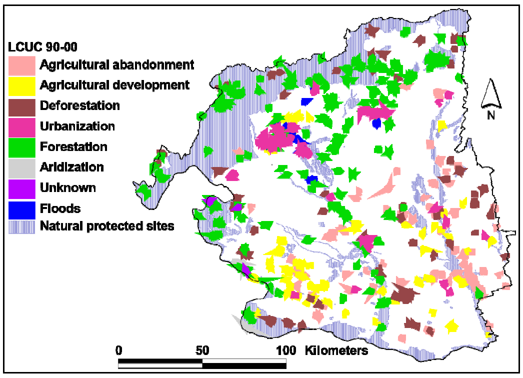

Fig. 2a – Main transitional dynamics and natural protected areas in the South-West Development Region (1990–2000).

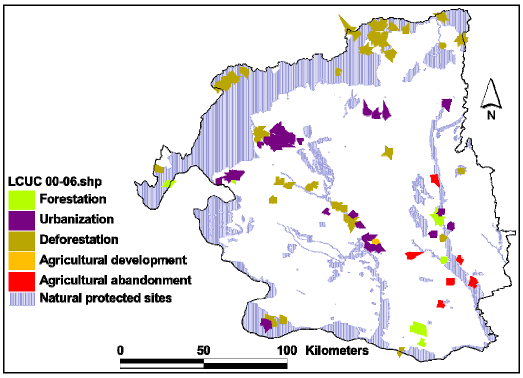

Fig. 2b – Main transitional dynamics and natural protected areas in the South-West Development Region (2000–2006).

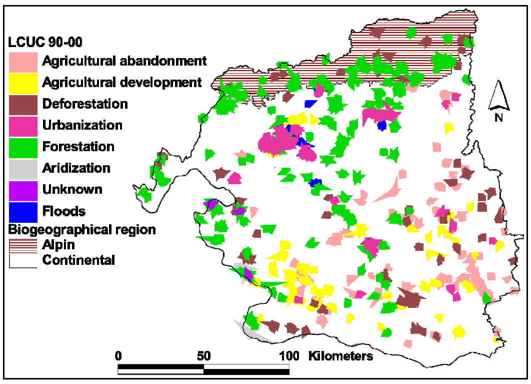

Fig. 3a – Main transitional dynamics by biogeographical region in the South-West Development Region (1990–2000).

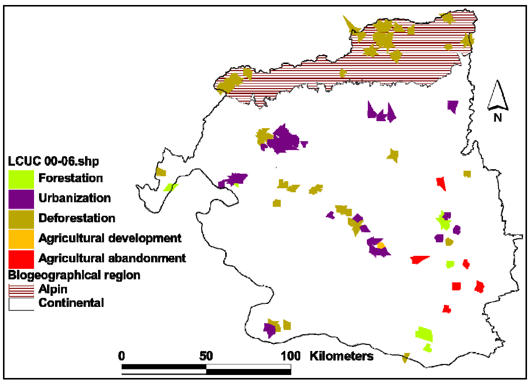

Fig. 3b – Main transitional dynamics by biogeographical region in the South-West Development Region (2000–2006).

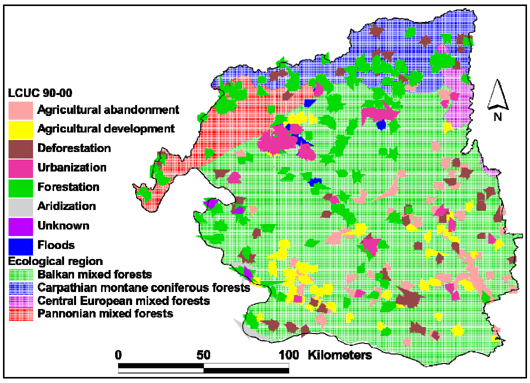

Fig. 4a – Main transitional dynamics by ecological region in the Romanian southwestern region of development (1990–2000).

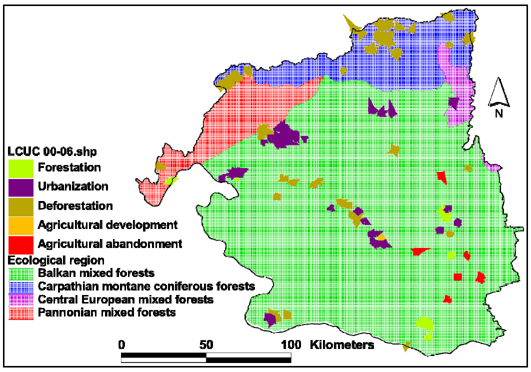

Fig. 4b – Main transitional dynamics by ecological region in the Romanian southwestern region of development (2000–2006).

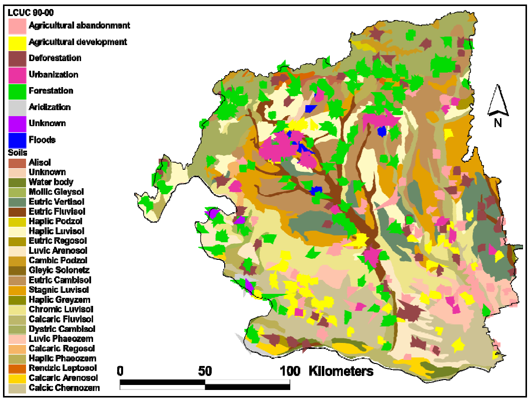

Fig. 5a – Main transitional dynamics by soil type in the South-West Development Region (1990–2000).

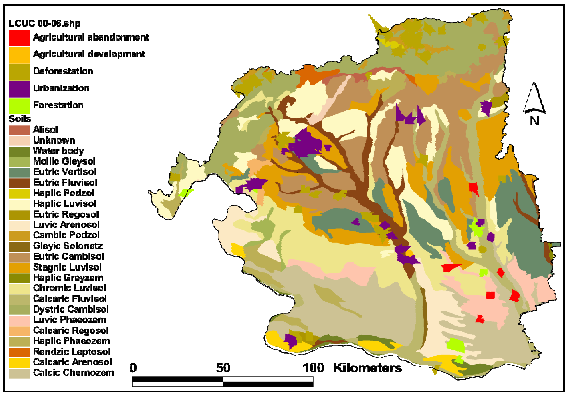

Fig. 5b – Main transitional dynamics by soil type in the South-West Development Region (2000–2006).

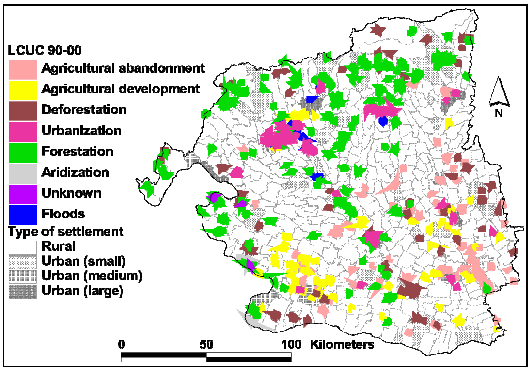

Fig. 6a – Main transitional dynamics by type of human settlement in the South-West Development Region (1990–2000).

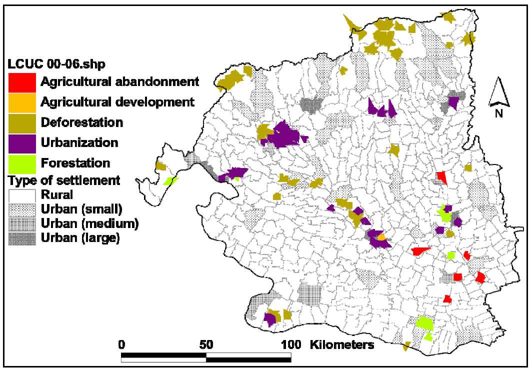

Fig. 6b – Main transitional dynamics by type of human settlement in the South-West Development Region (2000–2006).

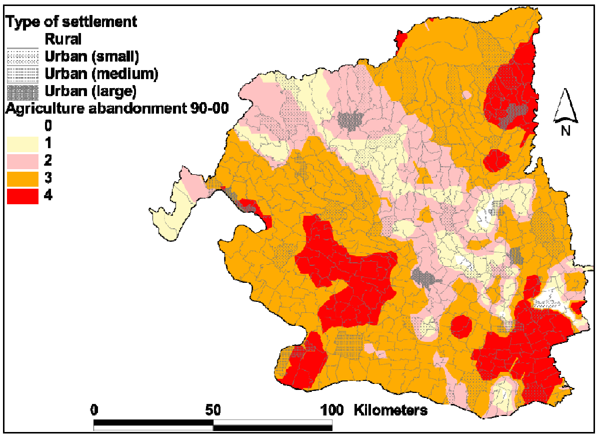

Fig. 7 – Agricultural abandonment in the South-West Development Region (1990–2000).

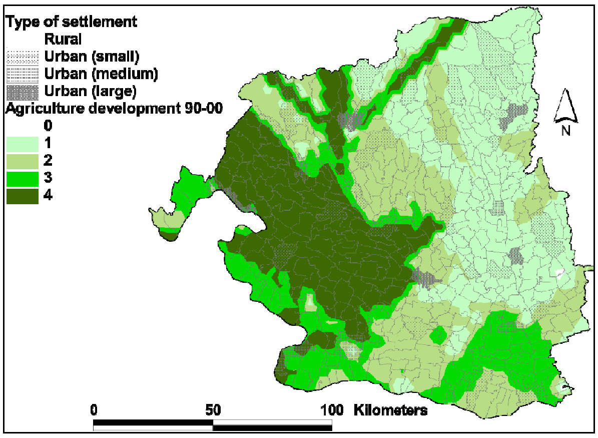

Fig. 8 – Agricultural development in the South-West Development Region (1990–2000).

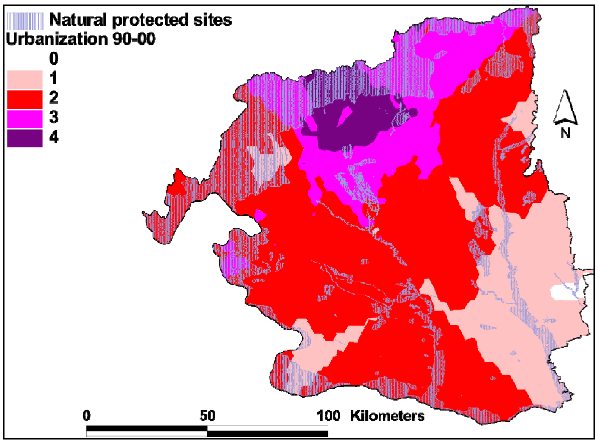

Fig. 9a – Urbanization and protected areas in the South-West Development Region (1990–2000).

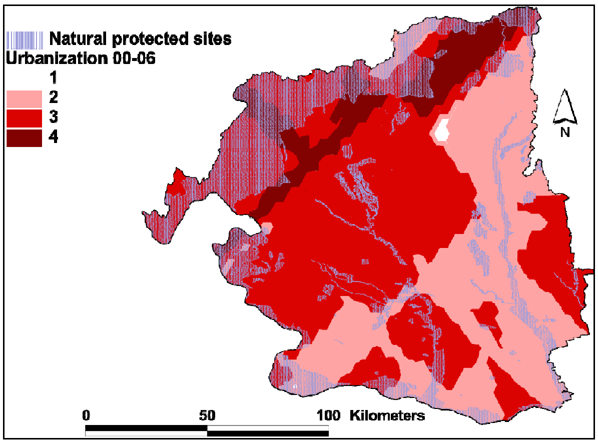

Fig. 9b – Urbanization and protected areas in the South-West Development Region (2000–2006).

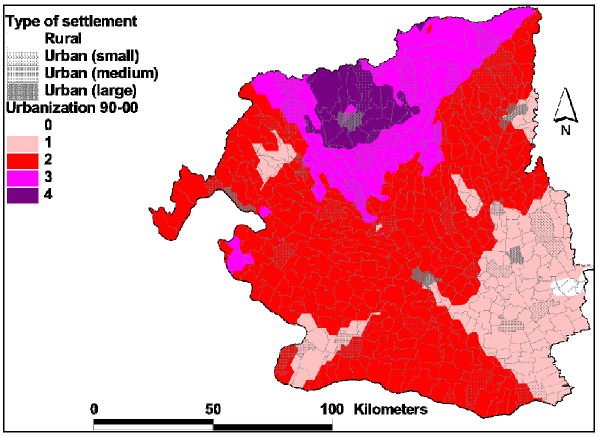

Fig. 10a – Urbanization by type of human settlement in the South-West Development Region (1990–2000).

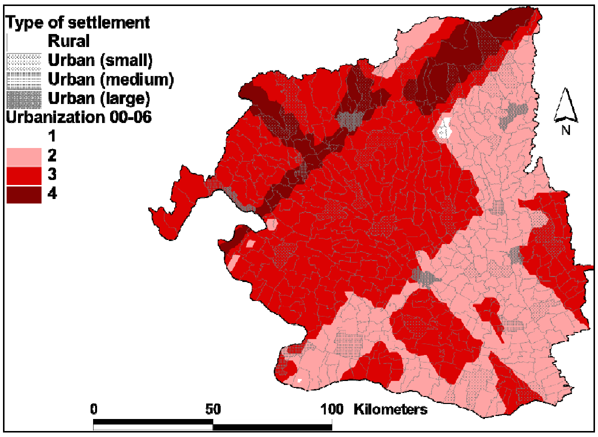

Fig. 10b – Urbanization by type of human settlement in the South-West Development Region (2000–2006).

4. CONCLUSIONS

The objective of the study was to assess the main drivers of environmental change reflected by transitional dynamics using land cover and use data in a particular region of Romania, in relation to its socio-economic particularities. Although the study was carried out over a particular region, it reconfirmed the previous national findings, identifying urban sprawl, deforestation and abandonment of agriculture as the main drivers of change.

Furthermore, the results reconfirmed the potential impact of these phenomena on natural protected sites and sensitive regions (such as the areas prone to aridity and drought, and alpine regions). From a theoretical perspective, the study underlined the deleterious effects of uncontrolled development induced by the restructuring economy, and provided additional evidence for the impact of economic underdevelopment associated with low environmental awareness, especially through the analyses focused on the deforestation and abandonment of agriculture.

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ANALYSE ET MODÉLISATION DE LA VULNÉRABILITÉ AUX MALADIES À TRANSMISSION HYDRIQUE DANS L'ESPACE URBAIN DE LA VILLE DE BATNA – NORD-EST ALGERIEN

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Mots clés: eau, ville, qualité bactériologique, risque, santé, SIG, Batna (Algérie).

Analysis and modelling of vulnerability to disease transmission water in the city of Batna – North-Eastern Algeria. In a semi-arid area the scarcity of water resources, including those for domestic consumption is often associated with the problem of potability, given their physical-chemical and bacteriological characteristics. The city of Batna, Algeria's fifth largest city, has to cope with the quality of drinking water from a microbiological point of view, since there are many cases of infiltration of sewage into the water supply network (cross- connection). The environmental situation presents a real danger to public health and can cause epidemics difficult to contain. The numerous epidemic outbreaks observed in the past, along with more recent ones, suggest that drinking water could significantly contribute to endemic diseases. Indeed, the results of the recent bacteriological analyses made by us throughout the water cycle from source to tap via the network, show the continuing deterioration of the bacteriological quality of the water supplied to the city of Batna. The results confirmed our assumptions about the quality of the management of this resource and we showed how the Batnean urban space is marred by the inconsistency of both urban fabric and the associated networks. To estimate and spatialize the level of risk, we rely on a method for assessing vulnerability by digital index coupled with a Geographic Information System (GIS). Several methods have been developed for the assessment of vulnerability to pollution, among these the DRASTIC method, mostly used worldwide, has been identified as one of the vulnerability methods specific to appraising groundwater pollution. In this article we present a method for estimating the risk of vulnerability to waterborne diseases (WD) in a middle town of north-eastern Algeria. This method can be applied to any drinking water distribution network, taking into account the five parameters influencing vulnerability (outdated networks, unplanned urbanization, type and quality of materials behaviour, population density, and lack of water resources). Synthesis maps, spatializing these parameters enable visualization of the main areas at risk of water supply contamination in the city. The results should contribute to the protection of vulnerable areas and WD control in an urban zone and will be used to develop concerted urban development master plans.

1. INTRODUCTION

La ville de Batna par son extension rapide et le développement des activités, liées à une démographie galopante, voit ses besoins en eau en constante augmentation, ces besoins sont en majorité jusqu' en 2007 satisfaits par des eaux souterraines**,** le barrage de koudiat M'douar n'est venu renforcer les apports qu'à partir de 2007. Les eaux destinées à la consommation ne sont pas toujours dénudés de pollution, certains éléments détectés sont plutôt alarmants. Dans la ville de Batna le risque de maladie microbienne associé à l'eau potable est actuellement un sujet hautement prioritaire pour les autorités responsables de la gestion des eaux. La fièvre typhoïde sévit durablement dans cette ville et continue d'entraîner plusieurs cas d'hospitalisations par an. Certaines années sont tristement marquées par l'ampleur de la contamination, par exemple l'année 2004 a enregistré 178 de cas de typhoïde, la propagation de cette maladie due à la mauvaise qualité de l'eau liée aux divers facteurs, tel que: une

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urbanisation rapide et anarchique non maîtrisable, vétusté des réseaux, une démographie galopante aggravée par une insuffisance quantitative des ressources hydriques et surtout la gestion de l'eau ne relie pas les aspects qualitatifs de l'eau aux problèmes de la santé humaine et environnement.

Pour mettre en évidence les causes réelles de vulnérabilité dans le temps et l'espace. Il sera nécessaire d'effectuer une spatialisation cartographique des différents paramètres influant sur le niveau de vulnérabilité. La carte de risque MTH fait ressortir l'hétérogénéité territoriale (spatiale) de l'exposition à travers la spatialisation des différents facteurs à risque et les vulnérabilités induites. L'approche indicielle des paramètres de vulnérabilité spatialisés génère un nombre important de variables dont l'interaction nécessite la mise en œuvre de base de données géo référencées associées à un SIG, ce qui permettra la conception des scénarios modélisés du risque MTH et ses impacts sur l'espace urbain. Les applications fondées sur les SIG et les méthodes d'analyse spatiale se multiplient en épidémiologie et en géographie de la santé. Ceci est le résultat de la prise de conscience de l'intérêt de mieux cibler les populations et les espaces à risques en santé publique (Charlotte Roudier Davel 2006).

2. METHODOLOGIE

Ce projet exige en premier lieu la caractérisation détaillée des secteurs urbains à cartographier, notamment l'identification des paramètres urbains et socio-économiques qui interviennent dans le phénomène de contamination de l'eau potable, provoquant donc les foyers des MTH.

L'importance de chaque facteur en termes de vulnérabilité dépend de son poids exprimé par un indice numérique qui représente une évaluation de niveau de risque de contamination. Le risque augmente avec la valeur de l'indice. Pour cette étude il sera nécessaire de:

1. Effectuer des analyses bactériologiques tout au long du cycle hydraulique urbain à savoir de la source au robinet en passant par le réseau.
2. Estimer le risque de contamination par un indice numérique basé sur la vulnérabilité et le poids d'impact des différents facteurs de vulnérabilité liés aux maladies à transmission hydrique (urbanisation anarchique, vétusté des réseaux, matériaux des réseaux, pression démographique ….).
3. Synthétiser le phénomène par la mise en œuvre de base de données géoréférencées associée à un SIG.

2.1. Présentation de la zone d'étude

La ville de Batna, capitale des Aurès, chef lieu de la wilaya, située à 425 km au Sud de la capitale, elle se trouve localisée entre 6°11'de longitude Est et 35°33'de latitude Nord. La ville est située dans une cuvette entourée de montagnes. Son altitude varie entre 900 et 1 040 m. La classe de pentes faibles (0 à 3 %) représente la plus grande partie de la surface, cette classe favorise la réalisation des divers réseaux mais en revanche elle se caractérise par une faible évacuation des eaux. L'assiette de la ville de Batna est traversée par deux grands cours d'eau (Batna et Tazoult), dont la confluence forme Oued El-gourzi, au sein même de la ville. Cette situation l'expose aux inondations lors des crues. La région de Batna est caractérisée par une gamme variée de faciès géologiques allant du secondaire jusqu'à quaternaire. La zone de la plaine (ville) est composée de formations quaternaires essentiellement des dépôts alluvionnaires récents à perméabilité élevée. La lithologie la plus répandue dans la zone montagneuse est à prédominance calcaires et marnes avec une perméabilité moyenne, et élevée par fissuration des calcaires. Le climat de la ville de Batna est celui d'une région semi-aride. La température moyenne est de 4°C en janvier et de 35°C en juillet. Durant l'hiver la température descend en dessous de zéro la nuit avec souvent des gelées. Durant l'été la température peut atteindre les 45°C à l'ombre. La pluviométrie moyenne est de 350 mm par an, ces conditions d'aridité particulières ont permis l'éclosion de nombreux foyers épidémiques de maladies hydriques dans la ville de Batna durant les saisons estivales.

La croissance progressive de la ville de Batna suivant plusieurs étapes s'est traduite par une typologie d'habitat très diversifiée entre collectif et individuel. La vétusté et l'absence de conformité des réseaux dans certains quartiers favorisent l'apparition des foyers de MTH par interconnexion (cross-connexion) entre réseau d'AEP et réseau d'assainissement.

Pour mieux étudier et analyser les paramètres influents sur la vulnérabilité aux MTH la ville a été découpée en 12 secteurs urbains (Fig. 1).

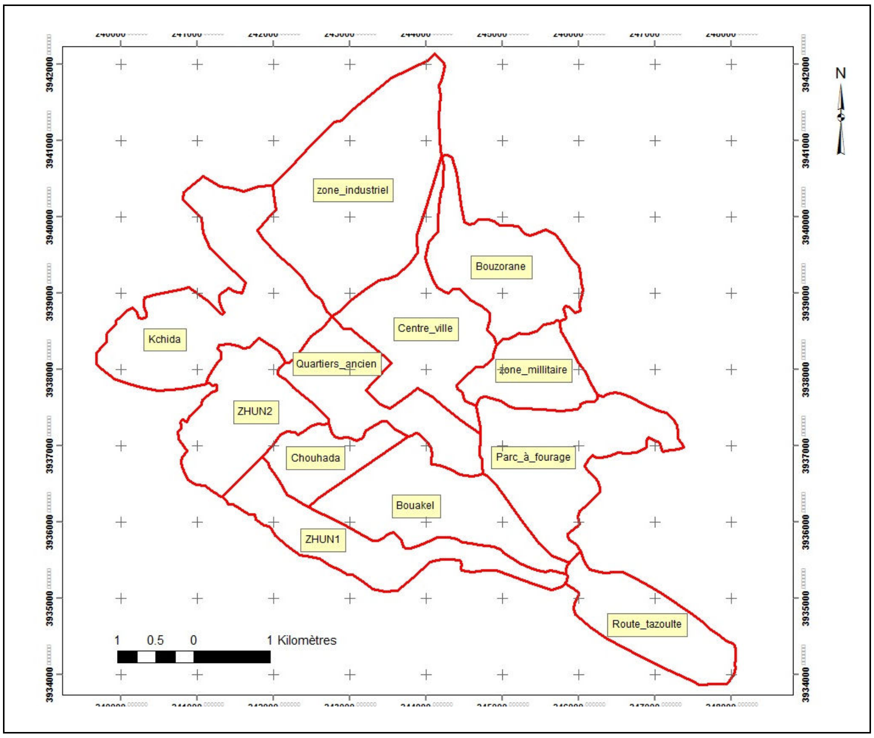

Fig. 1 – Secteurs urbains de la ville de Batna.

2.2. Les facteurs de vulnérabilité lies aux maladies à transmission hydrique (MTH) dans la ville

L'apparition des foyers épidémiques dans la ville de Batna est liée à la convergence de plusieurs facteurs aggravants dont les effets cumulés expliquent l'état de vulnérabilité.

✓ **L'insuffisance des ressources hydriques.** La ville de Batna est approvisionnée en eau potable à partir de 20 forages. La seule ressource en eau de surface est en service par le transfert de barrage Koudiat Medaour. Le volume distribué à Batna est de l'ordre de 22.952 m3/j, soit un déficit de 34.252 m3/j par apport aux besoins identifiés, le taux de satisfaction globale de la population est de 41%. La ville enregistre un déficit en eau situé autour de 59%, les ressources disponibles n'arrivent pas à couvrir l'ensemble des besoins. La distribution de l'eau est caractérisée par une discontinuité dans la plus part des quartiers (Fig. 2). Les coupures d'eau peuvent avoir des conséquences dramatiques au plan social et sanitaire, car en absence d'eau une multitude de mode d'approvisionnement en eau apparaissent et autant de risque de contamination et donc de foyers épidémiques non maîtrisables (Boukheris et Soukhel).

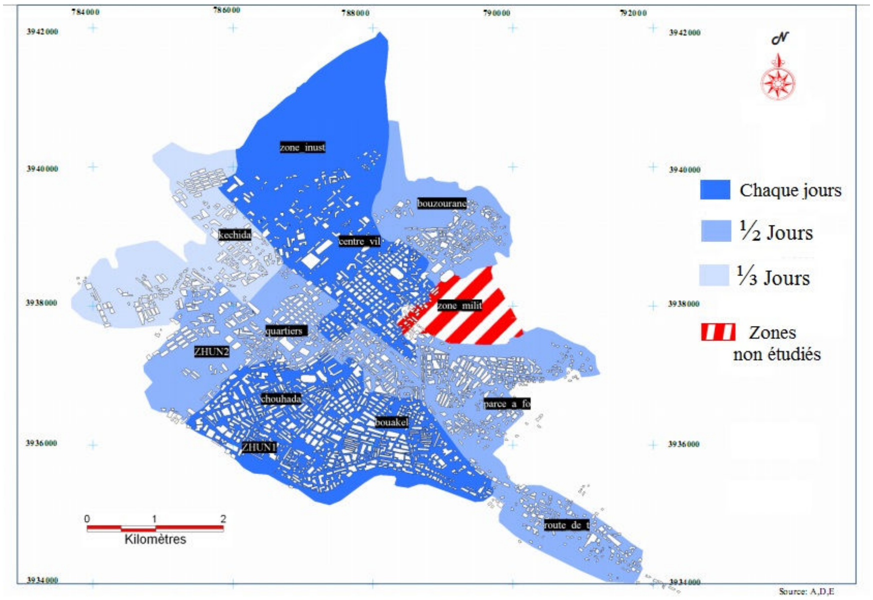

Fig. 2 – Programme de distribution de l'eau potable dans la ville de Batna.

✓ **Une forte poussée démographique.** La ville de Batna a connu un accroissement démographique élevé, résultat d'une forte intensité des migrations internes, et notamment de l'exode rural, ajouté à la croissance naturelle de la ville, la population totale s'élevait à 302.585 habitants en 2010. La croissance démographique a amplifié la crise de l'habitat; le développement de quartiers insalubres généré de nombreux problèmes surtout le problème de l'eau potable et l'assainissement. Selon Samuel Rufat (2007) la densité qui est un indicateur de la concentration des habitants et des flux est considérée comme le facteur le plus évident à la vulnérabilité. La carte de la densité (Fig. 3) indique des écarts importants d'un quartier à l'autre. Les plus marginalisés à habitats illicites enregistrent le plus de branchements illicites.

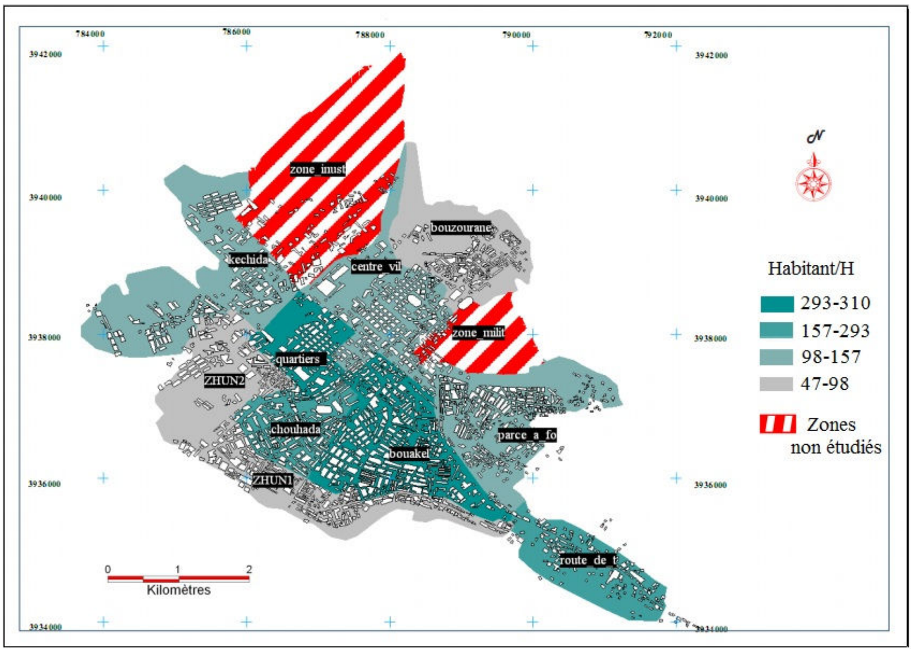

Fig. 3 – Densité de la population dans la ville de Batna (2010).

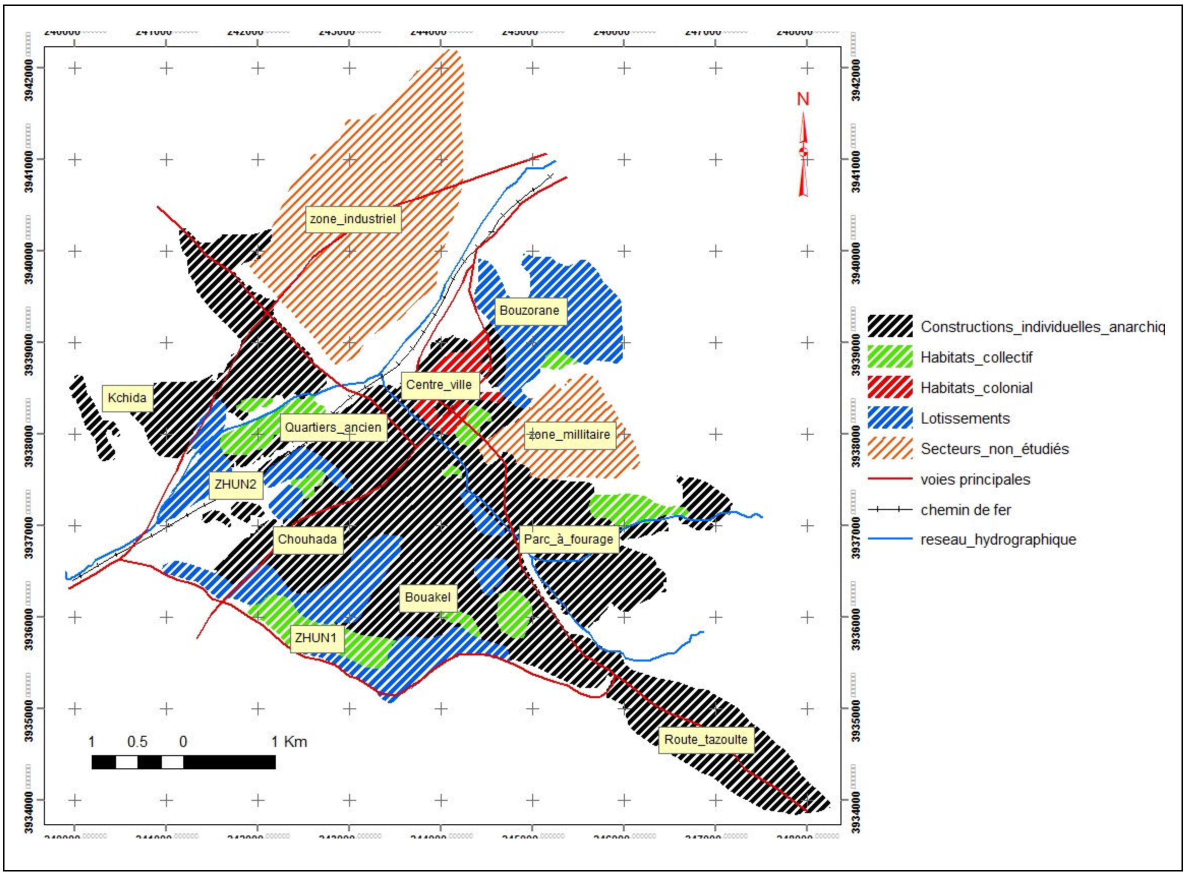

Fig. 4 – Les formes de l’habitat
dans la ville de Batna.

✓ **Vétusté du réseau.** La ville de Batna dispose d’un réseau de distribution d’eau potable de 447.053 mètres linéaires, le taux de branchement est estimé à 97%. L’état de réseau est vétuste à 60% (Fig. 5); plusieurs analyses bactériologiques ont permis de mettre en évidence les effets néfastes de la vétusté du réseau sur la qualité de l’eau distribuée. La vétusté des conduites entraîne des «cross--connexion» responsables de pollution donc d’augmentation de la fréquence de maladies comme la fièvre typhoïde voire des diarrhées chroniques. A cela s’ajoute le fait que 40% des eaux captés en Algérie pour les besoins de la population se perd en raison de la mauvaise qualité des canalisations (Remini, 2005).

✓ **Nature des matériaux de conduites.** Le réseau d’alimentation en eau potable dans la ville de Batna est constitué de toutes sortes de matériaux (Fig. 6): acier (6%) amiante ciment (20%), fonte (10%) était quasi-exclusivement utilisée avant 1945 puis utilisée jusqu’en 1970. PEHD (12%), PVC (52%) leur utilisation a été prédominante à partir de 1975; par ailleurs 57% des branchements particuliers sont en plomb (Algérienne des eaux 2008). D’après Rodier (1996) certains matériaux sont vulnérables et peuvent influencer de manière significative la qualité de l’eau livrée au consommateur, cette influence peut prendre des proportions lorsque se développent des phénomènes de corrosion (cas de canalisations métalliques et des bétons) ou dégradation (cas des matériaux de type organique).

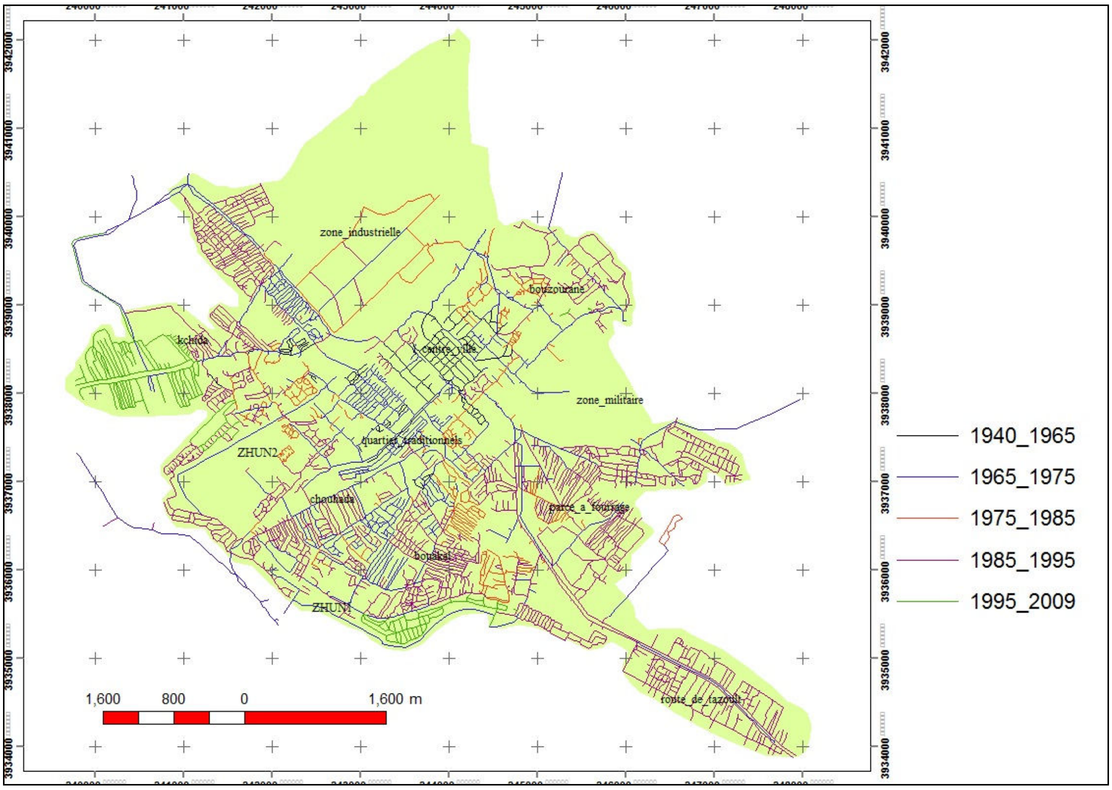

Fig. 5 – Répartition spatiale des conduites selon leur l'âge.

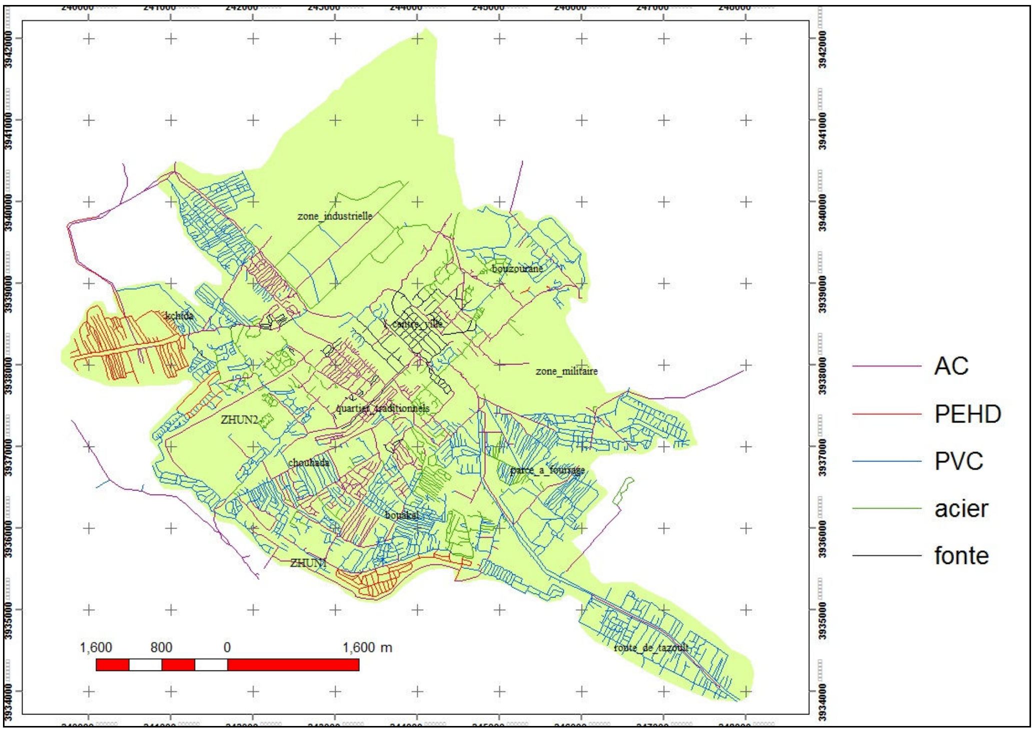

Fig. 6 – Répartition spatiale des conduites par type de matériaux.

2.3. Estimation de la vulnérabilité par l'indice numérique

Pour estimer la vulnérabilité à la pollution bactériologique de l’eau distribuée dans l’espace urbain, nous nous basons sur une méthode qui consiste à la détermination de l’indice de vulnérabilité, en tenant compte de tous les paramètres influents: l’insuffisance des ressources hydriques, vétusté des réseaux, matériaux des réseaux, densité démographique, urbanisation anarchique. L’importance de chaque facteur dépend de son poids (Tableau 1) variant entre une valeur de 05 pour les facteurs les plus significatifs et une valeur de 01 pour les facteurs qui le sont moins.

Tableau 1

Classification des paramètres selon leur influence sur la vulnérabilité

Paramètres	poids
Vétusté du réseau	**5**
urbanisation anarchique	**4**
type de matériaux	**3**
densité de la population	**2**
insuffisance des ressources hydriques	**1**

Affectation de différents poids aux paramètres a été faite sur la base des causes qui favorisent l’éclosion des foyers d’épidémie, par exemple la vétusté du réseau s’est distingué à chaque fois comme cause principale des «cross--connexions» responsables de la pollution, donc d’augmentation de la fréquence de maladies, notamment la fièvre typhoïde (phénomènes de corrosion, fragilité des conduites aux ouvertures des différents travaux et chantiers. Aussi l’urbanisation anarchique a un impact considérable sur la contamination et reste l’un des facteurs favorisant l’apparition et la persistance des MTH dans les quartiers spontanés qui enregistrent le plus de branchements illicites.

Dans cette méthode chaque facteur est codé de 0 à 4, suivant le degré de vulnérabilité aux MTH (Tableau 2). La plus petite cote représente les conditions de faible vulnérabilité à la contamination.

Tableau 2

Facteurs de vulnérabilité selon le degré d’influence

Age des conduites cote	**cote**	**Forme urbaine**	**cote**	**Type de matériaux**	**cote**	**Densité Hab /ha**	**cote**	**Distribution de l’eau par jour**	**cote**
1940–1965 4	**4**	**Habitat individuel anarchique**	4	**Acier (corrosion)**	4	293–310	4	**1/4j**	4
1965–1985 3	**3**	**Habitat colonial (tissu vétuste)**	3	**Fonte (vétuste)**	3	293–157	3	**1/3j**	3
1985–1995 2	2	Lotissement	2	**Amiante ciment**	2	157–98	2	**1/2j**	2
1995–2007 1	**1**	**Habitat collectif**	1	**PVC et PEHD**	1	‹ 98	1	**Chaque jour**	1

La vulnérabilité est évaluée par un indice numérique représentant la somme des cotes multipliée par le poids d’impact de chaque paramètre, tel que:

V: âge du réseau
F: forme urbain
M: type de matériaux
D: densité de la population
E: distribution de l’eau par jour

PV x CV+PF x CF +PM x CM+PD x CD + PE x CE =indice de vulnérabilité

L'indice de vulnérabilité ainsi calculé représente une évaluation du niveau de risque de contamination de l'eau potable. Les valeurs de l'indice de vulnérabilité (IV) varient entre faible et très forte; elles sont classées comme il en suit:

IV > 60 (vulnérabilité très forte). 45< IV< 60 (vulnérabilité forte).
30 < IV < 45 (vulnérabilité moyenne). 15< IV< 30 (vulnérabilité faible).

Appliquer cette classification à la ville de Batna permet de constater que les zones de forte contamination correspondent aux quartiers anciens de forte densité qui rallient la vétusté du réseau, les matériaux des conduites vulnérables, ainsi que les zones d'urbanisation anarchique non maîtrisables, sièges des branchements illicites, non-conformes aux normes techniques.

3. RESULTATS ET DISCUSSION

3.1. Résultats d'analyses bactériologiques de l'eau:

Le but essentiel des analyses bactériologiques est en premier lieu de confirmer la présence de bactéries, puis de définir les circonstances dans la quelle cette eau a été contaminée pour envisager les actions de protection adéquates.

3.1.1. Résultats des analyses bactériologiques de l'eau potable de la ville de Batna (2005–2009)

A la lecture de la Figure 7, il apparaît que sur 6.304 examens microbiologiques qui ont été effectués, 1.524 examens soit (24,17%) se sont révélés positifs, témoignant d'une contamination certaine de l'eau destinée à la consommation humaine par les bactéries.

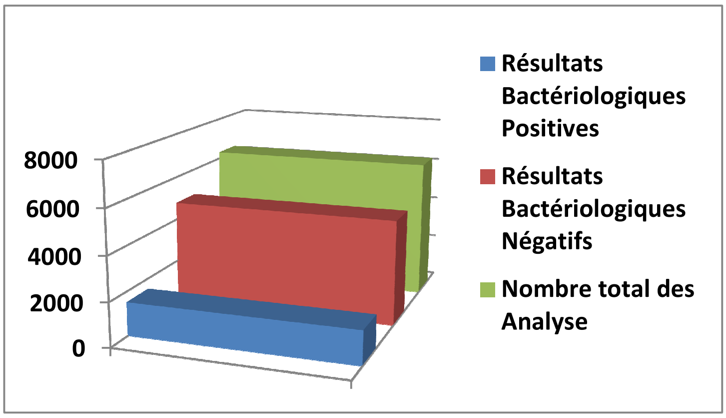

Fig. 7 – Résultats des analyses bactériologiques de l'eau potable.

3.1.2. Résultats des analyses bactériologiques d'eau par secteur urbain (2005–2009)

En général les eaux souterraines sont d'une grande pureté bactériologique, cette qualité se dégrade au fur et à mesure dans le réseau de distribution et avant d'atteindre le robinet du consommateur car la qualité bactériologique d'une eau n'est pas un paramètre stable, mais au contraire sujet à fluctuation, par pollution accidentelle, nécessitant des contrôles permanents et représentant la cause la plus fréquente de non potabilité de l'eau (Rodier, 2009).

La mauvaise qualité bactériologique de l'eau de boisson à Batna est due essentiellement à l'infiltration des eaux usées dans le réseau d'AEP (cross – connexion), ce facteur reste le plus favorisant à l'apparition des foyers des maladies à transmission hydrique notamment la typhoïde.

D'après le tableau 4, il apparaît que les secteurs Kechida, Parc à forage et Bouakal enregistrent un taux élevé d'eau impropre à la consommation par rapport à l'ensemble de la ville. Ceci est lié à la convergence de plusieurs facteurs aggravants dont les effets cumulés expliquent l'état de vulnérabilité. Ces quartiers sont généralement des quartiers densément peuplés et occupés de façon anarchique sans aucune planification préalable (Mpakam Hernanie *et al.*, 2006).

Tableau 3

Résultats d'analyses bactériologiques d'eau par secteur urbain (2005–2009)

Secteur urbain	Nombre total des analyses	Nombre négatif	Nombre positif	% d'eau impropre à la consommation
Centre ville	94	56	38	40,42
(Z'mala,Cité-Chicki)	363	243	120	33,05
Bouakal	243	131	112	46,09
Kechida	201	112	89	44,27
Chouhada	150	100	50	33,33
Bouzourane	75	41	34	45,33
Parc à forage	118	70	48	40,67
Route de Tazoult	27	19	8	29,62
ZHUN 1	105	80	25	23,80
ZHUN 2	158	111	47	29,74

La mauvaise qualité bactériologique de l'eau de boisson dans ces quartiers est due essentiellement à l'infiltration des eaux usées dans le réseau d'AEP (cross – connexion), ce facteur reste le plus favorisant à l'apparition des foyers des maladies à transmission hydrique notamment la typhoïde dans la vile de Batna.

3.2. Les cartes de synthèse (cartes de vulnérabilité)

Les cartes de synthèse sont utiles pour repérer les lieux où les risques et les vulnérabilités sont plus élevés au regard de l'ensemble des facteurs considérés (PropekZimmermann *et al.*, 2009). Dans cette étude ces cartes sont les résultats de la superposition de plusieurs couches d'informations relatant les différents facteurs de vulnérabilité liés aux maladies à transmission hydriques. D'après les figures 8 et 9 les cartes de synthèse nous ont permis une spatialisation de niveau de risque avant et après la modification des paramètres dans certains quartiers (rénovation du réseau, transfert des eaux du barrage).

3.3. Discussion: fiabilité et validité de la méthode

D'après l'approche indicielle des paramètres de vulnérabilité spatialisés et la mise en œuvre de base de données géo référencées associée à un SIG**,** les résultats obtenus permettent de visualiser les principales zones à risque de contamination bactériologique de l'eau distribuée dans la ville de Batna avant et après la modification de certains paramètres. Les zones de vulnérabilité élevée sont les quartiers anciens qui rallient la vétusté du réseau, les matériaux des conduites vulnérables. Ainsi que les zones d'urbanisation anarchique non maîtrisable (siège des branchements illicites, non-conformités aux normes techniques, absence de plan de raccordement AEP etc.) La situation de ces quartiers ne permet même pas le contrôle et l'entretien des ouvrages et des réseaux d'eau potable. Les cartes des secteurs urbains touchés par la fièvre typhoïde (Fig. 10, 11) nous ont permis de vérifier la validité de l'approche indicielle des paramètres influant sur le niveau de vulnérabilité. En effet la comparaison avec les cartes de synthèse avant et après la modification de certains paramètres montre clairement que les zones réellement contaminées avant et après 2006 correspondent à celles où les indices de vulnérabilité sont plus élevés.

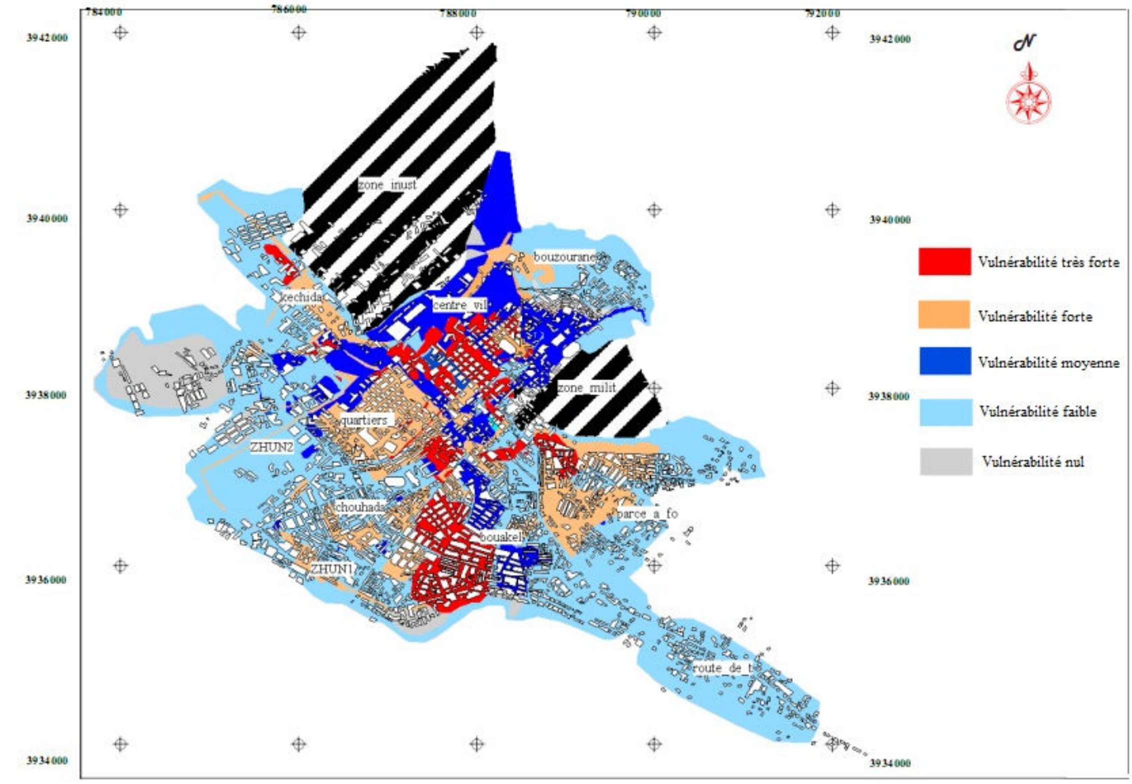

Fig. 8 – Carte de vulnérabilité avant la modification de certains paramètres.

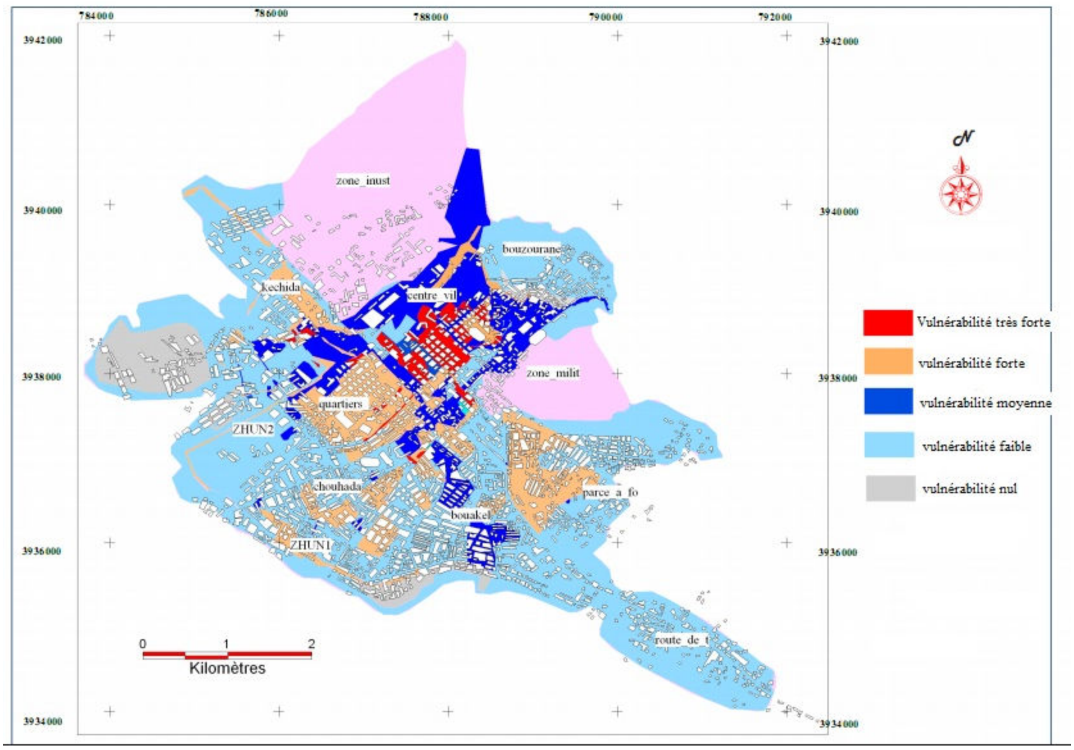

Fig. 9 – Carte de vulnérabilité après la modification de certains paramètres.

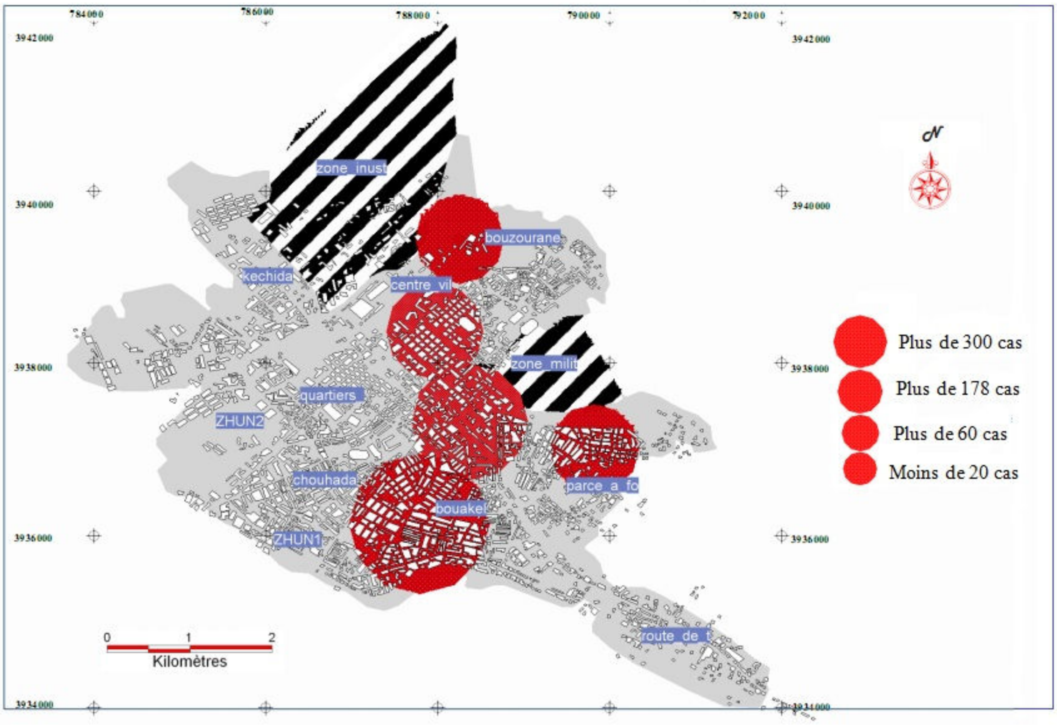

Fig. 10 – Secteurs urbains touchés par la typhoïde dans la ville de Batna (1999–2006).

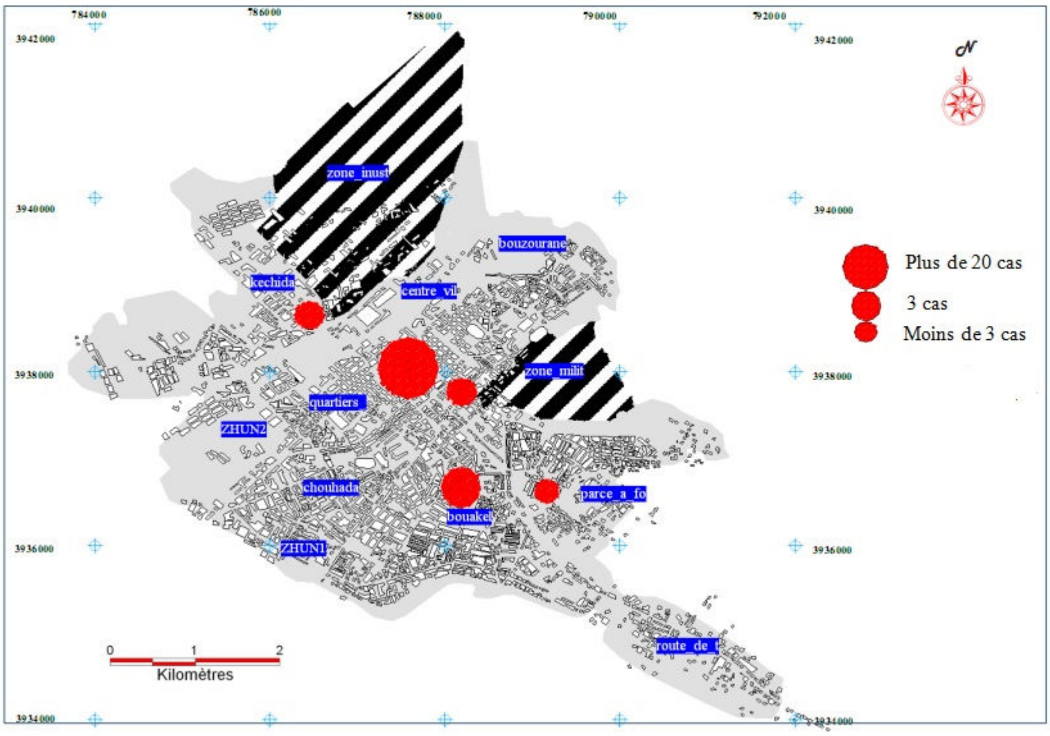

Fig. 11 – Secteurs urbains touchés par la typhoïde dans la ville de Batna (2006–2011).

Le modèle cartographique élaboré a été testé; il reflète la réalité du terrain (Fig. 12). Cette méthode peut être appliquée à tout réseau de distribution de l'eau potable avec une prise de considération des cinq paramètres. Les résultats obtenus doivent contribuer à la protection des zones vulnérables et à la maîtrise des MTH dans un espace urbain et pourront servir à l'élaboration des schémas directeurs d'aménagement urbain concertés.

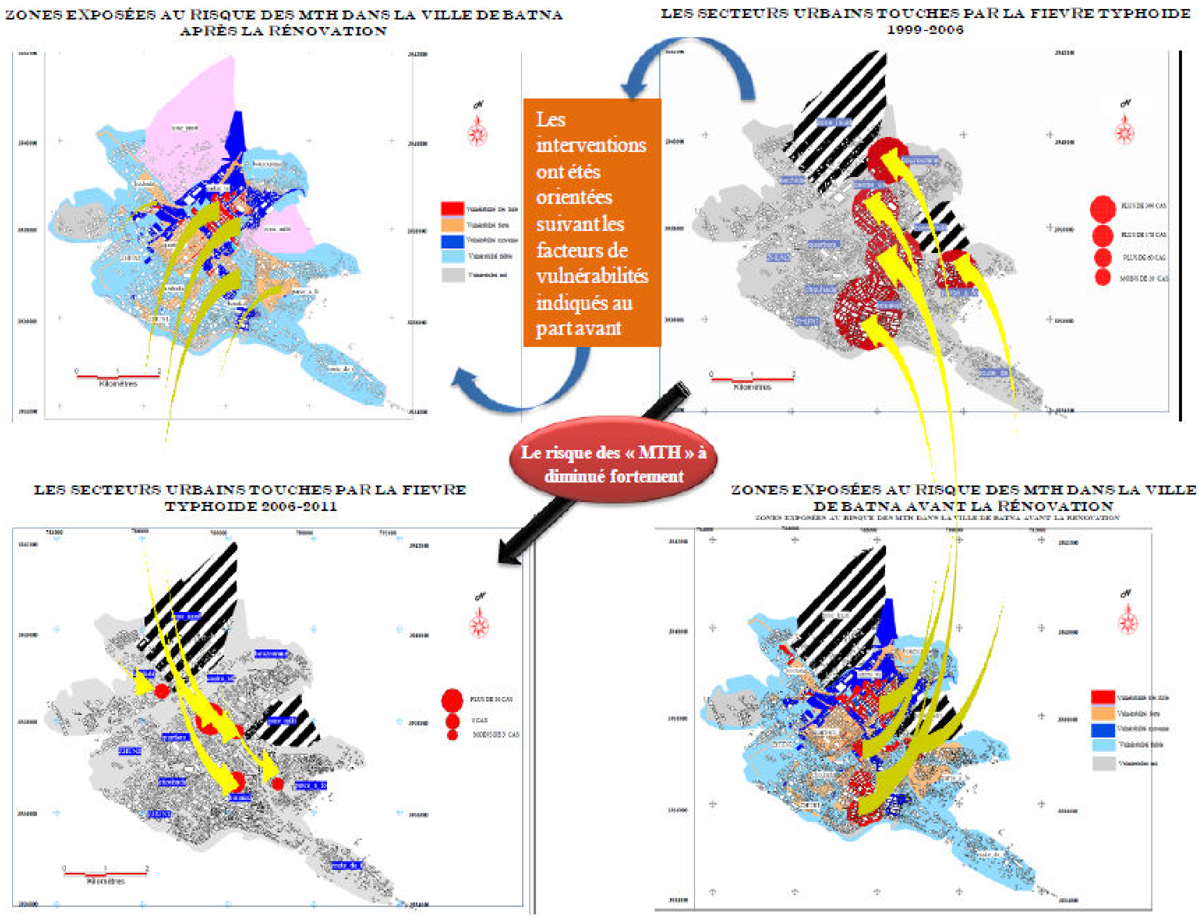

Fig. 12 – Fiabilité et validité de l'approche.

4. CONCLUSIONS

La prévention des maladies à transmission hydrique (MTH) doit rester une priorité dans les stratégies et les politiques de lutte contre ces affections qui pèsent lourdement sur le plan socio-économique. En fin pour des mesures de prévention et une gestion durable de l'eau, l'approche indicielle des paramètres de vulnérabilité et la mise en œuvre de base de données géoréférencées associée à un SIG adéquat s'imposent. Cette méthode peut être appliquée à tout réseau de distribution de l'eau potable en compte des cinq paramètres décrits dans la partie méthode. Dans le SIG chaque paramètre est notée sur une couche en lui affectant une valeur numérique correspondant a son poids, c'est-à-dire son influence sur la vulnérabilité de l'eau à la contamination. Ensuite ces cartes sont superposées sur une couche résultat ou sera calculé l'indice de vulnérabilité. Les différentes cartes éditées peuvent être utilisées comme des outils d'aide à la décision indispensable à la protection de la source et du consommateur. Par ailleurs la base de données numérique que nous avons élaboré, permettra un suivi spatio- temporel du niveau du risque dans chaque secteur de la ville et dont la nature et l'ampleur préludent à une situation sanitaire et environnementale catastrophique.

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GIS MODELLING IN THEMATIC MAPPING OF LAND COVER CHANGES IN THE FOREST-STEPPE REGION OF RUSSIA

ELIZAVETA KHAZIEVA *

Key-words: GIS, remote sensing data, forest-steppe region, thematic maps, land cover, Russia.

Abstract. Nowadays there are many remote sensing methods and tools, which help to deeply understand the land cover processes on the large area without field researches. The cartographic modeling is one feasible way to analyze and deeply understand the data and processes which take place in the region. A combination of different data (such as remote sensing data, statistical information, historical maps and others), a knowledge of the territory ensures integral investigation, and a better demonstration of the result. There are many different approaches and models, one of them being thematic cartography. This is part of cartography focusing on natural phenomena, social, political and economic issues, combining visualization and exploration methods, and targeting and supporting different groups of users (Tikunov, 1997). Models are useful and used in a vast array of GIS applications, from simple evaluation to the prediction of future landscapes. Cartographic modelling is a general methodology for the analysis and synthesis of geographical data. It employs what amount to an algebra in which single-factor maps are treated as variables that can be flexibly manipulated using an integrated set of functions (Paul *et. al.*, 1991). The main trends of landscape changes is croplands decreasing especially in the 1990s, the situation beginning to improve by 2000 – 2006s. It probably has to do with the reforming procedure which had been started since the 1900s. Around 2000, the economic situation in Russia had stabilized again (Ioffe *et al.*, 2008). For a better understanding of the impacts caused by political and economic developments on land use, further studies are necessary. The developed model has to be amended by adding some socio-economic data. It would help to better understand the process in a particular area and would allow to emphasize the drivers of changes more precisely.

1. INTRODUCTION

To understand recent changes in the Earth's system and provide adequate policy advice, quantitative and spatially explicit data and models are needed on how land cover has been changed by mankind and how it will be changed. The changes in land cover and land use are a significant cause of global change, it is an essential component of all considerations of sustainability (Geist, 2008).

Nowadays there are many remote sensing methods and tools, which help us to deeply understand the land cover processes on a large area without field researches. The cartographic modeling is one feasible way to analyze and deeply understand the data and processes which take place in the region. A combination of different data (such as remote sensing data, statistical information, historical maps and others), a knowledge of the territory ensures integral investigation, and a better demonstration of the result. The possibility of GIS modeling can be used to predict their behavior and performance changes. Consequently, it allows researches and persons in charge to protect and manage the area, and assures prompt reaction to the changes.

There are many different approaches and models, one of them being thematic cartography. This is part of cartography focusing on natural phenomena, social, political and economic issues, combining visualization and exploration methods, and targeting and supporting different groups of users (Tikunov, 1997).

During the last century, a significant expansion of agricultural activity, urbanization and industrialization might be observed (Moran *et al.*, 2004, EEA, 2005). The forest-steppe of the European part of Russia is the area of high human interference with natural processes in the

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landscapes. Therefore, it is necessary to observe the natural aspects and human activity as a united, inseparable system.

2. DATA AND METHODS

Landscapes are complex, spatially heterogeneous systems with many properties and values: this makes classification and mapping difficult, especially at regional scales (Mucher *et al.*, 2010).

Based on the method of interpretation of landscape as function of different factors which include climate, geology and geomorphology, soils, vegetation and so on, it is possible to obtain the integrated data base of landscape characteristics.

We aimed to observe the land use/landscape change from 1981 to 2006 for the forest-steppe region. Then, using these data source as a land cover change information with the other variety of data related to the natural aspects we suggested to develop the integrated GIS model for the spatial identification and analysis of land cover dynamic. Remote sensing provides excellent methods for this objective, especially with regard to a large area such as the forest-steppe region in Russia (the approximate area is 400 000 sq. km).

For the spatial modeling of landscapes and habitats the Geographic Information System (GIS) combined with remote sensing approaches and available environmental data sets should be used. Burrough and McDonnel (1998) define GIS as a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes. Remote sensing is strongly related to GIS, since it is the science of obtaining information about an object, an area or phenomenon through the analysis of data acquired by a device that is not contact with the object or phenomenon under investigation (Lillesand *et al.*, 2008).

The different data sources have been used for the development of an integrated model, including climate data, soils, etc. (Table 1). In order to achieve the homogeneity of the variety of data a preprocessing should be fulfilled. In this case, we used the data sets for 1981, 1990, 2000 and 2006 derived from The Global Inventory Modelling and Mapping Studies (GIMMS) as a retrospective type of information. This is a global measure of normalized difference vegetation index (NDVI) covering a 22-year period. The GIMMS data set was originally generated to characterize biophysical change as defined in the International Satellite Land Surface Climatology Project (ISLSCP) Initiative II collection. NDVI, in general, is a vegetation index used in climate models and biogeochemical models to calculate photosynthesis, the exchange of CO2 between the atmosphere and the land surface, land-surface evapotranspiration and the absorption and release of energy by the land surface (Tucker *et al.*, 2004). This data set provides improved results based on corrections for calibration, view geometry, volcanic aerosols, and other effects not related to actual vegetation change. Data published in 2004 by a group of authors (Tucker, Compton, Pinzon, Jorge, Brown, Molly) and supported by the University of Maryland, USA, who also owns the copyright to the data. The horizontal resolution of these data sets varies depending on the area, in our case we have approximately 5 kilometers resolution.

There are only few datasets for the whole territory describing land cover: the Land Cover Map of Northern Eurasia. It represents the spatial distribution of the major vegetated and non-vegetated land cover types for the year 2000. Another one is the Global Land Cover Classification derived from AVHRR sensor and afterwards analyzed and improved using different additional information. In our case, we considered the data derived from The Global Land Cover Facility project (for 1992-1993) as a model of land cover classification. This global land cover products are much finer in resolution and classification. More than 200 high resolution scenes are used for land cover type confirmation. Most of the scenes used were acquired by the Landsat Multispectral Scanner System (MSS), and a few by Landsat Thematic Mapper and the LISS (Linear Imaging Self-Scanning Sensor). These data sets have 1 kilometers resolution. Scenes were considered unsuitable if haze or poor quality data obscured the scene, or if the cover types in the scene could not be visually distinguished (Boriah *et al.*, 2008). For most scenes, the project member aimed to identify only one cover type within the scene. It was possible, however, to identify more than one cover type in some scenes if croplands were visually identifiable based on the spatial patterns of fields or if vegetation maps showed the presence of clearly identifiable cover types (Hansen *et al.*, 2000). As an integral part of the GIS model the climate data should be included. In this case the four monthly variables: average minimum, mean, and maximum temperature and precipitation were implemented into the procedure. The data were compiled using monthly averages of climate as measured at weather stations from a large number of global, regional, national, and local sources, mostly for the 1950–2000 period. We interpolated these data using the thin-plate smoothing spline algorithm implemented in ANUSPLIN (Hutchinson, 2004). Then the data layers were generated through interpolation of average monthly climate data from weather stations on a 30 arc-second resolution grid (Hijmans *et al.*, 2005). As long as we considered the pragmatic approach (Mucher *et al.*, 2006), which led to the selection of different key data sources for identifying and delineating landscape units, the FAO soil database had been taken into account. This database provides information on the soil unit composition for each of the 15,773 soil mapping units. The database shows the composition of each soil mapping unit, and standardized soil parameters for top- and subsoil. A soil mapping unit can have up to 9 soil unit/topsoil texture combination records in the database.

Using Explicit Cross Tabulation function in GeoMedia Product (Intergraph Corp.) we have obtained the GIMMS images classified with GLCF parameters (Fig. 1). Afterwards it was possible to apply the schema of transformation to the four NDVI data sets. Consequently, land cover images for four periods of time (1981, 1992, 2000 and 2006) were derived.

Table 1

The data sources used in the research

Data	Description	Source
Land Cover information	Land Cover Classification by GLCF	http://www.landcover.org/data/landcover/
GIMMS data	Landsat	http://glcf.umd.edu/data/gimms/
DEMs (SRTM, ASTER)		https://lpdaac.usgs.gov/products/aster_products_table; http://earthexplorer.usgs.gov/;
Climate data	Temperature, precipitation (past, current, future)	http://www.worldclim.org/
	Temperature Anomalies	http://neo.sci.gsfc.nasa.gov/blog/2009/02/19/avg-lst-anomaly/
Soils		http://www.fao.org/nr/land/soils/harmonized-world-soil-database/download-data-only/ru/

There were four categories of landscape which were used:

1. Croplands: lands with > 80% of the landscape covered in crop-producing fields. Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type.

2. Grasslands: lands with continuous herbaceous cover and < 10% tree or shrub canopy cover.

3. Wooded Grasslands/Shrublands: lands with herbaceous or woody understories and tree canopy cover of > 10% and < 40%. Trees exceed 5 m in height and can be either evergreen or deciduous.

4. Mixed Forests: lands dominated by trees with a per cent canopy > 60% and height exceeding 5 m. they consist of tree communities with interspersed mixtures or mosaics of needleleaf and broadleaf forest types. Neither type has < 25% or > 75% landscape coverage.

Spatio-temporal changes of land use analysis are significant for identifying dynamic changes in a certain period. The general analysis of the quantity, structure and environment of land-use change is useful to perceive the trend and character of land-use spatio-temporal change (Xin Chang *et al.*, 2008). The transformation of landscapes is an inevitable step of their development. Globally, land cover today is altered principally by direct human use: by agriculture and livestock raising, forest harvesting and management and urban and suburban construction and development (Meyer, 1995). Hence, in order to use land optimally, it is not only necessary to have the information on existing land use land cover, but also the capability to monitor the dynamics of land use resulting out of both changing demands of increasing population and forces of nature acting to shape the landscape. Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1989). Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest. Using the change detection methodology for images which reflect the land cover types for four periods we could obtain the image of the transformation types (Figs. 2, 3).

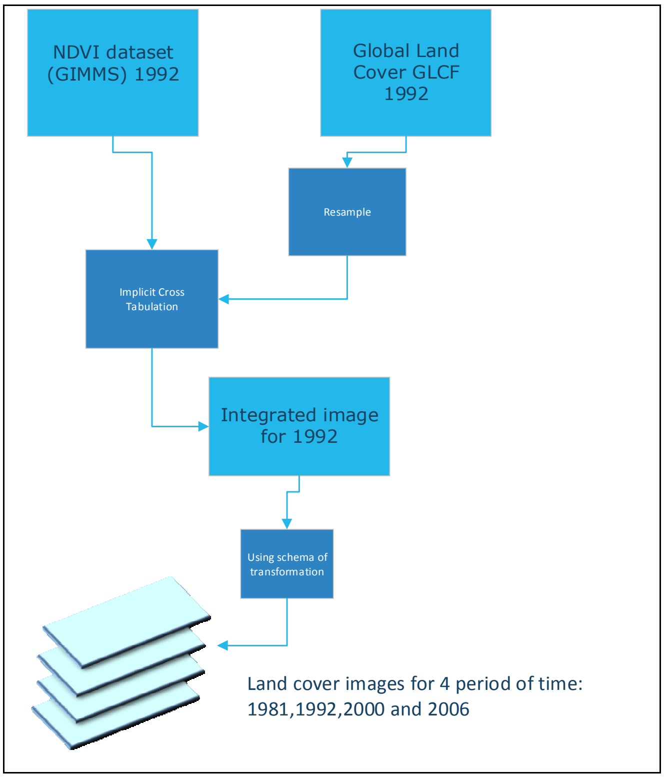

Fig. 1 – The schema of NDVI and GLCF data integration, preprocessing and analysis.

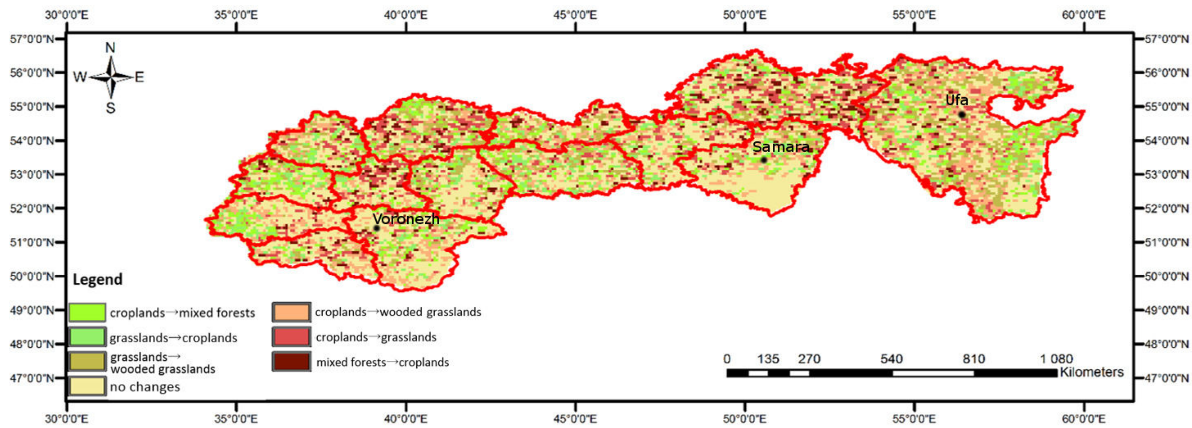

Fig. 2 – The variety of land cover types transformation (1981–2006).

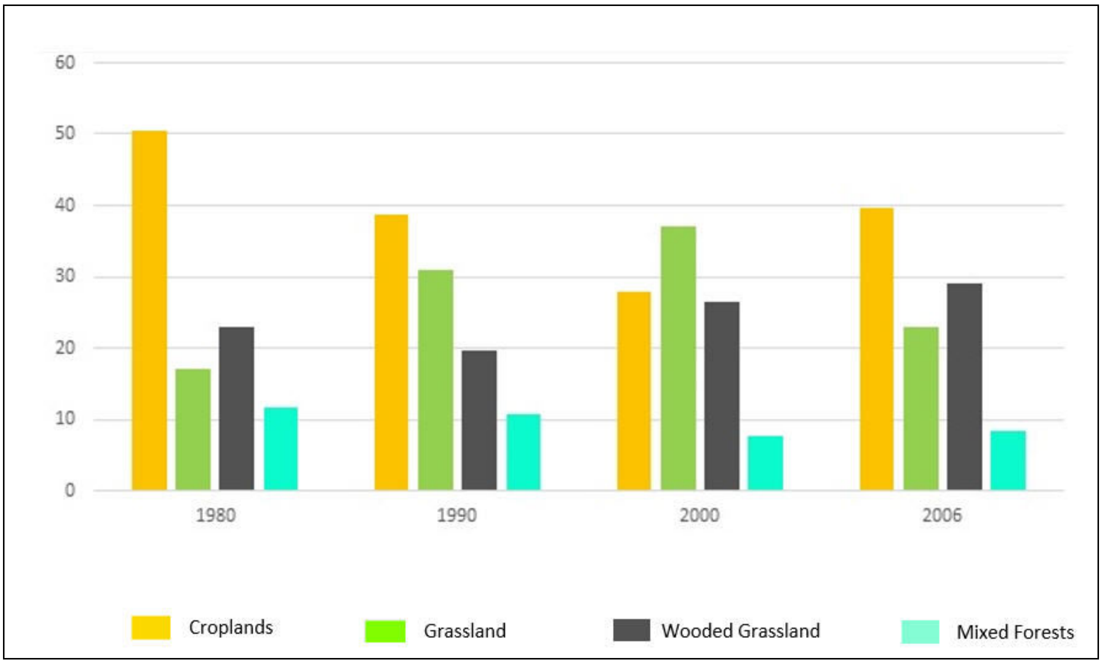

Fig. 3 – The distribution of prevailing land cover type (1980s–2006).

3. GIS MODELLING

Models are useful and used in a vast array of GIS applications, from simple evaluation to the prediction of future landscapes. Cartographic modelling is a general methodology for the analysis and synthesis of geographical data. It employs what amount to an algebra in which single-factor maps are treated as variables that can be flexibly manipulated using an integrated set of functions (Paul *et al.*, 1991). Generally, models are the sophisticated tools for characterizing and understanding environmental patterns and processes, and estimating the effects of environmental change at local, regional and global scales (Goodchild *et al*., 1993). Modelling of land use/cover and their changes depend on a variety of possible reasons. They could be roughly divided into two groups – the natural, biophysical conditions and the dominant socio-economic factors. However, at the regional scale the socio-economic assessment could hardly be implemented, socio-economic indicators should be evaluated for the local units. In our case, the kind of impact of human activity had been taken into account as part of land cover use data.

Thus, there were used different "natural" data for developing the model, including ratio temperature and precipitation, the relief information (slope, curvature, roughness and absolute elevation), type of land cover transformation and soils data set (Fig. 4).

Afterwards segmentation techniques (Burnett, Blaschke, 2003; Lucas *et al.*, 2007) were used for the spatial identification of the landscape units. Segmentation (object recognition, based on spatial characteristics) is the process of identifying spatial units, which are mostly derived from satellite imagery. Classification was subsequently based on statistics from the core of pixels at the center of each object, thereby avoiding mixed pixels from the margins (Briggs, 2003). In this particular case, the segmentation was based on the thematic data layers; the ratio of the temperature to the precipitation, soils, data derived from DEM and types of land cover changes.

Based on a variety of input datasets we have distinguished 10 classes that are characterized by a unique combination of all input parameters (Fig. 5, Table 2).

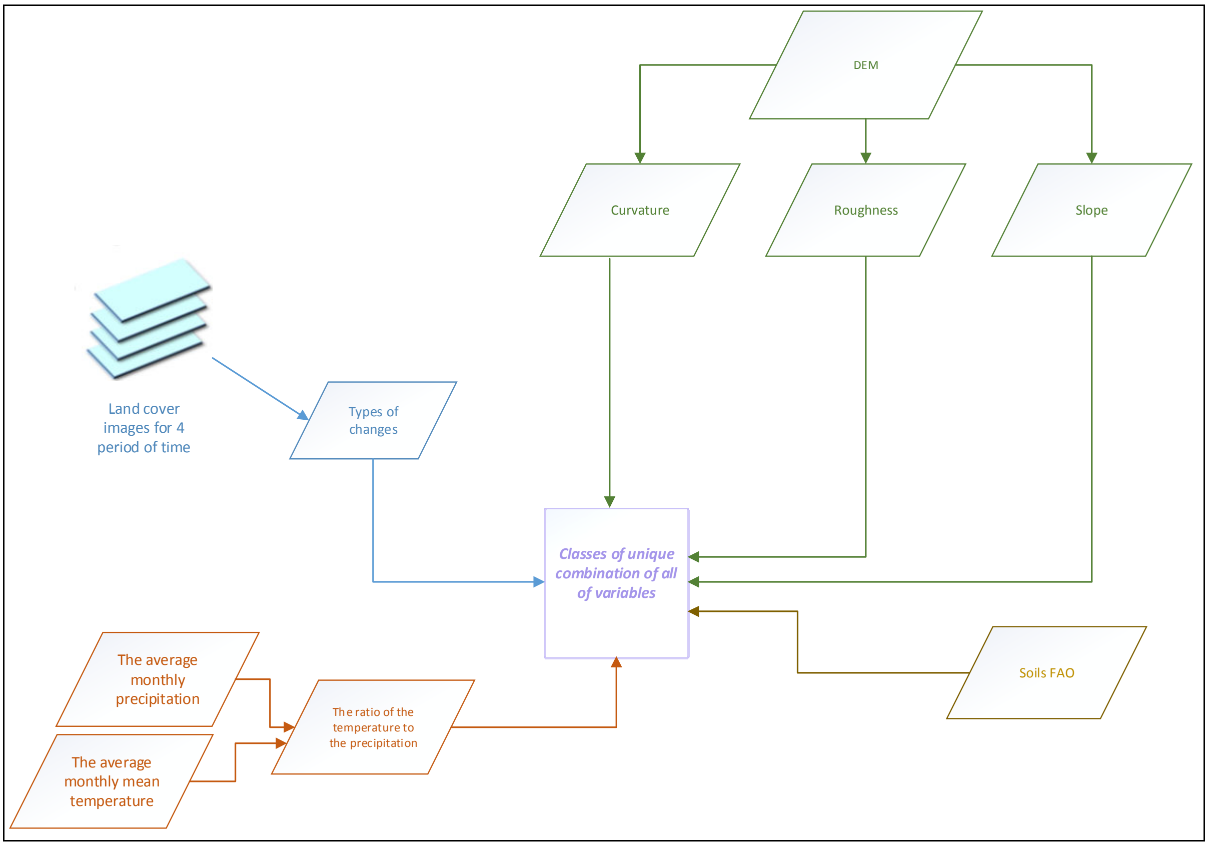

Fig. 4 – The integrated model of analysis of the input data.

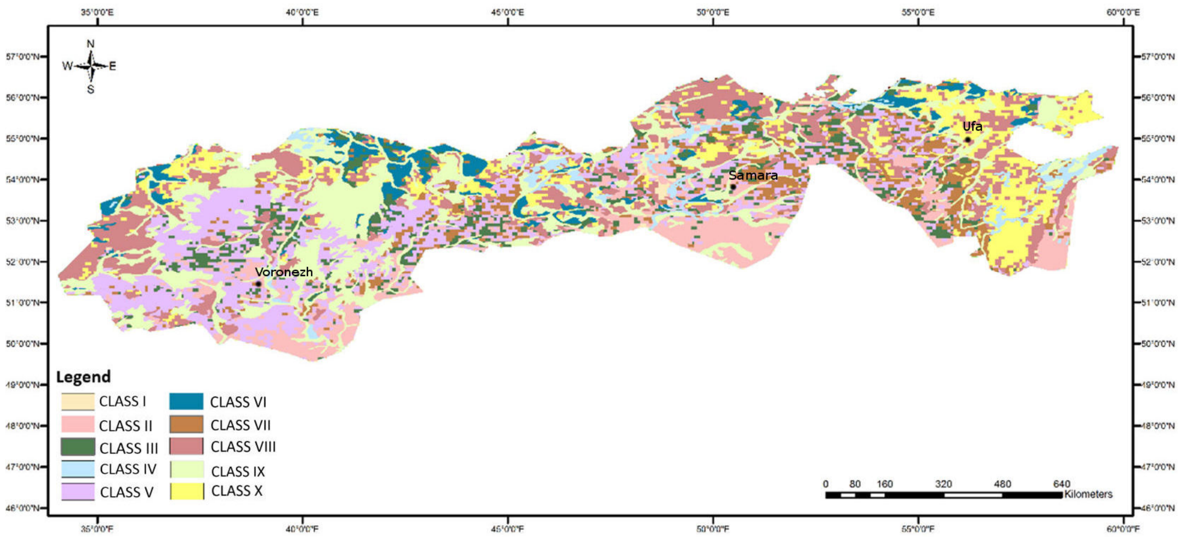

Fig. 5 – Thematic image of variables combination.

Table 2

The description of the landscape units with characteristics of input variables

Class	*Altitude (m)*	*Slope (º)*	*Soils*	*Temperature (℃) – average (spring –summer)*	*Precipitation (mm) average (spring –summer)*	*Prevalent type of land cover transformation*	*The share of the total area (%)*
I	100–150	1–2	Haplic Greyzems	18–20	60–70	croplands→ wooded grasslands	0,82
II	100–150	< 1	Haplic Chernozems	18–20	40–50	no changes	21,34
III	150–200	< 1	Luvic Phaeozems	16–18	60–70	croplands→ wooded grasslands	7,36
IV	0–50	< 1	Haplic Greyzems	18–20	60–70	no changes	3,08
V	150–200	< 1	Luvic Phaeozems	18–20	60–70	croplands→ wooded grasslands	19,52
VI	100–150	2–4	Eutric Podzoluvisols	16–18	60–70	grasslands→ wooded grasslands	4,41
VII	150–200	1–2	Luvic Phaeozems	18–20	70–80	grasslands→ wooded grasslands	6,76
VIII	150–200	< 1	Haplic Greyzems	16–18	60–70	croplands→ grasslands	11,34
IX	150–200	< 1	Haplic Chernozems (along rivers – Eutric Fluvisols)	16–18	50–60	grasslands→ wooded grasslands	14,98
X	150–200	1–2	Haplic Greyzems	14–16	60–70	grasslands→ wooded grasslands	10,39

4. RESULTS AND CONCLUSIONS

The main trends of landscape changes are the croplands decreasing especially in 1990s, the situation begins to improve by 2000–2006s (Fig. 3). It probably has to do with the reforming procedure which had been started since 1900s. Up until that time, the land had been under federal ownership; now the farmers received a partial ownership, however, little change in land use followed: similar to the Soviet practice, Russia's agriculture is still dominated by the former collective farms. Around 2000 the economic situation in Russia was again stabilized (Ioffe *et al.*, 2008). So in 2001, the new Land Code came into force. The Land Code regulates the transfer of state-owned lands to private property. Furthermore, these drivers are steered by the social and economic transition: changes in ownership, stagnation of agriculture, re-industrialization, infrastructure development, and others (Milanova, 2012).

The whole area is being characterized with the process of overgrowth, nevertheless this tendency could be clearly observed in the west regions. The eastern part of the territory is characterized by conversion of croplands into grasslands and wooded grasslands. The croplands had been changed by wooded grasslands and shrublands, also the grasslands had given place to wooded grasslands. The first type of transformation is more related to the southern areas with higher temperature (spring-summer season), chernozems, and flatter slopes and, in general, lower altitude. Another one is more typical of the north and east-north part of the territory. These areas are characterized by lower temperature (spring-summer season), greyzems and haplic chernozems on the steeper slopes. For a better understanding of the impacts caused by political and economic developments on land use further studies are necessary. Different spatial levels of the LUCC study help providing an understandable presentation of the geographical distribution of areas with different LUCC trends and degree of land cover transformation. Thus, the investigation and GIS modeling analysis on different scales should be fulfilled. The developed model has to be amended by adding some socio-economic data. It would help to better understand the process in a particular area and would allow to emphasize the drivers of the changes more precisely.

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CARTOGRAPHIE DE LA VARIABILITÉ SPATIALE DE LA SALINITÉ DU SOL DANS DE LA ZONE ENDORHÉIQUE DE GADAINE (NORD-EST ALGÉRIEN)

RABAH BOUHATA*, MAHDI KALLA**, HADDA DRIDDI**

Mots clés: salinisation, géostatistique, krigeage ordinaire, conductivité électrique, Gadaine (Algérie).

Mapping the spatial variability of soil salinity in an endorheic region (Gadaine, North-Eastern Algeria). The process of soil salinization is one of the causes of desertification in Algeria and in the world, according to the figures (FAO, 2005), where it found that 500 000 ha/year of soils belong to them. In eastern Algeria, the endorheic areas of Gadaine plain present an expanding soil salinization taking the form of a generalized phenomenon. The environmental and effective management requires a mapping of the spatial distribution of this geochemical phenomenon. To explore the spatial variability of soil salinity in this area, we used the approach of geostatistical mapping (ordinary kriging) to generate a map of salinity. 258 samples were taken laterally from the field, in order to determine the electrical conductivity (EC) of the soil. Results show that, the salinity affects a large part of the study area and also show the influence of the natural drainage on the spatial distribution. The use of database associated with digital mapping has helped to ensure the most accurate results.

1. INTRODUCTION

Prés de 33% des terres arables dans le monde sont affectées par la salinité, soit 7% de la surface terrestre (Gupta et Abrol, 1990). En Algérie, les zones arides et semi-arides constituent les espaces géographiques privilégiés de ce phénomène (Halitim *et al.*, 1987; Halitim, 1988). La mise en valeur du terrain agricole par l'instauration de systèmes de drainage adéquats dans les régions à caractère climatique aride et semi-aride, a permis une nette amélioration du rendement agricole (Dakak *et al* 2011).

On estime la salinité d'un sol à partir de mesures effectuées sur la conductivité électrique de celui-ci (Corwin et Lesch, 2005; Curtis Allen *et al.*, 2006).

Nombreuses sont les méthodes de mesures de la conductivité électrique (CE). Cependant la méthode de l'extrait dilué 1/5 (USSLS, 1954) que nous avons utilisé au laboratoire est généralement considérée comme la plus efficace pour la quantification de la salinité des sols. Selon (Richards ,1954; Calvet , 2003), les sols salins ont une CE supérieure à 4 ds/m à 25°C.

Les sols de la plaine de Gadaine au Nord-est algérien sont formés par des alluvions quaternaires dont une bonne partie est touchée par ce processus.

Cette salinisation généralisée des sols est liée aux caractéristiques morpho-climatiques de cette zone mais aggravée par une socialisation rapide de ces espaces endoréiques.

L'étude proposée dans cet article est basé sur les données de salinité mesurées sur des échantillons prélevés sur terrain et soumis à l'application de l'analyse géostatistique dans le but de dresser une carte de synthèse sur l'état de la salinité des sols. De tels documents permettent d'orienter les actions d'aménagement et de mise en valeur dans ces zones marginalisées.

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2. PRÉSENTATION DE LA ZONE D'ÉTUDE

La région d'étude fait partie des hautes plaines sud constantinoises de l'Est algérien qui constituent un vaste couloir dominé par deux chaînes de montagnes: le massif des Aurès au sud et la chaîne des Monts de Constantine au nord. Elle se trouve à quelques dizaines de kilomètres au nord de la wilaya de Batna, délimitée entre les fourchettes des coordonnées; Longitude: 6°12'15" E et 6°29'50" E, Latitude: 35° 55'51"N et 35°40'50" N. Selon l'Agence Nationale des Ressources Hydrauliques (ANRH) elle appartient au bassin versant des hautes plaines constantinoises (07–03) (Fig. 1). Située à une altitude de 784 m à 1246 m, la zone d'étude est caractérisée par une platitude impressionnante dont la pente ne dépasse guère les 5%. L'ensemble est étalé sur une surface de 348 km^2 représentant 46% de la surface totale. Ceci favorise la présence de l'endoréisme traduit par une multitude des sebkhas (Fig. 2) et chotts qui occupent le centre de la plaine.

Sur le plan géologique l'existence des formations quaternaires (sol de sebkha, limons salé) et formations triasiques (marnes bariolés et gypses bréchiques) contribuent largement au caractère salin (les chlorures et les sulfates de sodium) de ces espaces endoréiques. Le climat est de type semi-aride avec des précipitations faibles ne dépassant pas 400 mm annuellement d'où la pauvreté en végétation.

De manière générale, on retrouve dans cette zone des espèces steppiques et halophytes qui résistent à la salinité des sols; une végétation caractéristique de grosses touffes d'Atriplex ou de Salsolacées (Fig. 3).

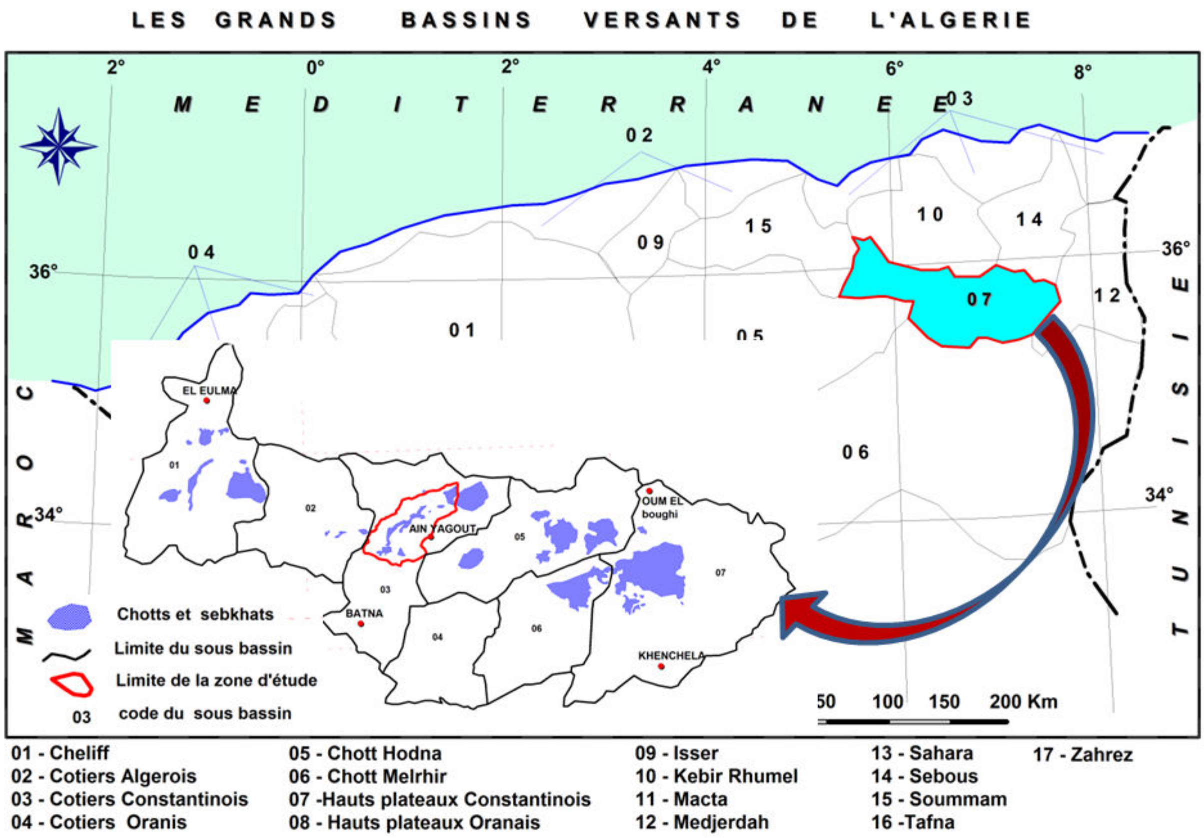

Fig.1 – Localisation de la zone d'étude selon la répartition de l'ANRH.

Fig. 2 – Un couvert végétal steppique et halophyte.

Fig. 3 – Sebkha Tinsilt.

3. MATÉRIEL ET MÉTHODOLOGIE

Echantillonnage

Les échantillons prélevés sur terrain ont été effectués et géoréférencés à l'aide d'un GPS de type Garmin (OREGON 550), L'échantillonnage des sols à été effectué sur une profondeur de 0-30 cm et avec une densité et une répartition permettant de couvrir tout la variation latérale des thématiques de terrain durant la saison d'été (mois de juillet) 2013. Le choix de cette période coïncide avec l'accumulation des sels à la surface du sol et une couverture végétale réduite à sa plus simple expression. La salinité des 259 points échantillonnés au GPS (Fig. 4) a été mesurée dans le laboratoire par la méthode de l'extrait dilué 1/5 (USSLS, 1954).

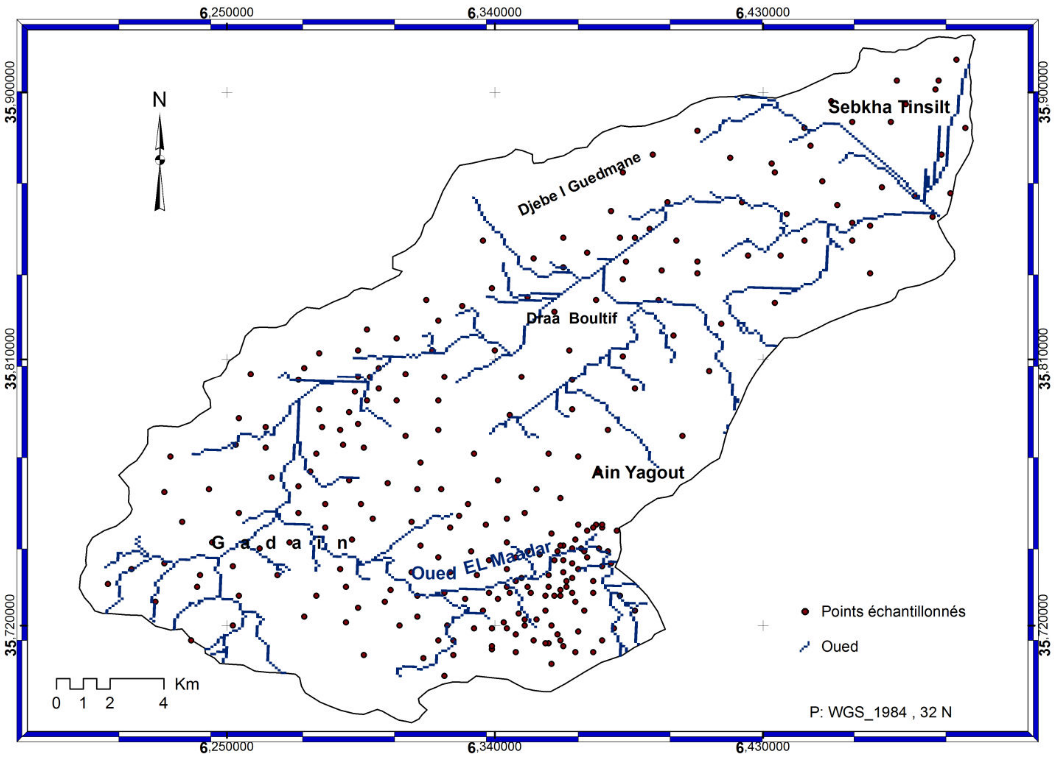

Fig. 4 – Carte de la répartition spatiale des échantillons.

La procédure géostatistique de krigeage (Webster et Oliver, 2001), fondée sur la théorie des variables régionalisées (Matheron, 1963), permet l'interpolation spatiale entre les endroits échantillonnés. Elle permet d'exploiter la corrélation spatiale entre des observations voisines dans l'espace pour prédire aux endroits non échantillonnés.

Le krigeage ordinaire (KO) est la méthode la plus générale et largement utilisée pour caractériser et cartographier la variation spatiale de la salinité des sols (Schloeder *et al.*, 2001; Walter *et al.*, 2001; Nawar, 2009; Reza *et al.*, 2010; Nawar *et al.*, 2011), l'application de cette méthode est réalisée à l'aide d'une Plate-forme ArcGIS; Geostatistical Analyst (Johnston *et al.*, 2001; ESRI, États-Unis, 2004;). A ce titre, les données ont été interpolées par krigeage ordinaire, le modèle sphérique utilisé, s'ajuste bien à nos échantillons.

Pour cartographier les valeurs de la conductivité électrique, nous avons reparti les 259 données en 5 classes conformément au classement adopté par «Manuel USDA agricole 60» comme suite:

Tableau 1

Mode de classement des sols salins

Non salines	Légèrement saline	Modérément saline	Fortement saline	très forte ent saline
0–4 dS/m	4–8 dS/m	8–16 dS/m	16–32 dS/m	> 32 dS/m

Source: Lamond 1992.

Les paramètres statistiques empiriques des données de la CE sont présentés dans le tableau suivant:

Tableau 2

Les données statistiques de la CE

Taille de l'échantillon	Moyenne	Ecart type	Maximum	Minimum
259	10,71	21,98	98,5	0,17

4. RESULTATS

La carte de la salinité obtenue par le krigeage ordinaire (Fig. 5) montre une grande variation de la salinité des sols sur le plan spatial, obéissant à de nombreux facteurs, tels que: la topographie, le réseau hydrographique, l'intervention anthropique, etc.

Cet état de la salinité spatialisée a fait l'objet d'une évaluation surfacique pour chaque classe (Tab. 3). Celle-ci servira à orienter les actions de mise en valeur agricole.

Tableau 3

Les superficies des classes de CE estimées

Classes de CE (dS /m)	Surface (Km^2)	%
0–4	203,67	58,52
4–8	48,43	13,91
8–16	46,78	13,44
16–32	31,68	09,10
> 32	17,44	05,01
Totale	348	100

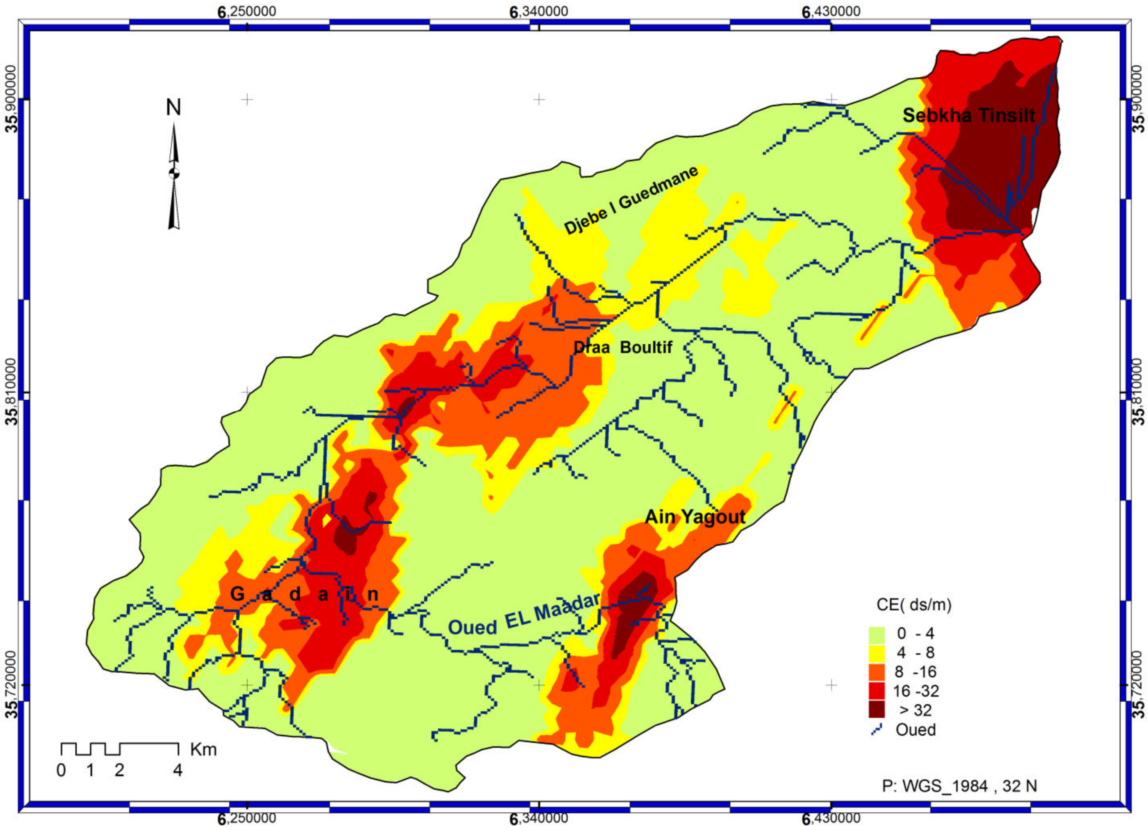

Fig. 5 – Carte de la salinité estimée.

En effet, nous pouvons constater que:

– Les sols non salés < 4 ds/m représentent plus de la moitié (58%) de la superficie totale de la zone d'étude, elles se localisent sur les bordures de la plaine de Gadaine qui se caractérisent par une certaine pente engendrant un drainage naturel vers Oued El Madher, -–émissaire principal – ce qui favorise une lixiviation des sels, évitant ainsi leur accumulation dans les profils. Cette catégorie des sols est souvent dédiée à la céréaliculture.

– Les sols légèrement salins (4–8 ds/m) représentent presque 14% (48,43 km^2) de la superficie totale, ils occupent les zones où les eaux de drainage et d'irrigation entraînent un début de salinisation, sous l'effet de la pression sociale. Les aptitudes de cette classe semblent répondre plutôt aux cultures commerciales, en l'occurrence le tabac.

– Les sols modérément salins (8–16 ds/m) couvrent une superficie similaire à la classe précédente avec 13,44% de la superficie totale. Ce type occupe généralement les chotts et les zones de la transition entre ces derniers et les sebkhas.

– La classe des sols fortement salins (16– 32 ds/m) occupent une superficie de 31,68 km^2 soit 09,10 %. Ces sols se localisent en auréoles autour des sebkhas, (sebkha Tinsilt et sebkha Falenta) où la salinité est supérieure à 32 dS / m représentant les espaces hypersalés de la cinquième classe.

Cette articulation spatiale des concentrations salines prend la forme d'un dégradé des valeurs de la salinité à partir du milieu des sebkhas vers les zones limitrophes (les chotts et les terres semi arables). Cette variabilité spatiale obéit d'une part au niveau et à la durée de submersion des sebkhas et d'autre part à la dynamique éolienne qui assure le déplacement des particules des sels vers les bordures.

Cependant les caractéristiques topographiques des terrains notamment la densité des réseaux hydrographiques et le niveau de drainage qu'il assure influent fortement sur les processus de salinisation.

5. CONCLUSIONS

La dégradation des sols est un phénomène généralisé, varié et complexe, n'épargnant aucun milieu bioclimatique. Les recherches menées ces dernières années montrent de manière incontestable le caractère préoccupant de ce fléau.

Cette dégradation peut prendre la forme d'une érosion, d'un lessivage, d'une salinisation ou d'une pollution des sols.

Dans cet article qui se focalise sur l'étude de la salinité et son articulation spatiale en milieu endoréique, nous nous efforçons d'évaluer l'étendue de la dégradation, les disparités spatiales du phénomène de salinité qui en découlent ainsi que les cause et les mécanismes qui en sont responsables.

En effet le résultat montre que prés de 42% de la superficie totale est plus ou moins touchés par les processus de salinisation (CE > 4ds/m). Le risque touchera à terme les sols agricoles limitrophes et on assistera sans doute à des processus irréversible de dégradation en égard au rythme d'anthropisation de ces espaces et en l'absence d'actions de protection et d'aménagement intégrées.

Il ressort de l'analyse spatiale que cette zone est soumise à une salinisation différentielle. Celle – ci s'accentue au niveau des dépressions occupées par les sebkhas et diminue de façon progressive vers les bordures. Les concentrations se réduisent à leur plus simple expression dans les secteurs où le réseau hydrographique est le mieux hiérarchisé et le plus dense, assurant un bon drainage.

Enfin, les résultats ont montré la contribution de l'analyse géostatistique et la modélisation spatiale pour générer une cartographie numérique précise pouvant constituer un outil d'aide à la décision pour la gestion et la durabilité des terres agricoles dans les régions arides et semi-arides.

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SEVENTY YEARS OF RESEARCH AT THE INSTITUTE OF GEOGRAPHY

DAN BĂLTEANU*

INTRODUCTION

The anniversary of a research institute represents not only a significant scientific event but also an emotional one, it is a moment of synthesis of some research directions and of the activity discharged by a whole generation of researchers whose competence and abnegation have contributed to the present scientific level attained by the respective discipline.

The Institute of Geography came into being on the 6th of February 1944, on the initiative of Prof. Vintilă Mihăilescu, and functioned by the name of *Institute of Geographical Research of Romania*, under the authority of the Ministry of Culture and the Cults. Establishing a national institute of geography was a necessity sustained by Simion Mehedinţi as early as 1925 at the celebration of 50 years of existence of the Romanian Royal Society of Geography. In his words, "It were enough to set up a great **Institute of Geography** for systematised work, associated with the necessary means, to soon bear fruit".

The Institute of Geography is sited in Bucharest and functions in the "Simion Mehedinţi House", donated for the purpose by its owner, Prof. Mehedinţi, the founder of modern Romanian Geography. The place, hosting the National Geographical Committee, and the periodical meetings of all of the country's geographers, has a special relevance for Romanian Geography. The Institute co-ordinates two research teams, one in Iaşi, the other in Cluj-Napoca, and has its own Natural Hazards Research Centre based at Pătârlagele, Buzău County.

In 1994, the Institute of Geography celebrated 50 years since its foundation. The festive session, held in the Romanian Academy's Aula Magna, was attended by outstanding Romanian and foreign personalities who, in their addresses, underlined the significant role played by the Institute's researches for the development of geography in Romania and abroad (D. Bălteanu, 1994).

Among the participants, Prof. Herman Verstappen (The Netherlands), the then Chairman of the International Geographical Union (IGU), took the floor saying: "your celebration marks out not only 50 years of important contributions Romania has made to the Science of Geography, but also the beginning of a new and interesting period of active co-operation and friendship".

In his message sent on the occasion of the 70th anniversary, Prof. Vladimir Kolossov (Russia), the now IGU Chairman, says: "The research made in your Institute covers the majority of present-day geographical domains, the research-workers being involved in major international projects and programmes. IGU gives a high appreciation to its collaboration with your Institute and to the great number of your specialists who participate in the activity of numerous profile commissions".

Throughout its 70 years of existence, the Institute has succeeded in concentrating the major preoccupations of outstanding Romanian geographical personalities, such as Vintilă Mihăilescu, Member of the Romanian Academy and the first director of the Institute of Geography (L. Badea, 1994); Academician Victor Tufescu; Prof. Tiberiu Morariu, Corresponding Member of the Romanian Academy, who led the Cluj-Napoca Geography Team for nearly four decades; N. Al. Rădulescu, Corresponding Member of the Romanian Academy; Professors Ion Conea and Raul Călinescu; the Iaşi Team Professors Ion Gugiuman, Constantin Martiniuc and Ioan Hârjoabă.

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Address occasioned by this Anniversary at the Romanian Academy, in the Aula Magna, October 10, 2015.

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The Institute's research goals, established in July 1944, were aimed at elaborating a scientific geography and a great geographical atlas of Romania, as well as complex regional studies; studies of soil and vegetation degradation; a study of town geography, the process of populating the Romanian Carpathian space, the ethnical and economic consolidation of peripheral regions; the adaptation of economic activities to environmental geographical conditions and the European market demands; the problem of the confederations of European countries; the study of floods, droughts and the rational use of Romania's waters; the traffic on the Danube and the Black Sea; Romania, a land of transition (Revista Geografică, **I**, 1944).

Despite all the efforts made by the communist regime after 1948 to fully subordinate Romanian science ideologically, geographical research within the Institute continued its upward course of development, succeeding each time to overcome the difficult moments and carefully cultivate the traditions of geographical research into the Romanian land and its people (D. Bălteanu, 1994).

In the communist period, research would focus on Physical Geography, on Geomorphology in particular, actually a main research domain of the Romanian geographical school in the past, as well. In addition, the methodological bases of Topoclimatology, Hydrogeography and Physical limnology were being laid, and biogeographical research also went on. Economic Geography did develop, but on the basis of some concepts that proceeded from a false premise, namely the "superiority of the centralised economy versus the market economy", with reference to "the efficiency of agricultural collectivisation and socialist industrialisation", the "planning of localities" associated with the demolition of some rural settlements, etc. Even in those conditions the Institute of Geography was in the forefront of the Romanian geographical movement through the synthesis works authored by its members, who also contributed to the development of branch geography and regional geography. The Institute was also known for the level of the scientific events it was organising.

In his address at the Institute's 50^{th} anniversary, Prof. Dan Rădulescu, member of the Romanian Academy, emphasised that "Romanian geography has proven its vitality", stressing on the necessity for Human Geography, much neglected in the past, to be more developed.

This short presentation covers mainly the post-1990 period, when the Institute was reintegrated into the structure of the Romanian Academy.

THE RESEARCH ACTIVITY

Researches carried out over the past two decades were part of some projects financed by the Romanian Academy, and of projects obtained at national and international competitions.

A new generation of researchers has been formed at the Institute over the past two decades. Their present achievements are quite remarkable, valuable studies being published in national and international volumes and journals.

The Institute of Geography's research programmes are correlated with the priority directions of the Romanian Academy's fundamental research plan, with the EU Danube Region Strategy, with the lines set by the International Geographical Union (IGU), and with the global programmes of climate, environmental and societal change.

The studies included in the Institute's research plan, elaborated by the Scientific Council through consultations with all researchers, are centred on the following issues: the elaboration of atlases and synthesis works on Romania; studies of physical, human and environmental geography of the national territory; the study of natural and technological hazards and risks; the elaboration of GIS-based maps; geographical research of territorial systems dynamics and assessment of local and regional development; geographical research of sustainable development in the light of the "global sustainability concept"; the integrated study of geosystems and the assessment of the environmental quality of protected natural areas. These topics are found also in joint research projects with various domestic and foreign users. The Institute has permanently benefitted from the support of the Section of Geonomic Sciences, Chairman Acad. Mircea Săndulescu, as well as from the leadership of the Romanian Academy represented by Vice-president Acad. Cristian Hera, the co-ordinator of this Section.

Geomorphological research has continued the regional traditional line, the preoccupations for geomorphological cartography and for the genesis and evolution of relief units, also developing new domains underlain by modern methodology and equipment. Synthesis works had in view the relief units, the role of neotectonic movements in the evolution of the relief (L. Badea, 2009), as well as numerous regional geomorphological studies (M. Sandu, 1998; M. Dinu, 1999; Gh. Niculescu, 2008).

The interest shown in the study of present-day geomorphological processes through field experiments and cartography to produce morphodynamic maps, and maps of various processes (sheet erosion, gullying, landslides, river processes) acquired new dimensions with highlight on the interdisciplinary character of geomorphological studies. Within this context, the aim was to assess land susceptibility, the vulnerability of settlements, of infrastructure and of the environment to geomorphological hazards. Correlating these aspects geomorphological risks could also be appraised.

Climatological research covered various theoretical aspects regarding the regional and national meteorological variables, atmospheric pollution and the impact of climatic hazards on society. The publication of some works jointly with researchers from the National Meteorological Administration, as well as Ph.D.-connected activities have revealed a good collaboration potential especially regarding the effects of climate change on both the environment and society.

Previous concerns for the methodology of working out topoclimatic maps on various scales (E. Mihai, Gh. Neamu, 1970; O. Bogdan, E. Teodoreanu, 1973; O. Bogdan, 1980) were continued at regional level, a topoclimatic map of the Danube Delta Biosphere Reserve being elaborated by O. Bogdan in 1999.

Scientific works deal with a wide range of meteo-climatic hazards (O. Bogdan, 2007), excess precipitation (C. Dragotă, 2006), the elaboration of geographical atlases with focus on the climate. At the same time, some of the Institute's specialists participated in climate change projects (D. Micu, 2014).

The geographical study of water resources, a topic of major significance for sustainable development, represents one of the central preoccupations of the Institute's researchers. Water assessments were made in relief units (P. Gâştescu, 2014) and comparative studies covered the Southern Carpathians in Romania and the Stara Planina Massif in Bulgaria (I. Zăvoianu, 1996).

The course of the Danube and the Danube Delta, investigated closely with profile institutions, had in view water circulation in the Danube Delta (B. Driga, 2004), the water balance of some lake complexes, the elaboration of water balance models and the estimation of the ecohydrological equilibrium between the lake complexes and the Danube arms (P. Gâştescu, 2014).

Researches of hydrogeography and geographical limnology in the Romanian Black Sea littoral area and in the Romanian Plain were aimed at appraising the water balance and the levels of pollution.

Biogeographical research had in view the biogeographical dissemination and signification of some plant and animal species, with emphasis on man-induced degradation of vegetation, the reduction of biodiversity and the impact of climate change on vegetation.

Researches into protected natural areas, inclusive of Ramsar and Nature 2000 sites, have revealed their biogeographical importance for the conservation of biodiversity (C. Drugescu, 1997, 1999; C. Muică, 2001).

The geographical study of the terrestrial vertebrate fauna involved some mammalian and bird populations from various areas, the dynamics of certain populations of mammals (S. Geacu, 2007, 2008), as well as syntheses of the historical evolution and origin of the terrestrial fauna in Romania (C. Drugescu, 1995).

Human Geography studies implied the methodological readjustment of the Institute's researchers to current research trends after ideological barriers had been lifted. It meant new bibliographic investigations, access to a big volume of statistical data, and the use of new cartographic tools (B. Mitrică, D. Nancu, 2014).

Several chapters of synthesis works are devoted to the geography of urban and rural population, the population structure by nationality and religion, population density and distinct age-groups at national and regional level. In-depth research into the urban and rural environments emphasised spatial and temporal disparities.

Representative studies deal with the metropolitan zones, with one-industry towns and some urban eco-systems (Târgovişte, Alexandria, Fieni, Bacău, etc.). Human geography approaches the vulnerability of human settlements in different relief units. The Institute of Geography has an old tradition of toponymic research, illustrated by the works of I. Conea, D. Oancea and S. Vlad. Investigations conducted over the past few decades have focussed on regional toponymy, on the standardisation of geographical names, in particular. This line of development is closely correlated with the scientific meetings organised by the late Prof. Victor Tufescu, member of the Romanian Academy.

The two-volume *Dicţionar Geografic al României* (Geographical Dictionary of Romania) published in 2008-2009 and co-ordinated by M. Buza, L. Badea and Ş. Dragomirescu, follows the recommendations of the Conferences of the UN Divisions of Standardisation of Geographical Names. Similarly, the publication of the dictionaries of the counties of Ialomiţa (S. Geacu, 1997), Galaţi (S. Geacu, 2008) and Gorj (D. Bugă, S. Dobre, D. Nancu, 2002) had the same end in view, namely, to put to account Romania's toponymic thesaurus.

The range of Historical Geography was widened with focus on the evolution of Romania's state borders (R. Săgeată, D. Baroiu, 2004), the evolution of some settlements from different regional units and the evocation of certain Romanian geographical personalities (S. Vlad et al., 2000).

Political and geopolitical studies tackled the role and place of Romania within the new European and international geopolitical and geostrategic architecture after 1990, when multi-national states were dismantled, and ethnic and separatist conflicts broke out (R. Săgeată, 2009).

Studies of industrial development in the 20th century, and its subsequent decline in the period of transition in connection with political and economic changes (C. Popescu, 2002; B. Mitrică, 2008) highlighted industrial dynamics, the economic and social effects of deindustrialisation and the development potential of industrial structures in the future; the decline of the urban population, the emergence of regional industrial clusters and the development of innovative industries were other topics of research (C. Popescu, 2014).

In the field of social geography the stress was laid on regional labour disparities and unemployment, social risks and social problems in vulnerable areas, such as the disadvantaged mining zones (I. Mocanu, 2008).

Regional geography studies, carried out under various research projects, were reported in chapters of synthesis works (C. Popescu, D. Bălteanu, 2005), regional works on disadvantaged mining zones (C. Popescu, editor, 2003), the rural settlements of Bucovina (L. Guran editor, 2004) and in synthesis studies as well (R. Săgeată, 2010).

Complex environmental issues, generated by the difficulties and inconsistencies of the post-communist period in Romania, imposed setting up a new section at the Institute of Geography, namely, "Environmental Geography and Geographical Information Systems".

Research themes involved geographical studies on protected natural areas, the man-environment relationship in the light of sustainability, the environmental impact of climate change, the land use-environment relation, and integrated research of complex areas (M. Sima, 2014).

Of special interest proved to be the study of natural and technological hazards at national, regional and local levels, as well as research into the prevention of major risk phenomena on a national scale. Research-work involved interdisciplinary studies of floods and landslides, the elaboration of maps of susceptibility, hazard and risk on various scales.

Several researches had in view the effect of mining explorations and the processing of non-ferrous metal ores on the rivers, as well as pollution sources and the morphodynamic particularities of their transfer and cross-border impact (M. Sima).

TRAINING OF YOUNG SPECIALISTS

The Institute of Geography has five Ph.D. supervisors who direct the Ph.D. candidates in Physical Geography and Environmental Geography. Each year, the Institute organises, jointly with the Faculty of Geography – University of Bucharest, an annual scientific session for Ph.D. and M.A. students; an International Summer School on "Natural Hazards and Sustainable Development in Mountain Regions", now at its 12^{th} edition, is held at the Natural Hazards Centre, Pătârlagele, Buzău County.

Alongside other ten partners from different European countries, the Institute was involved in the Marie Curie European project– CHANGES (2011-2014) regarding the interdisciplinary training of young researchers in hydro-meteorological hazards and associated risks. The project, co-ordinated by Twente University (The Netherlands), evidenced the necessity for permanently correlating the formation of the young generation with the latest methods and techniques in the respective field.

PUBLICATIONS, PROJECTS AND INTERNATIONAL INTEGRATION

The Institute of Geography entertains a close collaboration with the main universities in elaborating fundamental works for Romanian science and culture, e.g.: *A Geographical Monograph of Romania* (1960), *The National Geographical Atlas* (1972-1979), *The Geography of Romania* (a 5-volume treatise, 1983-2005); comprehensive regional studies: *The Geography of the Romanian Danube Valley* (1969), *The Getic Piedmont* (1970); theoretical works and numerous studies in various fields of geography. These works reflect the steady evolution of concepts and methods connected with the traditions of the Romanian geographical school and the progress made by geographical thought worldwide. The analytical foundation of elaborating synthesis works was the result of in-depth branch research integrated into the territory as a whole and of promoting new research directions (Bălteanu, 1994). The findings were published in many Ph.D. theses, e.g. L. Badea, Al. Roşu, Gh. Niculescu, O. Bogdan, I. Zăvoianu, E. Mihai, E. Teodoreanu, H. Grumăzescu, I. Ştefănescu, and in theoretical works, some of them being syntheses (V. Mihăilescu, 1968), or new research directions.

The Institute of Geography has been developing a sustained activity for integrating Romanian Geography in the international sphere. Acknowledging Romania's preoccupations for the problematique of global environmental change, the Co-ordinating Council of the International Geosphere-Biosphere Committee held a meeting in Romania (Sinaia, 2004), emphasising the significant potential of Romanian interdisciplinary research into the environment and society.

Next, the Institute was invited to participate in several projects under the European programmes FP6 and FP7. As a result, in 2006-2009, the Institute was involved in a project on *Climate Change and Variability: Impact on Central and Eastern Europe* (CLAVIER), co-ordinated by the Max Plank Institute for Meteorology in Hamburg. The analyses made revealed the impact of climate change on tourism, energy production and land degradation.

Another project referred to *Building Capacity for a Black Sea Catchment Observation and Assessment System Supporting Sustainable Development* (EnviroGRIDS, 2009–2012), co-ordinated by the University of Geneva (Switzerland), the Institute's task being to assess changes in agriculture and national parks. To this end, environmental assessment indicators were used and a GIS-system to study invasive plant species was established.

The impact of climate change on the agricultural use of water resources in connection with farming land fragmentation in Romania was analysed under the FP7 Project on *Climate change and impacts on water supply*, co-ordinated by the Vienna Mayorality.

The Institute of Geography's team of researchers entailed in the European Project: *Enabling Climate Information Services for Europe* (ECLISE, 2011–2014), co-ordinated by the Royal Netherlands Meteorological Institute, followed the impact of climate variability and change until 2050 in three domains: towns (Baia Mare), agriculture (the Bărăgan Plain) and land degradation (Vrancea Seismic Region). Estimations of environmental quality and natural and technological hazards in a cross-border region, the Calafat-Turnu Măgurele sector (2012–2013), were made jointly with Bulgarian specialists.

Over the past ten years, the Institute of Geography took part in various projects (financed by the British Academy, NATO and the World Bank) on heavy metal pollution of the Danube and the river network from the west of Romania, as well as landslide-related risks across the country.

The projects, financed from domestic sources, referred to the impact of mining on the environment; the transformation of old salt pits into tourist areas; the development of indicators for the management of natural resources; geographical research for the territorial planning of transport networks and GIS systems for the evaluation of hazard maps and assessment of the vulnerability of environment and localities to flooding.

Over the past two decades, the Institute of Geography has entertained relations of collaboration with profile institutions from eleven countries (Belgium, Bulgaria, China, France, Greece, Great Britain, Poland, Republic of Moldova, Slovakia and Hungary) materialised in bilateral projects, workshops and the publication of scientific papers.

A comprehensive international collaboration was aimed at an interdisciplinary study of the Carpathian Mountains, financed and co-ordinated by the United Nations Environmental Programme (UNEP), the result being the *Carpathian Environment Outlook* (2007), a work containing different scenarios on the future evolution of the Carpathian environment and society.

The Institute's researchers have published one-author volumes, especially Ph.D. theses, as well as team works and numerous articles in profile Romanian and foreign journals.

An important work that makes a comprehensive presentation of Romania is *Atlasul Istorico-Geografic*, published in Romanian, English, French and German (two editions: 1996 and 2007).

A volume much appreciated both in this country and abroad is *Romania. Space, Society, Environment,* published in Romanian and English (2005, 2006), which depicts the main aspects of the transition period and of integration into the European Union.

The category of "scientific services", a notion increasingly more used to designate applied research aspects, includes two atlases: 1) *The Enviroment and Electricity Transmission Grid* and 2) *The Soil Quality and Electricity Transmission Grid* (2003, 2004), as well as three volumes (2005 a, 2005 b, and 2006) published jointly with the Ministry of Industry and Resources. These volumes point out the complex impact of the energy sector on the environment and the quality of soils.

Another work on current environmental and shepherding issues in the Romanian Carpathians, correlated with social aspects, is *Changing Social Conditions and Their Impacts on Sheep Transhumance in Romania and Bulgaria* (2010), financed by Japan's Ministry of Research and published in Tokyo, co-ordinator Prof. Kazuko Urushibara-Yoshino.

In 2009, the Institute of Geography organised a Conference of the International Association of Geomorphology in the town of Braşov, part of the papers being issued by Elsevier Publishing-House in the volume *Recent advances in landslide investigation* regarding the topical problems of man-environment relations closely dependent on global climate change.

The Institute of Geography puts out two journals: *Revue Roumaine de Géographie / Romanian Journal of Geography* (two issues / year) indexed in several international databases, and *Revista Geografică* focussed mainly on the Institute's internal life and promotion of young researchers.

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THE ACADEMIC GEOGRAPHY OF TIMIŞOARA AT THE 55th ANNIVERSARY INTERNATIONAL CONFERENCE, MAY 16–17, 2014, TIMIŞOARA, ROMANIA

In 2014, the Geography Department of the Chemistry, Biology and Geography Faculty, West University of Timişoara, celebrated 55 years since the first programme of geography studies in the city of Timişoara was launched, at the History, Geography and Constitution Faculty of the 3-year Pedagogical Institute, founded in 1959.

For the celebration of this special event, the Department of Geography organized an International Conference on *The Academic Geography of Timişoara at the 55th Anniversary*, May 16–17, 2014. The almost 100 scientific papers presented at the Conference were grouped by plenary sessions and 9 thematic workshops attended by over 150 researchers and faculty staff from all the universities in Romania (with Geography studies in the curriculum), as well as from France, Great Britain, Germany, the United States of America, Austria, Spain, Hungary, Serbia, the Republic of Moldova and Armenia.

The event was part of a series of scientific and cultural manifestations organized on the occasion of the 70th anniversary of the West University of Timişoara (founded in 1944).

The Conference was opened in the morning of May 16, 2014, in the Aula Magna of the University, in the presence of the Head of the University, members of the local authorities (the Prefecture and Timiş County Council, Timişoara Mayoralty, etc.), who delivered messages of greetings and granted excellence and honorary diplomas to the Geography Department of the West University. Participants in this event were also the Chief of the University Chancellery, all the Vice-rectors of the West University, the Head of the University Senate, the Chief manager and other members of the administrative departments of the University, many professors of the University, friends of Geography, alumni, retired professors, members of their families, and relatives or descendants of former professors of Alma Mater Timisiensis.

Noteworthy among the guests were Mr. John Webb, Vice-rector for International Relations of the University of Angers, France, Academician Dan Bălteanu, The Chair of the National Geographical Committee; Prof. Mihai Ielenicz, Ph.D., Head of the Romanian Geographical Society; Prof. Ioan Ianoş, Ph.D., Head of the Romanian Professional Association of Geographers and Doctor Honoris Causa of the West University of Timisoara; Prof. Constantin Rusu, Ph.D., Head of the Senate of Al. I. Cuza University, Iaşi; Prof. Laura Comănescu, Ph.D., Dean of the Faculty of Geography, Bucharest University; Prof. Dan Petrea, Ph.D., Dean of the Faculty of Geography, *Babeş-Bolyai* University, Cluj-Napoca; Prof. Corneliu Iaţu, Ph.D., Dean of the Faculty of Geography, *Al. I. Cuza* University, Iaşi; Prof. Alexandru Ilieş, Ph.D., Dean of the Faculty of Geography, Oradea University; Prof. Vasile Efros, Ph.D., Dean of the Faculty of Geography, Suceava University; deans of Geography departments, geography professors, researchers, Ph.D. students, etc. The largest delegations came from Cluj-Napoca (18 participants), Oradea (14), Bucharest (11), Iaşi (8), and from abroad: Novi Sad, Szeged, Angers and Pécs, with 4-8 members each.

The Geography Department of the West University of Timişoara granted excellence and honorary diplomas to prestigious Romanian and foreign geographers for their fruitful collaboration with the Geography Department of Timişoara and for their contribution to the affirmation of the science of Geography.

At the close of the festivity, a 400-page volume *55 Years of Geography at the West University of Timişoara* (authors: N. Popa, M. Olaru, R. Creţan, S. Jucu, P. Urdea, and Gh. Ianoş, with a Preface by Prof. Marilen Pirtea, Ph.D., the Rector of the West University), was launched there. The book put out in 2014 by the West University Publishing House, was presented at the Conference by its scientific reviewers Prof. Ioan Talpoş, Ph.D. and Assist. Professor Mădălin Bunoiu, Ph.D.

At 11.30 a.m., scientific papers and plenary session debates in the Aula Magna were held by Dan Bălteanu (*Romanian Geography – Recent Developments and Future Challenges*), Ioan Ianoş (*The Death of Geography Through the Suicide of Geographers?*), André-Louis Sanguin (*End of Geography or Revenge of Geography? The Human Societies between a Smooth World, a Spiky World or a Flat World*), Pompei Cocean (*Geographical Mental Space and Territorial Cohesion*), Peter Jordan (*Thoughts on a Concept of Language Geography*), Nicolae Popa (*55 Years of Academic Geography in Timişoara: Steps, Options, Certitudes and Utopias*).

The 9 workshops hosted the afternoon papers on the following topics: *Interdisciplinary in Geomorphological Research*; *Critical Toponymy, Collective Memory and Spatial Identity*; *New Trends in Territorial Regeneration*

Rev. Roum. Géogr./Rom. Journ. Geogr., **59**, (1), p. 79–81, 2015, Bucureşti.

Strategies – between Spatial Justice and Economic Reason. Local Answers to the Consequences of Globalisation; *Is Tourism a Viable Solution for Local and Regional Sustainable Development?*; *Human Society between Pollution, Natural or Anthropogenic Hazards and Associated Risks*; *The Dialogue between the Demographic System and the Economic System: Influences, Similarities, Challenges*; *Sustainable Cities*; *Political Territories, Territorial Policies, Limits: More Competitiveness, or Cohesion in the Sustainable Development of the European Space?*; *New Geographies and the Romanian Geographic Curriculum: Reconsideration of the Place and Role of Geography in the Romanian Educational System*.

The second day of the Conference, May 17, was devoted to field trips, traditional in any geographical scientific event. One of the field trips, organized in the Romanian–Serbian cross-border area on the Timişoara–Vrsac–Belgrade and return route, benefitted from the scientific collaboration of the colleagues from the Geography Faculty of Belgrade University. The second field trip, including the Timiş–Cerna tectonic corridor, the Iron Gate and the Danube Gorges, highlighted the geographical complexity of the Romanian Banat.

Several exhibitions, revealing the traditions, contributions and potential of the Geography of Timişoara were also organized on the occasion of this Conference: a profile book exhibition, including major publications after 1990 by the Geography Department members, an exhibition of books and documents from the first period of Geography teaching in Timişoara (1959–1979), an exhibition of maps drawn by 1st-year students of the GIS Masters Program, a minerals and crystals collection of the Geography Department in collaboration with Professors Ion Cotăescu and Mădălin Bunoiu from the Faculty of Physics of the West University of Timişoara, and an exhibition of photographs from Patagonia by geologist Tiberiu Stoia. All these contributed to promoting an image of diversity and unity representative for the Geography Department of the West University of Timişoara.

We consider that the varied range of activities, the quality of scientific papers and debates, as well as the number of participants in this Conference proved the interdisciplinary openness of the Geography Department of the West University of Timişoara, the scientific expertise of its members, creating favourable premises for its future evolution, for the Geography of Timişoara being representative in Romania and abroad. What made the Conference a success is mainly participation in its proceedings. The important number of participants in the debates granted it the academic scope and breadth we had hoped for. Therefore, we wish to express our gratitude to you and expect to have you again in Timişoara at the next editions of the Conference.

Nicolae Popa

110 ANS D'ENSEIGNEMENT GÉOGRAPHIQUE À L'UNIVERSITÉ *ALEXANDRU IOAN CUZA* DE IAŞI ET LA XXXIVe ÉDITION DU COLLOQUE INTERNATIONAL GÉOGRAPHIQUE *DIMITRIE CANTEMIR*, 17–19 OCTOBRE 2014, IAŞI, ROUMANIE

Dans un automne riche de tous les points de vue, la célébration de 110 ans d'enseignement géographique à l'Université «Alexandru Ioan Cuza» de Iaşi pendant le déroulement du Colloque géographique international Dimitrie Cantemir est venue comme un fruit mur et plein d'aromes. En 1904, Ştefan D. Popescu initiait la première Chaire de Géographie, fait qui a été précédé par plusieurs essais d'introduire la géographie dans l'Université pendant la deuxième partie du XXe siècle. Depuis 1904, la géographie a connu une histoire riche avec les empreintes de plusieurs personnalités géographiques: Ion Simionescu, Mihai David, Gheorghe Năstase, George Vâlsan, Scarlat Panaitescu, Neculai N. Lupu, Victor Tufescu, Ioan Şandru, Constantin Martiniuc, Ion Sîrcu, Vasile Băcăuanu, Victor Sficlea, Mihai Apăvăloaiei, Neculai Barbu, Ion Bojoi, Ioan Hârjoabă, Gheorghe Lupaşcu etc.

Le 17 octobre 2014 – L'ouverture du Colloque a eu lieu dans l'Aula Mihai Eminescu de l'Université «Alexandru Ioan Cuza». Pendant deux heures se sont déroulées plusieurs activités: le mot de bienvenu de la part des représentants du Rectorat et de la Faculté de Géographie et Géologie; la remise de médailles anniversaires (110 ans d'enseignement géographique à l'Université Alexandru Ioan Cuza de Iaşi) et des diplômes d'excellence aux personnalités géographiques internationales et nationales. Les représentants des principales facultés de

Géographie de Roumanie (Bucarest, Cluj-Napoca, Timişoara, Oradea) ont donné des diplômes et plaques anniversaires à l' occasion de 110 ans d'enseignement géographique à Iaşi. Le professeur Antoine Bailly de l'Université de Genève, le prix Vautrin Lude (équivalent du Prix Nobel en Géographie), a tenu la première conférence sur *Les nouvelles régionalisations en Europe*, suivi par Jean-Paul Carrière de l'Université Polytechnique de Tours avec *Résilience territoriale et durabilité: le Développement Territorial Durable, une stratégie de redynamisation des territoires ?* Les séances plénières de la première journée du colloque se sont déroulées sur plusieurs thématiques nouvelles auprès celles classiques: Mutations territoriales, développement territorial durable (DTD) et nouvelles gouvernances; Nouvelles gouvernances territoriales; Les territoires du DTD; Petites villes et DTD; Ruralité et DTD; Développement régional et local; DTD, paysage&tourisme; Articulation des politiques publiques sectorielles et territoriales; caractéristiques des territoires et mobilités. Transition post-communiste et crise économique. Manifestations spatiales, impact et conséquences. Dans les 16 séances parallèles de la première journée ont été présentés 108 communications et 9 posters. Parmi les institutions présentes, il faut remarquer: l'Académie Roumaine (Acad. Dan Bălteanu et M.C. Alexandru Ungureanu), l'Université «Babeş-Bolyai» de Cluj-Napoca, l'Université de Bucarest, l'Université d'Ouest de Timişoara, l'Université d'Oradea, l'Université de Suceava, l'Université de Craiova, plusieurs instituts de recherché et universités étrangères.

Le 18 octobre 2014 – la deuxième journée du Colloque et de fête anniversaire géographique a marqué une première partie avec une séance plénière (Bernard Pecqueur – *Le développement territorial: une voie innovante pour les collectivités locales?;* Bruno Jean – *Le développement territorial durable: vers un développement territorial solidaire pour réussir le développement des territoires ruraux;* Ioan Ianoş – *Géographie roumaine et le développement territorial intelligent*) et 7 sessions parallèles (42 communications et 7 posters) et une deuxième partie avec une visite guidée de la ville et de la mairie de Iaşi (bâtiment historique). Dans la soirée, le partenaire principal de cette fête, l'Opéra National Roumaine de Iaşi, a présenté un spectacle en l'honneur de 110 ans d'enseignement géographique à l'Université Alexandru Ioan Cuza de Iaşi. Ce spectacle «Les Troyennes» (après Euripide), avec une mise en scène d'Andrei Şerban, a couronné une fête géographique de grande taille. A la fin du spectacle, le doyen de la Faculté de Géographie et Géologie, Corneliu Iaţu, a remis la médaille anniversaire et le diplôme d'excellence à l'Opéra et au manager de l'Opéra, Madame Beatrice Rancea.

Bilan final du Colloque géographique international du «Dimitrie Cantemir»: 155 communications, 16 posters, 250 participants (dont 50 étrangers de France, Suisse, Canada, République Moldova, Maroc, Algérie, Tunisie etc.).

Le 19 octobre 2014 – la troisième journée du Colloque a été dédiée à l'application itinérante dans le nord de la Moldavie. Les thèmes de l'application ont été: l'héritage religieux médiéval, l'architecture 1900, cuisine moldave, paysages ruraux de la Bucovine, aspects sociaux roumains actuels. Les objectifs principaux ont été: le monastère de Voroneţ; le monastère de Suceviţa, le centre traditionnel de poterie noire de Marginea, le centre historique de la ville de Botoşani.

Corneliu Iaţu

Gérard Joly (2013), *Dictionnaire biographique de géographes français du XX^e^ siècle, aujourd'hui disparus* (Biographic dictionary of today disappeared French geographers of the XX^{th} century), U. M. R. Prodig, Paris, 186 pages, 546 photos.

Fruit d'un long et minutieux travail de documentation bibliographique et d'information directe, l'ouvrage dirigé par Gérard Joly est un outil très nécessaire pour tous ceux qui s'intéressent à l'histoire de l'une des écoles fondatrices de la géographie moderne, école qui s'est développée en parallèle avec les écoles géographiques allemande, anglaise, américaine et russe.

Le dictionnaire a été conçu par un groupe important de collaborateurs (57) et a employé les renseignements fournis par de nombreuses personnalités de la géographie française, certains passées même dans un monde meilleur, comme Max Derruau, Jean Tricart, Pierre George, Michel Phlipponneau, Philippe Pinchemel, Gabriel Rougerie etc.

À l'exception des grands précurseurs du XIXe siècle, dont il ne faut pas oublier Elisée Reclus et Paul Vidal de la Blache, la plupart de ceux qui ont illustré la géographie française ont marqué par leur activité le siècle passé, et cela dans tous les domaines notables de la géographie, que ce soit dans la géographie physique ou la géographie humaine.

Le coordonnateur du livre et ses collaborateurs ont dû manifester une grande impartialité et objectivité pour nous donner un tableau complet de tous ceux qui se sont manifestés dans la vie géographique universitaire française, même si les circonstances politiques ou les raisons de santé n'ont pas permis à certains d'arriver à une finalisation officielle.

Le dictionnaire accorde une attention facilement concevable aux figures de proue de la géographie française et insiste sur le caractère multilatéral de leurs préoccupations scientifiques – Pierre Birot (géographie physique complexe), Henri Baulig (géomorphologie dans la conception davisienne), André Cholley (géomorphologie et géographie régionale), Max Derruau (géomorphologie et géographie humaine), René Raynal (géomorphologie périglaciaire), Jean Dresch (géographie des milieux désertiques), André Guilcher (morphologie littorale), Philippe Pinchemel (géomorphologie, épistémologie de la géographie), Gabriel Rougerie (biogéographie), Camille Vallaux (océanographie, géographie politique), Albert Demangeon (géographie humaine et régionale), Jean Tricart (géomorphologie, aménagement du territoire), Jean Brunhes (géographie humaine, géographie de la France et de la Suisse), Maximilien Sorre (géographie humaine, géographie de la Péninsule Ibérique), Raoul Blanchard (géographie des Alpes, géographie urbaine), Lucien Febvre (géographie historique et sociale), Pierre George (géographie urbaine et politique), Pierre Lavedan (géographie des villes), Pierre Gourou (géographie rurale et tropicale), Maurice Le Lannou (géographie humaine et régionale), Jacqueline Beaujeu-Garnier (géographie de la population et des agglomérations humaines), Étienne Dalmasso (géographie économique), Étienne Juillard (géographie agraire et sociale), Bernard Kayser (géographie des relations ville-campagnes), Jean Labasse (études sur l'espace financier), Hildebert Isnard (géographie du Maghreb), Aimé Perpillou (géographie rurale), Pierre Monbeig (géographie de l'Amérique Latine), Michel Phlipponneau (géographie rurale et appliquée) etc.

Ce qui donne une valeur particulière à la géographie française est le développement de plusieurs centres régionaux de recherche et d'enseignement, centres qui ne se sont jamais senti étouffés par la dominance autoritaire de la capitale et ont su se spécialiser dans des domaines divers, comme Bordeaux (géographie tropicale), Strasbourg (géomorphologie), Grenoble (géographie des Alpes), Toulouse, Clermont-Ferrand, Dijon etc.

D'un autre côté, au niveau international, la géographie française a déposé beaucoup d'efforts pour se tenir au courant avec les tendances modernes parus dans la géographie après la deuxième guerre mondiale, surtout sous l'impulse de la géographie anglo-saxonne, mais aussi par l'activité de certains géographes français en Amérique, comme Jean Gottmann. La participation régulière aux conférences géographiques internationales, l'organisation de nombreuses manifestations pareilles et même la direction de certains organismes mondiaux, comme l'U.G.I., ont permis un contact permanent avec l'activité des géographes des autres pays.

Le livre de Gérard Joly ne néglige pas le rôle des géographes dans la consolidation des relations de recherche et de collaboration scientifique entre les géographes français et la Roumanie. Evidemment, le rôle fondamental dans cette direction a été celui d'Emmanuel de Martonne, qui a passé ses deux thèses de docteur avec des sujets sur la Roumanie, après de longues années de travail sur le terrain, qui a orienté vers l'étude des problèmes géographiques roumains plusieurs de ses élèves (Robert Ficheux et Geneviève Vergez-Tricom, ces-ci ayant aussi enseigné en Roumanie, André Nordon, François Weymuller et Odette Girard), a facilité la spécialisation en France de certains géographes roumains et a organisé les excursions géographiques à travers la Roumanie qui sont devenues la source d'information pour le chapitre consacré à la Roumanie du tome IV de la

Géographie Universelle. On n'oublie pas de mentionner le rôle considérable joué par Emmanuel de Martonne, Bertrand Auerbach et le jeune démobilisé Georges Chabot, en tant que membres du Comité d'Études auprès de la Conférence de la Paix de Versailles, pour tracer les nouvelles frontières, correctes, de l'Europe Centrale.

Parmi les autres géographes français qui se sont préoccupés des roumains, on n'oublie pas Jacques Ancel, auteur très bien informé des *Peuples et nations des Balkans* (1926).

Dans les premières années d'après la deuxième guerre mondiale une relative froideur est intervenue dans les relations politiques et scientifiques entre la France et l'Europe de l'Est, mais après le dégel de 1955, une nouvelle génération de géographes français a manifesté son intérêt pour la Roumanie. Une contribution essentielle dans cette direction fut celle d'André Blanc, bon connaisseur des problèmes de toute l'Europe du Sud-Est, collaborateur avec Pierre George, Henri Smotkine et Ion Şandru aux *Républiques socialistes d'Europe centrale* (1975) et auteur du livre au titre significatif *La Roumanie – le fait national dans une économie socialiste*, paru la même année. Comme autrefois Emmanuel de Martonne, André Blanc a dirigé vers la Roumanie l'intérêt de certaines de ses collaboratrices. D'autres travaux, de moindre ampleur, sont dues aux géographes français orientés politiquement vers la gauche, comme Pierre George ou Jean Suret-Canale.

Le livre est richement illustré, avec de nombreuses photographies, systématiquement ordonnées en 10 chapitres thématiques. Certaines de ces photos, inconnues en Roumanie, sont pour nous d'un intérêt réel, comme celles montrant Emmanuel de Martonne et Robert Ficheux dirigeant une excursion dans les Carpates Occidentales, ou bien Robert Ficheux devant la Faculté de Médecine Vétérinaire de Bucarest, ou il était hébergé etc. Un bref chapitre introductif et des annexes intéressantes accompagnent le texte proprement-dit du livre – une chronologie générale et presque complète de tous les géographes inventoriés, un index des personnes reconnaissables figurés sur les photographies etc.

Un ouvrage très utile pour une future histoire de la géographie et un exemple de travail consciencieux et rigoureux.

Alexandru Ungureanu

Sorin GEACU (editor) (2014), *Bibliografia lucrărilor ştiinţifice ale membrilor Institutului de Geografie, 1995–2014* (A Bibliography of scientific productions by the members of the Institute of Geography, 1995–2014), Edit. Universitară, Bucureşti, 265 pages.

On the occasion of the 70th anniversary of the foundation of the Institute of Geography, a Bibliography of the research results obtained over the past 20 years has been issued. It contains 3,567 titles published by the authors (in alphabetical succesion, but also in chronological order). The seven chapters of this work are: I. Books and dictionaries; II. Chapters introduced in volumes; III. Articles included in periodicals and volumes; IV. Works published in abstracts volumes; V. Maps and guides; VI. Anniversaries, Commemorations, Evocations; VII. Miscellanea. The Bibliography ends with an authors' index.

Althrough the period covered is not particularly long, yet the scientific results published by the Institute of Geography members are quite remarkable. The aspects approached come from all Geography branches: Geomorphology, Climatology, Hydrology, Phytogeography, Zoogeography, Soil Geography, Environmental Geography, Toponymy, Historical Geography, Population Geography, Geography of Human Settlements, Economic Geography, Geography of Tourism, Theoretical Geography, History of Geography, Cartography and Geopolitics.

The ordinary succession of published works reveals the wide diversity of scientific interests, combining traditional works with approaches to new, interdisciplinary research directions.

The volume, basically an efficient tool not only for profile specialists, combines tradition with continuity, representing also a necessity in the conditions of the current informational explosion.

The Bibliography is useful both to geographers and to workers from scientific areas Geography interrelates with, e.g. the Natural Sciences, the Socio-Human Sciences and the fields of engineering.

Monica Dumitraşcu

Radu Săgeată (2014), *The urban systems in the age of globalization. Geographical studies with focus on Romania* (Sisteme urbane în perioada globalizării. Studii geografice centrate pe România), Lambert Academic Publishing, Saarbrücken, Deutschland/Germany, 14 chap., 91 figs, 256 pages.

This English language volume, intended to a foreign readership, analyses the impact of globalizing fluxes on the Romanian urban system in the conditions of transition from a central-based economic, pyramid-like system, to an economy underlain by free competition and participative democracy. In this respect, Romania is typical of the entire Central and East-European space emerged from under the Soviet-type political-ideological and economic influence and assuming the European and Euro-Atlantic structures.

The fourteen chapters of this work, representing as many facets of this impact, are introduced by a technical methodological section discussing the key concepts of the studied domain, e.g. globalizing cores and fluxes, globalization-urban systems relationships, development between the economy and culture – a component of sustainable development, as well as the concept of 'cosmopolitan city'.

Since the intended foreign readership is not very familiar with the particular aspects of Romania, the author begins with a presentation of strengths and weaknesses induced by three major geographical landmarks: the Carpathian Mountains the River Danube and the Black Sea (*Chapter One*). Furthermore, he presents the main geostrategic assets of this country within the new, post-1989, architecture of Europe: Romania, a state of European cross-roads, a possible emerging hub in the future and, last but not least, a factor of regional stability. The end section of this chapter discusses the historical and geopolitical background against which the present-day borderlines of this country had been traced, generating disparities between the political and ethnical frontiers, the respective minorities subsequently contributing to cross-border to cooperation.

Chapter Two goes on the same general line of approach, this time shifting the analysis from political frontiers to administrative bounds, with insights into the mediaeval administrative-territorial structures the counties of to-day are based on, the succession of regional structures in the territory of Romania, and the main post-1989 proposals for the country's regionalisation. In the author's view, an alternative solution, detailed out and argumented (*Chapter Three*), would be the administrative delimitation proceeding from towns with polarising functions and their functional relationships in the territory.

Chapter Four assigns towns in Romania the role of antrepreneurial initiative and inter-communal co-operation, discussed from both a historical perspective and its topicality, given the growing importance of local communities as actors of territorial governance.

The gaps between the local cultural heritage, embodied in traditional products and in products of global cultural consumption, which tend to blur asperities, but also cultural individuality and try to oust traditional products (*Chapter Five*) through lower prices and aggressive marketing.

Chapter Six familiarizes the foreign reader with the particularities of the Romanian urban system shaped by the permanent action between processes of fragmentation, materialized by the numerical multiplication of towns in the territory, and processes of integration, visible in the formation of ever larger zones of influence that underly the emergence of regional structures. This scientific approach continues in *Chapter Seven* which dwells on the interaction between the two processes (fragmentation and integration) in the built-up area of Bucharest, Romania's capital-city and of its zone of influence.

Chapter Eight focuses on industry, a town-generating factor, the importance of this sector for the central-based economy of Central and Eastern Europe, and the regional disparities of industrialization. The author undertakes a detailed analysis of the correlation existing among political decisions, industrialization and urbanization, exemplified by Romania's iron-and-steel industry, one among those benefitting from major investments during the centralized economic system.

The industrial decline that followed the year 1990 and the solutions of spatial reconversion after unsuccessful privatizations, generalized negligence and corruption, the desire for fast-gaining profits manifest at all levels, are topics discussed in *Chapter Nine*. Services, primarily commercial activities, less developed previously, are seen to fill in the place left by the declining industry.

Another consequence of the above phenomenon is expounded in *Chapter Ten* devoted to the new ethnical minorities and their impact in the territory, especially in the large cities. Thus, the changed ethnical composition is reflected in urban segregation and physiognomy, which bears the cultural mark of these population, a defining feature of the cosmopolitan brand of large cities.

The discussion on urban physiognomy goes on in *Chapter Eleven*, this time with reference to the political factor which, in certain historical periods, filters globalizing fluxes, allowing for their selective penetration represented by certain cultural models visible in some characteristic architectural layers of the building stock.

The next two chapters (*Twelve and Thirteen*) deal with the complex problematique of peripheral areas and the role of globalizing fluxes in stimulating cross-border co-operation, as well as similitudes and disparities between Euro-regions in the West, Central and Eastern parts of Europe, particular aspects on euro-region set-up at Romania's borders. The role of doublet settlements in directing cross-border co-operation fluxes is illustrated by the cross-border co-operation euro-regions existing at the EU eastern frontier.

The *last chapter* of the volume follows on the same line of cross-border approaches with highlight on transborder natural hazards, exemplified with case-studies of flooding episodes in Romania and in its neighbour states over the last ten years, having in view that much of Romania's frontiers (1,817 km, that is 57.7% of their total length) run along watercourses.

Looking at the complexity of this volume, *The Urban Systems in the Age of Globalization. Geographical Studies with Focus on Romania* represents a work of reference for contemporary Romanian Geography, warmly recommended to both specialists and the general readership abroad

Bianca Mitrică

Virgil Gârbacea (2013), *Relieful de Glimee* (The Glimee landforms), Presa Universitară Clujeană, Cluj, 258 pages, 56 figs, refers., summary in English.

Geomorphological evidence and fundamental research in general are known to be the necessary solid ground for establishing effective land utilization. The present book integrates itself into promoting good practice and effective land use by offering the geomorphological base for potential solutions.

The book entitled *The Glimee landforms* (in Romanian) of Professor Virgil Gârbacea represents the crown of his decade-long work devoted to the research of this kind of relief, especially in the Transylvanian Tableland, at the same time incorporating a wide range of studies (papers, PhD theses, maps, etc.) of other researchers who tried to decipher various aspects of this particular kind of environment. The aim of the work, as stated by the author, is to delimit, both from a scientific and a practical view point, a particular type of relief, in order to determine the optimal land use.

The term *glimee* is defined as massive landslide processes which affect both the shallow deposits and the rocks beneath on a depth of tens of meters. The resulted forms range from simple mounds or long ridges to large areas of complex morphology (a multitude of positive micro-landforms, tabular landforms and longitudinal depressions, sometimes with micro-depressions containing wetlands or small lakes, and transversal depressions). Being used in many regions of Romania, the term *glimee* was adopted by the IGU, on the occasion of the International Congress of Geography held in New Delhi (India) in 1968, and introduced in the international vocabulary for defining this particular process and the resulted forms.

The work refers to old *glimee* landforms, assumed to have formed in Late-Glacial and Holocene (up to the Sub-Boreal) and having larger sizes than the morphologically similar, but more recent landslides. This type of landslides has a high frequency and imposes a specific geomorphic landscape on large areas in the Transylvanian Plain, the southern part of the Hârtibaciu Tableland and the Moldavian Plain, still without completely missing in other units.

A large introduction chapter presents the variety of geographical names and terms used throughout Romania for the various issued and evolving microforms. It also puts the *glimee* landslides in relation to the various landslide classifications existing in Romania, in different other countries or functioning at an international level.

The book makes an in-depth geomorphic analysis of the *glimee* relief, covering all aspects referring to: their position on slopes and integration in the general relief evolution, morphography and morphometry, favorable conditioning factors, morphodynamics, geomorphic processes shaping them after their formation, their age and potential triggering causes.

After the general analysis, the regional aspect is synthesized for the main *glimee*-affected regions of Romania (The Transylvanian Tableland, The Moldavian Tableland and others) and also detailed *glimee*-cases are presented based on the existing researches.

The book gathers a large amount of research experiments and results from a series of authors, critically discusses them and attempts to form a coherent view on the *glimee*-type relief. It is worth mentioning that the author, Prof. Virgil Gârbacea, sometimes avoids formulating a conclusion and leaves room for future research and interpretation of the methods and results.

An important chapter is the concluding one, which highlights the variety of local geographic conditions which have to be carefully taken into consideration for the purpose of the sustainable use of the land in agriculture. The applied interest of the *glimee* landscape is discussed, given the high frequency of this type of relief especially in the Transylvanian Tableland. The author underlines the need for a detailed investigation of the local conditions which are considered essential in an applied research, even for the analysis of the local geodiversity at a micro-scale and the need for an interdisciplinary study of the issuing micro-environments, with the aim of differentiating a multitude of "shade" conditions primarily depending on the relief. It is also pointed out that the geomorphic observations mainly conducted upon the Transylvanian *glimee* can be of use in the study of such landslides in other parts of Romania. An important tool is assigned to the geomorphologic mapping, as well as the mapping of other physical conditions (hydrological, soil, phenology of the natural vegetation, etc.).

Marta Jurchescu

Radu Săgeată (coord.), Daniela Nancu, Bianca Mitrică, Mihaela Persu, Nicoleta Damian, Claudia Popescu, Irena Mocanu, Ines Grigorescu, Liliana Guran, Paul Şerban, Dragoş Baroiu (2014) *Euroregiunile de cooperare transfrontalieră din Bazinul inferior al Dunării. Studiu geografic* (Cross-Border Euroregions in the Lower Danube Basin. Geographical Study), Edit. Academiei Române, Bucureşti, 339 p., 48 tables, 130 figs., refers., summary in English.

This work, elaborated by a research-team of the Romanian Academy's Institute of Geography, is the result of the participation of this country in the *EU Strategy for the Danube Region*. The main purpose of writing was to point-out and analyse cross-border co-operation potential, as well as Romania's development characteristics and opportunities in the region and in Europe.

The six chapters of the book discuss the theoretical-methodological framework of trans-border zones and of cross-border co-operation Euroregions, the mutual relationships established among them in the course of time, the role of human settlements in shaping these relations, and the particularities of the cross-border co-operation structures Romania is part to. In order to illustrate the above, a comparative case-study has been undertaken between the Euroregion system at the east German frontier and that at Romania's frontier, both falling into the category of asymmetric Euroregions.

The central body of this volume, also the most comprehensive one (Chaps. II, III, IV and V), is devoted to the many-sided analysis of the cross-border co-operation potential and to the system of cross-border co-operation Euroregions at the frontiers of this country, with highlight on the historical, ethnical, demographic and socio-economic particularities of cross-border administrative units. At the same time, several Euroregions and cross-border convergence areas, considered to be relevant for each transfrontier zone Romania is part to, represent case-studies analysed in great detail.

The last section of the book looks at Romania's maritime frontier, the geostrategic and geo-economic inter-conditionings in the Black Sea Basin, as well as the advantages for Romania's geographical position as energy hub in the transport of hydrocarbons from the Caspian Sea to the European Union.

A long list of bibliographical references and a summary in English are appended.

By its structure and the wealth of latest information, the book is recommendable to a wide readership – specialists, teaching staff, students and the public at large interested in the dynamics of the cross-border areas Romania is part to, especially in the current geopolitical and geo-economic context.

This achievement is the outcome of a research-theme on the *Geographical Study of Euroregions and Cross-border Co-operation potential in the Conditions of Romania's Integration into the European Union*, included in the research plan of the Romanian Academy's Institute of Geography, 2007–2011.

The contents of the book fall in line with the EU major research and innovation programme *Horizon 2020* and the *Strategy of territorial development of Romania 2035*, a strategic document guiding development processes in the territory in the light of local evolutions, of prospective trends for the year 2035 and of European territorial development targets.

The data used rely mainly on the Population and Housing Census, October 20, 2011, the statistical databases: TEMPO-Online (National Institute of Statistics), EUROSTAT, the Chamber of Commerce and Industry of Romania, and on the latest censuses in neighbouring countries.

Elena Ana Popovici