

ECOLOGICAL STABILITY AS A DETERMINANT OF NITRA REGION DEVELOPMENT IN SLOVAKIA

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Abstract

Nitra region is evaluated based on the analysis of land use ecological stability in the present article, which is significant for its development, particularly in terms of increasing potential for tourism. The coefficient of ecological stability (C_{ES}) was used to evaluate the ecological stability of the region as a relatively simple ecological indicator for quality of life determination in the region. Three basic methods were used of calculating C_{ES} according to the methodology Michal (1982), Löw et al. (1984) and Miklós (1986). The districts of Nitra region differs by natural conditions from each other. There are represented three types of natural areas: foothill (Zlaté Moravce), upland (Nitra, Levice, Topolčany) and lowland area (Šaľa, Nové Zámky, Komárom). The highest value of C_{ES} was in the district of Zlaté Moravce. A higher value of C_{ES} was in the district of Topolčany. The lowest value of C_{ES} was evaluated in the district of Šaľa, where do absent ecologically stable elements. Nitra region is classifies as an area of low to median ecological stability, which is critical to the improvement and development of the region need to make eco-stabilizing elements and eco-stabilizing management measures. On the basis of country originality can be expressed the impact of human activity on the landscape and its features. Originality coefficient of the cultural landscape for individual districts of Nitra region is following: Komárno and Levice - 0.16; Nitra - 0.17; Nové Zámky - 0.15; Šaľa - 0.07; Topolčany - 0.56; Zlaté Moravce - 1.49. Slovakia is in terms of the authenticity of cultural landscapes evaluated coefficient of 2.01. Based on the analysis it can be concluded heterogeneity in the origin of cultural landscapes in the Nitra region.

Key words: anthropogenic activity, ecological stability, Nitra region, tourism

INTRODUCTION

Evaluation of all the conditions and prerequisites for sustainable land use is considered evaluation of the ecological stability of the landscape. Evaluation of ecological stability is an important part of several land use and landscape ecological documentation.

The concept of spatial ecological stability was introduced by [3]. This concept includes dynamic ability of the landscape structure to retain spatial ecological relationships between individual ecosystems (to ensure the exchange of matter, energy and information) for the dynamic variability of the conditions and forms of life, even assuming that the country is made up of local ecosystems with different

(and low) degree internal ecological stability. For stable country can be considered such a country where it is permanently ensured the possibility of using production and non-production functions, in which there is irreversible disruption of the functional potential of the country resulting from human activities.

Assessment and evaluation of the degree of ecological landscape is realized in different ways. Often takes place following the review only real vegetation, or the current landscape structure and tertiary landscape structure [9]. Another more complex method is based on a comparison of natural conditions and the type of land use [5], or the assessment of landscape support, protecting and reducing its ecological stability, and evaluating information on

hazards abiocomplexes stability, the current state of land use and pollution load [7].

The basic importance for assurance ecological stability of area has ecologically important segments of the country, which are ecologically important: landscape elements, landscape units, landscape area and line communities. These segments are local, regional, trans-regional bio geographical significance, respectively biosphere importance.

The Nitra region is one of the most productive agricultural regions of Slovakia with a total farmland area of 468 669 ha, which is the highest in Slovakia and the share of agricultural land in Slovakia (19.3%). The Nitra region, according the National Strategy of Regional Development 2007-2013, is predominantly rural, slow-growing region of the Slovak Republic, with reasonable attractiveness and position, average degree of readiness for innovation, competitive on average outside of the center of EU development activities and the possibility of cross-border cooperation with Hungary.

The term "territorial development" is not precisely defined, but can be seen as purposeful recovery area [8]. The issue of regional policy is closely linked to spatial planning, which may, through its essential function in the long term contribute to increase the potential of the region.

The aim of this paper is based on an analysis of land use to assess the ecological stability of the region, which is essential for region development particularly in terms of increasing potential for tourism. Only under favourable natural environment is conducive to the development of all activities in the region.

MATERIALS AND METHODS

Definition of area

The Nitra region is the object of analysis. It is located in the southern part of Slovakia. It is a heterogeneous region of Slovakia in terms of ethnic structure. In Nitra region is 7 districts (15 towns and 354 villages). Nitra region occupies 12.8% of the Slovak Republic of the

total area of Slovakia. Overall, there are more than 700 thousand inhabitants and population density represents 111 inhabitants/km⁻². In the Nitra region is 12.7% from the total population live in Slovakia. In Figure 1 are shown area of Nitra region districts and the number of inhabitants.

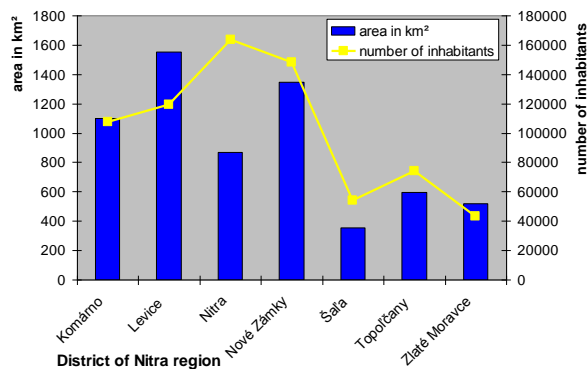


Fig. 1. The area and number of inhabitants of the Nitra region

Source: Own calculation on the basis of data from Statistic Office of The Slovak Republic (2014)

Methodology for evaluating of ecological stability

Data on the area of land resources for the period 2003 - 2013 were obtained from the RegDat Statistical Office of the Slovak Republic. The obtained data were processed by the methods of analysis and synthesis. Interpretation of results is compiled in the form of tables and graphs using MS Office. Characteristics of the current (secondary) landscape structure studied area based on the methodology LANDEP [6]. The coefficient of ecological stability (C_{ES}) was used to assess the ecological stability of the country as a relatively simple indicator determinant ecological quality of life in the region. The three basic methods of calculating C_{ES} based on the work by [2], [1] and [4] were used.

Calculation of the coefficient ecological stability of the landscape according to [2] is the following:

$$C_{ES} = S / U$$

where: C_{ES} – coefficient of ecological stability; S – the area of elements with stable or positive influence; L – the area of elements with unstable and negative influence.

[4] considers the highest quality areas the greatest proportion of high-value elements of

landscape significance from an ecological point. The formula was used to calculate:

$$C_{ES} = (\sum p_i \cdot k_i) \cdot P^{-1}$$

where: C_{ES} – coefficient of ecological stability; p_i – the area of individual elements (our land cover classes); k_i – coefficient of the eco-stabilizing capacity of individual elements; P – the area of elements in hectare. Calculation of the coefficient of ecological stability under [1]:

$$C_{ES} = (1,5A + B + 0,5C) / (0,2D + 0,8E)$$

where: C_{ES} – coefficient of ecological stability; A – percentage of surfaces with 5 degree of environmental quality (forests, water elements); B – percentage of surfaces with 4 degree of EQ (riparian vegetation, game refuges); C – percentage of surfaces with 3 degree of EQ (meadows and grazing elements); D – percentage of surfaces with 2 degree of EQ (arable land); E – percentage of surfaces with 1 degree of EQ (built-up areas). Several methods are used to measure human interventions into the original landscape structure, which affect its ecological stability. The coefficient of natural cultural landscape is one of them [10]. Originality coefficient of the cultural landscape has a simple formulation:

$$C_{OCL} = (FL + PG) / AL$$

where: C_{OCL} – coefficient originality of the cultural landscape; FL – forest land; PG – permanent grassland; AL – arable land.

RESULTS AND DISCUSSIONS

The districts of the Nitra region differ by natural conditions from each other. They consist of three types of natural areas: foothill (Zlaté Moravce), upland (Nitra, Levice, Topoľčany) and lowland area (Šaľa, Nové Zámky, Komárom). Based on the analysis of land resources of selected areas (Table 1), which determines land use, we can conclude the diversity represented by individual elements (ecosystems) in the region.

Forest elements, meadows and grazing elements and water elements are considered as ecologically stable elements. For the unstable elements in the region are considered built-up

areas, other areas (eg transport infrastructure) and arable land is used for intensive agricultural. The arable land ranged from 78.22% (Šaľa) to 36.00% (Zlaté Moravce) of the total area of the district is dominant in the monitored districts of the Nitra region (Figure 2). Forest elements, environmentally stable elements, have the largest acreage in the district of Zlaté Moravce (43.58%) and Topoľčany (28.41%) and lowest in Šaľa (4.09%), Komárno (6.35%) and Nové Zámky (7.71%). The meadows and grazing elements, as environmentally stable elements, dominate in the Zlaté Moravce (10.02%) and Levice (7.92%). In all the districts of Nitra region are located a few water elements, which contribute significantly to the ecological stability of the area. The highest spatial representation of water elements is in Komárno (5.10%) and the lowest in Zlaté Moravce (0.81%).

Ecological stability of the landscape is conditional gene pool conservation of important species and sites, as well as diversity and an acceptable level of activities in the region. The stability of the country in terms of possibilities of the region used in tourism and environmental quality discusses the number and area of ecologically important landscape (protected areas, NATURA 2000 sites).

The excessively intense human rights are threat to the ecological stability, which act as pressure tension. These are primarily claims arising from economic activities, construction and occupation of areas and also the pollution of the individual elements of the environment. In Table 2 is treated analysis of protected areas. The three protected landscape areas (PLA) – PLA Ponitrie (District of Nitra, Topoľčany and Zlaté Moravce), PLA Štiavnické vrchy (Levice) and PLA Dunajské luhy (Komárno) extend to Nitra region. The total area of the PLA in the territory of the Nitra region is 4.65 % of the total area. Number of small protected areas is 119, representing 0.66% of the area of the region, of which 14 National natural reservations (NNR), 46 Natural reservations (NR), 18 Natural landmarks (NL) and 41 Protected areas (PA).

Table 1. Comparison of land resources used in the districts of Nitra region in Slovakia in hectares in year 2003 and 2013

District of Nitra region	Year	Type of land use									
		ploughland	hopyard	vineyard	Garden	orchard	meadows and grazing land	forest lands	water areas	built-up areas	other areas
Komárno	2003	75743.9	0	2398.2	2179.1	1598.7	4679.2	6921.1	5624.6	6338.8	4543.4
	2013	93485.5	0	2986.7	2815.9	465.2	12754.8	29043.3	2306.5	7711.2	3544.9
Levice	2003	61590.5	0	2162.7	2697.1	283.5	1771.5	8840.2	1365.0	6528.5	1834.0
	2013	95174.4	0.1	3575.1	3109.3	2069.0	4309.7	10345.8	4221.9	9031.7	2913.8
Nitra	2003	27866.8	0	235.9	855.7	219.0	507.4	1453.2	987.7	2742.1	722.2
	2013	33925.5	32.8	281.7	1504.6	275.9	1923.6	16894.7	829.6	2772.7	1327.4
Nové Zámky	2003	19217.8	0	496.6	1155.4	168.6	5208.0	22627.7	428.3	2148.9	666.2
	2013	75982.0	0	2206.5	2172.2	1411.3	4800.9	6980.7	5614.0	6500.9	4345.4
Šaľa	2003	93577.1	0.1	2958.9	2771.5	468.3	12280.6	29236.1	2318.8	7828.9	3673.6
	2013	60926.3	0	2136.4	2663.6	259.8	1628.6	8868.3	1367.9	6745.2	2476.9
Topoľčany	2003	94919.7	0.01	3583.2	3053.2	2075.7	4152.6	10381.8	4210.0	9104.5	3325.8
	2013	27838.3	0	207.9	836.5	233.0	387.0	1457.1	967.5	2843.5	819.1
Zlaté Moravce	2003	33574.9	34.0	280.6	1482.1	266.8	1899.2	16977.3	832.6	2899.9	1516.1
	2013	18760.0	2.4	540.2	1128.5	184.8	5220.5	22711.2	423.8	2175.8	970.5

Source: Own calculation on the basis of data from Statistic Office of The Slovak Republic - RegDat (2014)

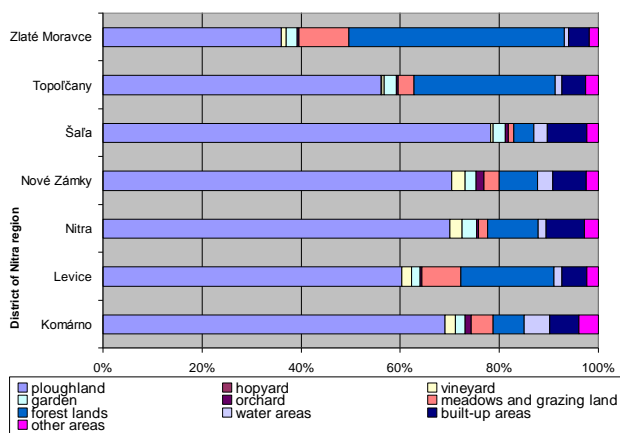


Fig. 2 Percentage share landscape elements in the districts of Nitra region in Year 2013

In the district of Komárno and Nové Zámky is the biggest area representation of small protected areas of the districts of Nitra region. The district of Komárno is considered to ecological the most stable area in terms of the number and area of protected areas. On the territory of the Nitra region is 58 Special Areas of Conservation (SACs) and 8 Special Protection Areas (SPAs) that are part of NATURA 2000. Nitra region represents 21.1% (SPAs) and 12.2% (SACs) of the total

number of NATURA 2000 areas in Slovakia. Also, these areas contribute to an increase of ecological stability of the region.

Table 2. Protected areas in the Nitra region, as significant areas of ecological stability

District of Nitra region	NNR		NR		NL		PA	
	A	B	A	B	A	B	A	B
Komárno	2	165.8	20	418.1	0	0	10	951.3
Levice	2	339.9	7	220.5	2	1.2	6	113.8
Nitra	2	53.5	2	89.3	2	1.3	9	5.4
Nové Zámky	6	864.9	11	190.5	6	59.8	7	185.8
Šaľa	0	0	0	0	6	29.1	1	5.9
Topoľčany	1	30.1	5	110.9	2	5.5	4	45.6
Zlaté Moravce	1	8.8	0	0	1	8.4	4	215.9

Legend: NNP – National natural reservation; NR – Natural reservation; NL – Natural landmark; PA – Protected area; A – number of areas; B – area in hectare

Based on the analysis of landscape elements occurring in the districts of Nitra region the ecological stability of the area was assessed by using the coefficient of ecological stability. From a methodological point of view is the evaluation of ecological stability based on three different approaches for evaluating of landscape elements. Methodology of C_{ES} calculating of the authors [2], [1] and [4]

include Slovakia and the Czech Republic among the most commonly used. Comparison of ecological stability coefficients for districts Nitra region are interpreted in Table 3 and Figure 3.

Table 3. Ecological stability coefficients for districts of Nitra region

District of Nitra region	Ecological stability index by		
	[2]	[1]	[3]
Komárno	0.14	0.89	0.25
Levice	0.14	0.89	0.25
Nitra	0.15	0.83	0.25
Nové Zámky	0.14	0.83	0.25
Šaľa	0.06	0.45	0.20
Topoľčany	0.50	2.70	0.41
Zlaté Moravce	1.28	5.95	0.57

The highest values of C_{ES} are in the district of Zlaté Moravce. This district shall be assigned to the area with the prevailing natural elements, intermediate and high stability. Higher values of C_{ES} are also in the district Topoľčany. Lowest values of C_{ES} were evaluated in the district of Šaľa, where absent ecologically stable elements. It is a territory dominated by intensive agricultural use. In terms of ecological stability Nitra region belongs to the area of low to moderate ecological stability.

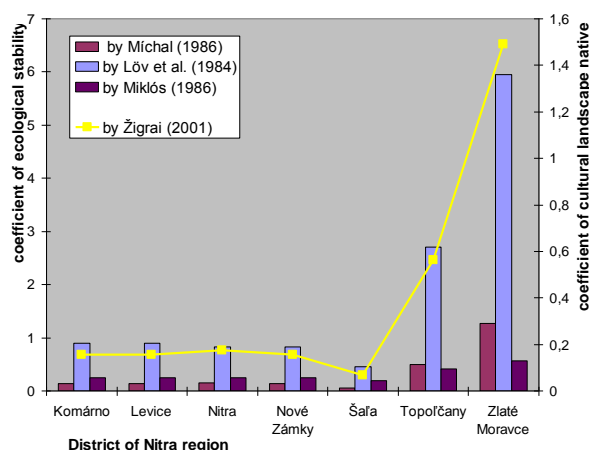


Fig. 3. Comparison of ecological stability coefficients and coefficients authenticity of cultural landscapes in the districts of Nitra region in Slovakia to 2013

There is requirement to make eco-stabilizing elements and eco-stabilizing management measures to the improvement and development of the region.

Human intervention in natural conditions in the Nitra region is very significant. Area of interest is among the regions of Slovakia, which man altered with his activity, his interventions in the original natural landscape structures, particularly agricultural use and the associated removal of forest ecosystems in the past, changed the face of the country (region). Impact of human activity on the land and its elements can be expressed in terms of the originality of the cultural landscape.

Coefficient of originality of the cultural landscape for each districts of Nitra region is following: district Komárno and Levice - 0.16; district Nitra - 0.17; District of Nové Zámky - 0.15; district Šaľa - 0.07; Topoľčany - 0.56; district Zlaté Moravce - 1.49. Slovakia is rated coefficient of 2.01 in terms of originality cultural landscapes. Based on the analysis it can be concluded heterogeneity in of originality of cultural landscapes in the Nitra region. Foothill areas exhibit higher originality (Zlaté Moravce), because there is high share of forest ecosystems, lower agricultural use and a higher degree of ecological stability. Lowland area is evaluated lower degree of originality landscape, where dominates agricultural land use and low ecological stability (southern districts of Nitra region, particularly Šaľa).

C_{ES} is a key element for design measures within the formation and development of the country at present. Calculation of C_{ES} is normally used in the processing of various landscape-ecological studies in spatial assessment of the country and under. In practice, C_{ES} apply within the territorial systems of ecological stability as documentation of nature and landscape protection.

CONCLUSIONS

Nitra region represents a heterogeneous environment in terms of representation of eco-stabilizing elements. The highest values of the coefficient of ecological stability are in the district of Zlaté Moravce and lowest in the district of Šaľa. In the region do absent in particular water elements. In Komárno district

is the highest spatial representation of water elements. In the use of land resources in Nitra region are no significant differences in the span of ten years.

The agriculture is significant factor intervening in the natural environment. It is an important element in the employment of the population predominantly rural areas in some districts of Nitra region. Toward the practice is necessary to give priority to intensive production methods that will have minimal negative impacts on environmental elements. According the evaluation of number of protected areas, it is also important to ensure their practical protection, which is the result of the need to protect the elements of nature and landscape. A common problem in Nitra region is a conflict of interest socio-economic activity of man and nature and landscape protection.

Nitra region can be rated as an area of low to moderate ecological stability despite interventions in the natural structures in each district. Occurrence and diversity of protected areas can make a significant contribution to maintaining the total stability of the country despite the increasing intensity of the socio-economic activities of the region's inhabitants. The region has the opportunity to develop activities in the field of tourism with a focus on agro-tourism. In the region occurring natural protected elements do allows the development of ecotourism, which combines the activities of tourism and environmental education and environmental awareness of the population.

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