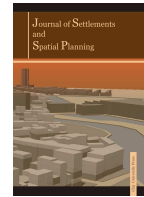




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Dynamics of the Structuring Vectors of Geographical Landscapes in Bucovina, Romania

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ABSTRACT

The paper analyses the vectors of geographical landscapes dynamics of Bucovina, following an appropriate model in Soloneț basin, located at the morphological contact between the mountain area of Obcina Mare and Suceava Plateau. The territorial evolution is analyzed through multiple structural factors and causalities, synthesized in the structural elements of geographical landscapes of Bucovina. During the period of 1772-2013 under analysis, it is also revealed that the process was influenced by functional developments recorded particularly after the installation of the Austrian administration (1775-1778) and has continued until today, by the succession of economic cycles. Highlighting the complex process of landscape changes in Bucovina completes a series of studies carried out previously and, discusses the need for mapping data corroboration with the functional developments geographical space, expressed synthetically by spatial structuring elements of landscape dynamics. Throughout the 240 years, the structural and functional changes in Bucovina are materialized in the basin of Soloneț through a landscaping dynamics vectors, differentiated through the structural quality of geographical space, The determined functional role of structuring factors in territorial shaping and were represented by: the villages cores, forests, mining and communications. Differentiation of meanings and dynamics of landscape orientation structuring vectors, corresponding to each economic cycle materialized in Bucovina.

1. INTRODUCTION

The development of economic activities in a region such as Bukovina has been conditioned by a series of social and historical processes reflected territorially at the level of geographical landscapes [1].

From 1775 to 1918, when Bukovina was a duchy of the Austro-Hungarian Empire [1], [2], there was a sequence of economic cycles typical of mining, of logging and of soil utilization for agriculture, taking place in separate or overlapping periods, across most of the province or only in certain areas, depending on accessibility, construction of roads and subsequently railway [3a].

Obviously, this succession of favouring factors and conditions reflected on the social relationship component in the area and on the organisation of space and of the geographical landscape.

The present analysis focuses on a territorial subcomponent of Bukovina, the river basin of Soloneț river, covering an area of 210.7 sq. km., where two categories of subunits combine, i.e. Obcina Mare (the Great Ridge) to the west, and the piedmont Plateau in the centre and east of the basin, these latter two being the major subunits of the greater Suceava Plateau (fig. 1). The analysis of the structural components of geographical landscapes provides the capacity to underscore the physical-geographical or organisational characteristics of the geographical space which have served as factors of the geographical landscape and which, obviously, have a proven status as vectors of spatial dynamics [4]. Among these, we may also include accessibility - roads, genesis and development of villages, forests, and mineral resources, namely salt, which, sequentially, acted as structuring elements of territorial dynamics [5].

The questions that arise deal with the key elements that were fundamental to the evolution of geographic landscapes, the structuring elements which generated such dynamics, and, especially, the structural vectors of the geographical space [10].

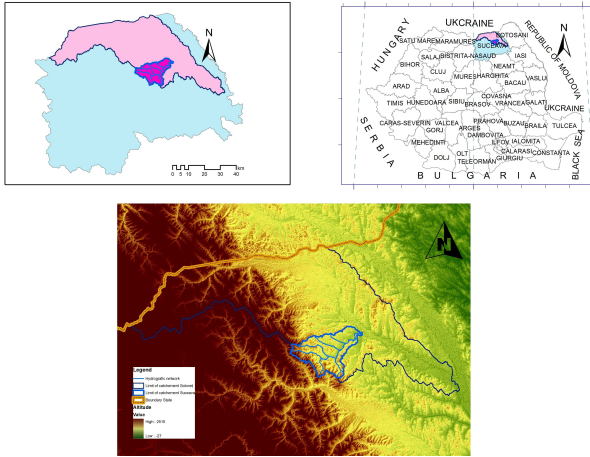


Fig. 1. Location of the Soloneț basin.

The hypothesis of our study was to identify the structural elements of the appropriate territorial system Soloneț Basin to support the geographical landscape typology and structure their vectors. The stated goal of the present study is to identify the structuring vectors that contribute to the dynamics of the landscape, and how they have evolved, in what direction, in what manner and with what force, according to the sequence of business cycles and human resource dynamics, the reflections of these vectors territorial in emerging landscape hubs or axes and lines generating the supports for subsequent developments of geographical landscapes. Among the goals of the study we also aim to solve, at least partially, the matrix dilemmas of landscape dynamics, among the physical and geographical coordinates of space: river network, morphological contact, forests and pasture areas, with the anthropogenic coordinates of space, such as: salt mines, expanding human habitat and the emerging communications networks.

2. THEORY AND METHODOLOGY

Employing a multi-criteria analysis of the role of the structural components of the landscape for each era/period of economic cycles under review, the paper has two key aims: on the one hand, the interpretation of various cartographic sources (i.e. Iosefina topographic Military Survey 1772 [7], the Austrian Die Dorf Bukowina maps of 1856 [8], the Austrian maps from 1900, compared with 1982 cadastral plans, at 1-5,000 scale [9] and orthophotos from 2012 [9].

Furthermore, the paper seeks an appropriate interpretation of the references on the genesis and development of the network of settlements in the basin

[1] and of other recent bibliographic sources, containing direct references to the above-mentioned geographical area [2], [13], etc.

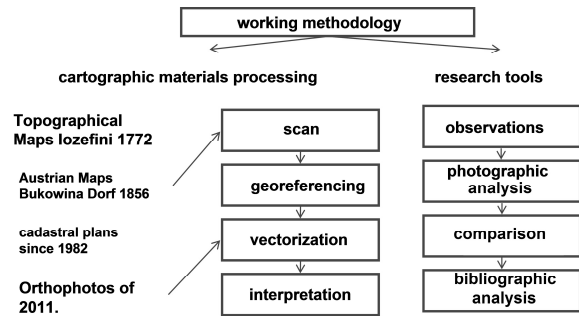


Fig. 2. Working methodology.

The cartographic material was processed using ArcGIS 9.3 software, in order to achieve geodifferentiation of maps, vectoring of main elements, forming of rasters and collecting vector data and exporting them into Excel or .jpg format.

Field observations from the whole surface of the basin have proven to be important in identifying the major structuring lines of geographic space, playing a role in drawing three-dimensional vectors as part of a complex relationship in a synergy of geographical space, the forests, the villages and the roads.

The methodology was not confined to elements of overlays of maps from different eras, with surveys dating back to over 240 years, rather it also sought to identify on the ground the nodes of the different networks that leave an imprint on the geographic space, such as: the correlation between road networks and mapping networks, between settlement networks and forest borders, or of networks generated by salt mining at Cacica and the footprint of his industrial dimension on the basin, in order to highlight the role of specific 19th century economic cycle in the concurrent or subsequent development of geographical landscapes.



Fig. 3. North perspective of Soloneț Basin, of the western morphological contact between Obcina Mare and Moldavian Plateau.

The physical geographical contact generated a series of development arguments, through the complementary resources favouring rural development. The peripheral nature of these resources in relation to the position in the basin is relevant in particular for the status of this geographical space at the passage from Suceava Plateau to the mountainous area of Obcina Mare (the Great Ridge), (fig. 3). The forest also played a particularly important role over time, among others not only as a source of firewood, but also because, within the synergy of the area's development, logging was linked to mining development. Indirectly, over time, the forest influenced the development of the river network and made an important contribution to the regeneration of more or less anthropogenic landscapes [4].

The changes at the level of multiple contact points (morphometric, morphological, biogeographical and anthropogenic or anthropogenic landscapes) occurred at different rates, their coordinates being the space-time and scaling developments [3], [4]. To the detriment of nature and forest area, changes produced sequences of vegetation, as a result of climate change, and on the second level, as a result of forest area management aimed at maximising benefits during the succeeding economic cycles in the region [1a], therefore with an anthropogenic role in the dynamics of space [4], [11].

A key role of in the changing forest landscape was the dynamics of forest landscapes following the implementation of the geographical space reorganisation laws (Law 18/1991 or Law of 2000-2001) [12].

The challenges faced in addressing the theme are related to the fact that the temporal and spatial dynamics of the geographical landscape determine, more often than not, not only irreversible changes but also substantial changes in both structural and functional terms, generating, eventually, new landscapes and modifying existing ones, which results in an overlap that is difficult to distinguish the precise time of the events and the area of the initial core of developments in the current landscape [10], [5].

In various works subscribing to the traditional approach to landscape dynamics we can observe an overlap of the theme with the development of land utilisation [5], [12], [14]. From the outset, we should state that the two concepts converge or unfold in adjacent manner, with a relative overlap to the extent that geographic space, generated by the structural and functional evolution, remains the source for new geographical landscapes can thus be redefined as the structural elements of geographical space.

The organisation of traditional activities follow spatial and temporal evolutions in which inter-specific relationships are established in terms of land use depending on the degree of utility and the needs of the community [6].

Many perceptual tests recommended for the analysis of territorial developments and thus the dynamics of landscapes, such as implemented methodological [18] was complemented by correlating evolutionary elements with dynamic functional mapping, in order to identify relationship of the landscape with development as right representation of the rural territorial systems dynamics.

Another point of difficulty consists in identifying the dynamics of the structuring elements of Soloneț Basin and pinpointing its particular role in the whole region of eastern Bucovina. On the other hand, another difficulty was the decryption of the evolutionary mechanisms of the geographical landscapes in connection with the previously mentioned structuring elements, which we consider to be fundamental for the analysis of the vectors of landscape dynamics [3], [5].

3. RESULTS AND DISCUSSION

The traditional analysis of the dynamics of the landscapes in the area under investigation, i.e. Soloneț basin, brings out three types of landscape dynamics, (Figure 4):

a). Slightly modified landscape, corresponding mainly to the upper basin section, stretching between the peaks of the Obcina Mare, in the unincorporated areas of villages Runcu, Maidan, Solonețu Nou, Pleșa, Cacica, Vârfu Dealului and Vârvata, featuring higher altitudes in the basin, at 600-900 m, with predominantly regenerated or natural forest landscape and is furthermore found in the northern unincorporated area of Todirești village, in well-preserved forest areas.

b). Moderately modified landscape, in the upper basins of the rivers Soloneț, Vârvata and Maidan, and on the right side of the river Soloneț at altitudes between 500-600 m. In these regions, deforestation has led to current geomorphologic processes, ranging from landslides to the manifestation of torrents, marking, overall, the contact area between the other two types of landscapes affected by the dynamic (slightly modified and extensively modified). The positioning of the moderately modified landscape along the contact alignments between the inter-fluvial peaks and the floodplain areas, at the level of high-energy slopes or along the reverse cuesta slopes – the basin of Cașvana - confirms the possibility of tracing the vectors of the dynamics of geographical landscape from the valley to the ridge.

c). Extensively modified landscape unfolds at an altitude between 300 and 500 m and includes the built-up areas and their proximity, especially in areas that have undergone successive conversions from natural to anthropogenic, in the period from 1772 to 2011, a conversion which impacted the natural forest and pasture areas and resulted from the expansion of

the human habitat and the development linked to salt mining.

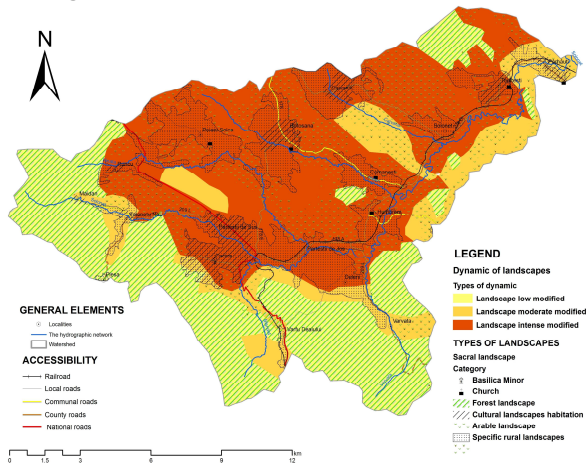


Fig. 4. Map of the dynamics of geographical landscapes and of landscape types.

3.1. Types of landscapes

The main types of geographical landscapes existing today in the Soloneț river basin are: forest landscapes (with different roles and types of habitats and biodiversity), the habitation cultural landscape (those parts of the village that retain the organisational elements of a convergent rural area, mixed cultural, Romanian and Austrian), and the landscape specific to dissociated countryside housing, sacred landscape and agricultural landscape [10], [18].

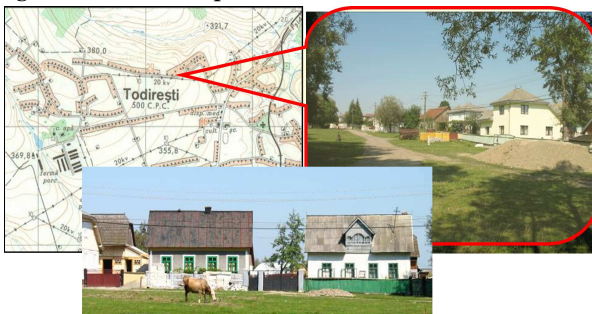


Fig. 5. Todirești village - types of different rural cultural landscape.

Forest landscape covers the slightly modified landscape type, where the structuring element is the forest, yet with difficult to perceive changes as regards its structure and composition.

The habitation cultural landscape overlaps built-up village areas, forming territories with a strong footprint of the communities that inhabited them and is visible in all areas, but mostly in Cacica, Pârteștii de Sus, Runcu, Solonețul Nou, Botoșana, Cajvana, Todirești and Pârห์ăuți.

The sacred rural landscape is defined by the values of cultural heritage, which became more diverse owing to the cultural infusion during the Austro-Hungarian occupation: Catholic sacred landscape

represented by the Greco-Roman basilica of Minor and the Lourdes grotto in Cacica and the Orthodox sacred landscape reflected by outstanding architectural ensembles, part of the national cultural heritage, such as the church dedicated to All Saints' Sunday in Pârห์ăuți, the wooden churches in Todirești (1781) and Pârห์ăștii de Sus (1779) dedicated to the Holy Archangels Michael and Gabriel, wooden church the Assumption in Comănești (1772), the wooden church St. Dimitrios in Botoșana, built in 1810.

Agricultural landscape accompanies the habitation and forest landscapes, occupying most of the Soloneț basin area and used to be one of the landscapes with a strong dynamic and rapid expansion in the 18th and 19th centuries. At the first impact with the rural space, the landscape gives a touch of originality to all the elements that define the mental space in the Soloneț basin.



Fig. 6. House of traditional architecture in Cacica.

The traditional approach is complemented by the contemporary approach, which is based on a multi-criteria analysis of the geographical landscapes and crosschecking it with the sequence of economic cycles unfolding in the basin. The analysis that we performed regards the types of landscapes and especially the on spatial-temporal dynamics delivered the following categories of structuring elements of geographical landscapes, to which correspond, to a relative degree, the structuring vector of landscape dynamics.

3.2. The structuring elements of landscape

Discussions on the structuring nature of the landscape involve identifying those traits that have favoured or conditioned in advance a certain type of dynamics of geographic landscapes. From this point of view, the morphological contact between the two types of units and the river network of Soloneț Basin serve as conditions of landscape dynamics, while the favouring factors of landscape dynamics include: the forest, salt mining, road and accessibility expansion, human habitat and its functionality, playing the role of

structural elements and favouring factors of the dynamics of landscapes.

3.1.1. Contact morphology as a structuring element of landscape

Overall, the basin has a west - east orientation and, gradually, towards the east, its surface tapers towards the convergence of the rivers and Suceava. From this perspective, the Soloneț river basin is shaped as an amphitheatre widely opened towards the east, with the greatest heights (750 m) near the villages of Runcu and Maidan and over 660 m near the villages of Solonețu Nou and Pleșa. The structuring character of the dynamics of the landscape, through the morphological contact unfolding on the eastern slopes of the Obcina Mare peaks and the depressions of Cacica and Solonețu Nou in the piedmont plateau is linked to the complementary role of resources in the two subunits (wood, building materials, agricultural land), and the role that these contact alignments have played in terms of the development of the towns along it.

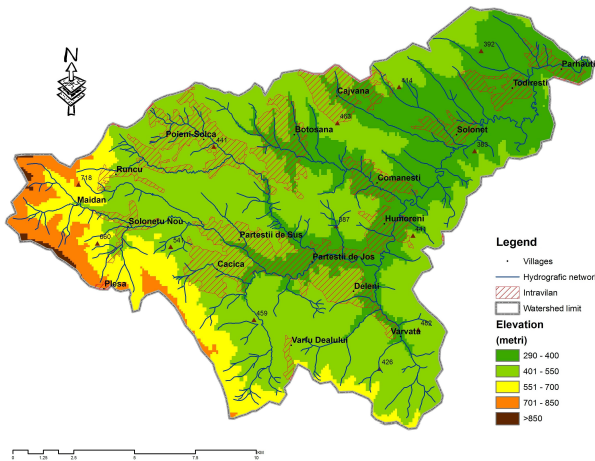


Fig. 7. Basin hypsometry and built-in areas.

Moreover, such contact played a structuring role in landscape dynamics owing to the manner in which the main lines of retreat or advancement of geographical landscapes played out in quasi-perpendicular fashion onto the alignment [18], [17].

3.1.2. The river network as a structuring element of the dynamics of the geographical landscape

In agreement with the asymmetric development of Soloneț river basin, due to the regressive pushing of its course towards the southwest and, gradually, of the mid and lower Soloneț to the east, thus extending the left tributaries, favoured a different dynamic of forest and agricultural landscapes, as follows: marked, on the slopes of Oșoi river, to the right of Soloneț river, and mitigated, due to the action of the

river network, at the level of cuesta reverse on the left of the Soloneț river course. To a large extent, this structuring typology of the dynamic, must be seen from another perspective too, namely in view of the creation of successive, emerging, lines, of landscape dynamics through the action of the river network, between the river convergences in the middle and lower river basin.

On the two slopes of the Soloneț river basin, the river system has had different roles as regards the dynamics of the landscape. The eastern slope experienced a strong dynamic, as evidenced by current processes on Osoi hill, whereas the slopes on the left of the Soloneț underwent complex landscape dynamics, from moderate to pronounced, due to the structuring role played by the left tributaries of the Soloneț.

3.1.3. The forest as a structuring element of the dynamics of the landscape

The most significant deforestation in the Soloneț basin occurred between 1772 and 1856 [12]. The forest area decreased substantially from 155.4 sq km to 76.6 sq km.

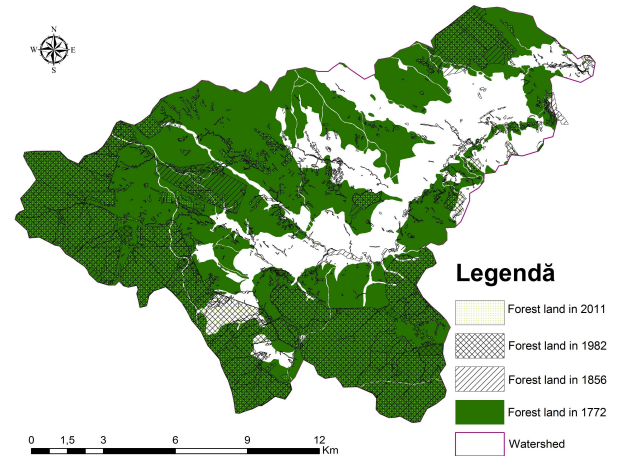


Fig. 8. Evolution of forest land between 1772 and 2011.

The main causes that determined this dynamics of forest landscape must be traced back to the change in government through the annexation of Bucovina to the Habsburg Empire [15], the logging of beech to obtain Illyria ash (used in glass industry), salt mining in Cacica and, most importantly, the expansion of farmland in the new villages that were established after 1800 [16]. The areas that formerly had been covered by forests and became gradually farmland were affected by landslides, amid potential energy of slopes and entered the specific cycle of dynamic vectors of geographical landscapes in the vicinity of built-up areas, especially in the centre and east of the basin [17], [15]. Comparative analysis and georeferencing of land use maps, between 1772 and 1856 gradual withdrawal in certain alignments of forest areas to the benefit of agricultural areas can be observed, with the surface of

the latter increasing from 27.1 sq km in 1772 to 68.4 sq km in 1856, hence a doubling of the areas, while built-up areas increased from 1.2 sq km to 1.7 sq km during the same period, following the establishment of new localities: Runcu, Solonețu Nou, Cajvana.

In analysing the forest land area, we considered necessary to subdivide the Soloneț basin into 4 sectors, corresponding to the different energies of the relief and the relationships with networks of localities.

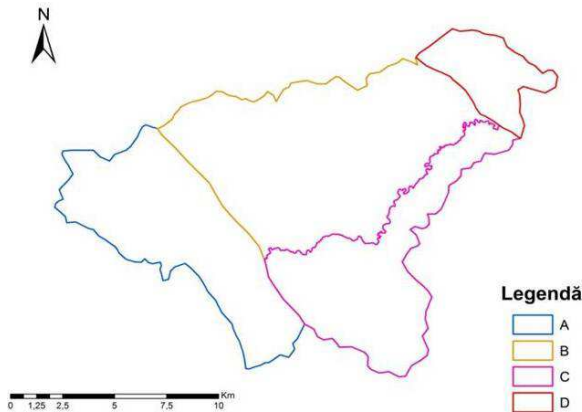


Fig. 9. Subsectoral division of forest dynamics.

By analysing the three major periods, based on successive analogies, we were able to decipher the rate of the dynamics of forest landscape over a year, yielding the following findings:

Sections/ Forest dynamics rate over one year	1772- 1856	1856- 1982	1982- 2011
A	-1,66646	0,05196	0,07
B	-5,1352	-0,24056	0,115448
C	-1,72038	0,013746	-0,11928
D	-0,73583	-0,06974	0,060552

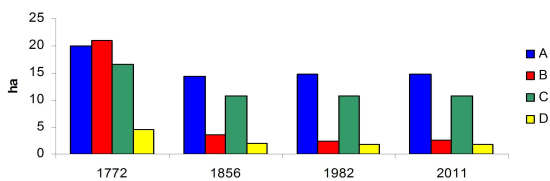


Fig. 10. Subsectoral division /rate of forest dynamics over a year.

The fastest deforestation rate occurred between 1772 - 1856 throughout the basin [4], especially in the northern sector of the basin, in the plateau area, which was more accessible to deforestation operations, the chief goal being the expansion of the areas of agricultural land and villages (-5.1) [12], [12a]. Considerably lower values were recorded for all the other analysed sections, i.e. between -0.7 and -1.7. As we advance towards the contemporary period, the lowest rates of deforestation were recorded in the mountain area in the western basin, the analysis

showing that, over a year, about 0.1 ha of forest land would disappear in the lower basin.

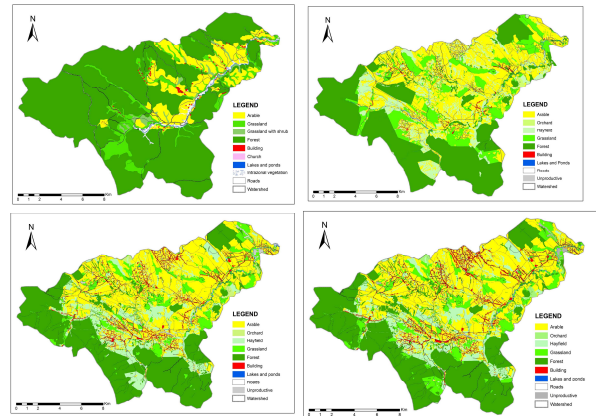


Fig. 11. Land use evolution during 1772-2011 in Soloneț basin.

In conclusion, we can argue that the forest, as a structuring vector of the landscape, was more strongly felt in this role in the 18th and 19th centuries rather than in the latter half of the 19th and the beginning of 20th c.



Fig. 12. Landslide on the Osoi Hill effect of former deforestation.

3.1.4. Villages as structuring elements of the landscape

The analysis of map overlays and the development of built-up areas over the reference period indicates, on the one hand, that a generation of villages existing in the 18th century, which mainly occupied the courses in the lower and middle part of the basin, among them Părâuți, Todirești, Soloneț, Comănești and Humoreni, followed by another generation of younger villages, established after the commissioning of the Cacica salt mine and the resulting establishment of communities in the more isolated areas in the basin, towards Obcina Mare, where ethnic Polish, German, Ukrainian populations were predominant, etc.

As such, the villages in the Soloneț basin act not only as a structural element of the landscape, but also as a structuring element of landscape dynamics, as villages favoured the expansion of communications networks, the retreat of forest lines due to mining, the

development of farm holdings, pastures and hayfields. Four contributing factors were found to have contributed to territorial dynamics of villages: valleys, salt resources, forests and roads. Furthermore, villages recorded largely regressive territorial development along the rivers and agglutinative on the cuesta reverse in the northern central part of the basin and predominantly with a divergent dynamics in the areas of Polish settlement or predominantly of the regressive agglutination in areas of Romanian traditional housing.

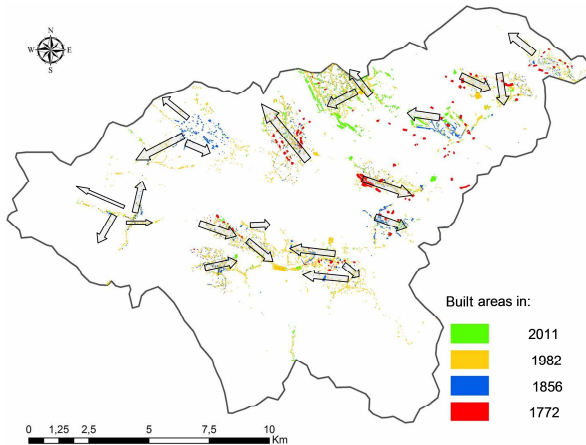


Fig. 13. Dynamics vectors of the inhabitable landscape.

4. CONCLUSION

The analysis of complex structural elements of geographical landscape and landscape dynamics indicates that the vectors that subsume the role of the elements that contributed to the dynamics of landscapes are generally oriented mainly from north-east towards south-west and south, with branches ascending towards the main peaks of the river basin, confirming that these reflect, above all, the occupation of space for habitation purposes of space and the gradual expansion of settlements and of communications networks.

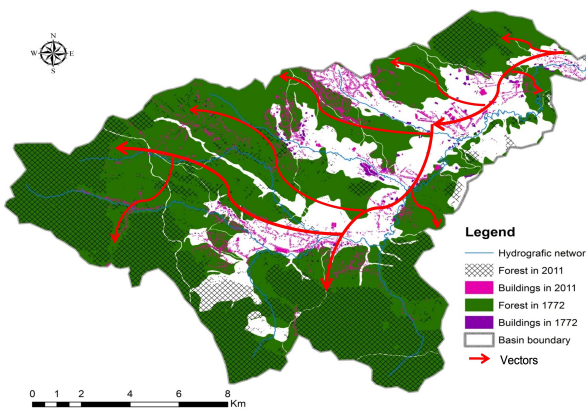


Fig. 14. Main orientation of the structuring vectors evolution in Soloneț basin.

The diagram of structuring vectors of the dynamics of landscapes in the Soloneț river basin

exposes four basic categories of vector components: economic cycles, structural elements, landscape typologies and structuring vectors.

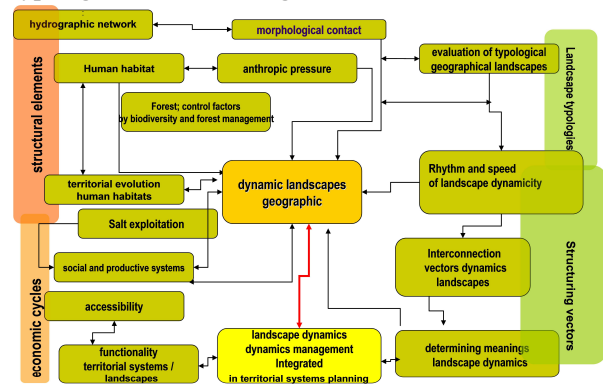


Fig. 15. Diagram of the structuring vectors.

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