

Landscape classification on the basis of the ecological and social aspects

Milena Moyzeová

Institute of Landscape Ecology of Slovak Academy of Science
Štefánikova 3, P.O.BOX 254, 814 99 Bratislava. The Slovak Republic
e-mail: milena.moyzeova@savba.sk

Abstract. The aim of this contribution is to present the methodology of environmental effect evaluation of anthropogenic activities to the landscape structure and quality of residential environment and to compare identified and specified problems with their perception by local inhabitants. The methodology was verified on the study area – agriculturally intensively used landscape – Trnava district.

Key words: quality of residential environment, perception problems, landscape classification, Trnava district

Introduction

Landscape as a space is under continued pressure of production and nonproduction human activities. On one side these activities are aimed at the sustainability and protection of undisturbed ecological valued ecosystems, regeneration of affected and reconstruction of destroyed ecosystems, devastated natural values of the landscape. On the other side human activities act as stress factors which directly or indirectly endanger and devastate natural ecosystems. Human activities, in literature often marked as socioeconomical phenomena, reflect relationships and impact of the land use of the community (Miklós 1985). These activities cannot be excluded from the landscape because of their importance for the development of human society and its existence. They can be partly limited or eliminated, mainly the intensity of the negative impact, synchronization of landscape development with properties of the landscape structure and its tension. This process is based on the environmental management which is based on the creation of a natural-social territorial system that is able to synchronize requirements of social development with the needs of nature protection and protection of natural resources and its ability to retain the ecological stability at the same time (Izakovičová, Miklós, Drdoš 1997).

Aim of this document is to present new approaches of landscape evaluation based on the evaluation of ecological and social aspects of the landscape and to verify methodological procedure on the regional level – in intensive agricultural utilized landscape of the Trnava district.

Basic features of the study area

The model area – Trnava district with its basic features - number of inhabitants (126 382) and area (741 km²) - belongs to the medium sized, densely inhabited districts of Slovakia. Administratively it is considered of 44 rural settlements and one town (Trnava) that is at the same time the district and county capital. From geomorphological viewpoint the area is created by two basic geomorphological complexes – Podunajská nížina

lowland (part of the Trnavská pahorkatina hills and Podunajská rovina plain) and Malé Karpaty Mts. The present landscape structure of the majority of settlements is arable land of high quality (bonitation) suitable for agriculture. It occupies 72,2% of the district area. Forests cover 17,7% of the area and are concentrated mainly in the northern part of the district, in settlements situated in the Protected Landscape Area Malé Karpaty. Forest ecosystems of this area are of high value as to the gene-pool and nature-protection. Rural settlements of the district have mainly agricultural character with dwelling, partially recreational function. Agricultural production is concentrated on plant and animal production. Farming on arable land dominates in plant production. Cereals, corn and in the last period also sunflower are the characteristic cultivated plants. In the past the area was significant from the viewpoint of vinemaking, because it was the part of the Malokarpatská wine road. At present the cultivation of grape decreases. Animal production is concentrated especially on hog and beef breeding. The district is an industrially developed district of Slovakia. Industry is focused into the town of Trnava – dominant branches are machinery, food and textil industry. From Slovak aspect the district has dominant position due to the production of electric energy. There is the nuclear power station in Jaslovské Bohunice. Economical activity of other rural settlements is represented by small operations of production, storage and repair character. The area is significant also from the viewpoint of traffic. Some significant traffic corridors go through the area: the motor-way Bratislava–Trnava–Považie and the railway Bratislava–Žilina–Košice–Ukraine.

Methodological approach

Landscape evaluation of the Trnava district was based on the evaluation of the residences located in the district and on the differentiated quality of the environment. Implemented methods consisted of an analyse, interpretation and evaluation. Analyses were aimed at the appearance, identification and spatial expression of parameters in the current landscape structure, positive socioeconomical phenomena, negative socioeconomical phenomena and the analyse of the residential communities which are also including the results of the sociological surveys. Interpretations and evaluations consisted of partial evaluation of the ecological quality of the current landscape structure, landscape-ecological signification of positive socioeconomical phenomena and stressability of the area (parametric expressed through the value of the calculated coefficient). Closure evaluation of the quality of the environment has been determined as a difference of the values of the calculated coefficient with added results of the sociological survey.

Ecological quality assessment of the present landscape structure

For the evaluation of the problems of endangerment of ecological quality of spatial settlement structure was used the calculation of the coefficient of structure (Miklós et al. 1985, Izakovičová, Kartúsek 1991):

$$K_S = \sum_{i=1}^n \frac{p_i k_{p_i}}{p}$$

where : K_s - coefficient of structure of landforming unit

p_i - area of single elements

k_{p_i} - coefficient of ecological significance of elements

p - area of landforming unit

n - number of elements

For the values of the area of single landscape elements were used. The total values of lands recorded by the Institute of Geodesy and Cartography. Coefficients of ecological significance of the present landscape structure were established according to the papers of the authors Jurko (1990), Miklós (1992) - modified.

The result value of the coefficient established the ecological quality of spatial structure of the settlements in the Trnava district. The spatial structure of the settlements anthropogenically less changed is of higher quality.

Assessment of human activities on landscape components

This part of assessment consisted from partial and synthetical evaluation of positive and negative human impacts on the landscape.

Influence of positive human activities

The positive influence on landscape structure was evaluated on the basis of the occurrence and numerousness of positive elements in each settlement. The elements of nature protection, territorial system of ecological stability and protection of natural and cultural-historical resources enter and affect the evaluation, too. Significance of positive elements was established by the method of Fuller's triangle. We used the following figure:

$$K_{VPP} = \sum_{i=1}^n \frac{v_i k_{VPP_i}}{\rho}$$

where : K_{VPP} - coefficient of the structure of positive elements of landforming unit
 v_i - occurrence or numerousness of single positive elements
 k_{VPP_i} - coefficient of significance of single positive elements
 ρ - area of landforming unit
 n - number of elements

Influence of negative human activities

This part was aimed at the evaluation of the influence of stress factors on landscape structure. We evaluated three categories of stress factors from the viewpoint of their occurrence and significance. The first category includes the primary stress factors: industrial buildings, agricultural buildings, waste dumps and settlements without canalization. The second category includes the secondary stress factors: polluted air, contaminated soil, contaminated underground waters, polluted water courses and water planes, damaged vegetation, noise, protection zones, contamination of river sediments by heavy metals and intensive traffic. The third category includes the natural stress factors: radon risk, seismicity, water and wind erosion. Similarly as in positive phenomena the significance of each stressor we established by the help of pair comparison of the scale of appearing stress factors in the settlements by the method of Fuller's triangle. Land load by stress factors was calculated according to the figure:

$$K_{ZSF} = \sum_{i=1}^n \frac{v_i k_{ZSF_i}}{\rho}$$

where : K_{ZSF} - coefficient of the structure of stress factors of landforming unit
 v_i - occurrence or numerousness of single stress factors
 k_{ZSF_i} - coefficient of significance of single stress factors
 ρ - area of landforming unit
 n - number of elements

Settlements analysis on the basis of human potential

In the analysis of human potential characterized according to the selected indices as numerousness and development of inhabitants, movement of people, age structure, educational structure etc. was included also the

analysis of the answers from directed discussions and questionnaires of sociological research in three samples of respondents - municipality mayors, inhabitants of 8 selected municipalities, Roman-Catholic priests.

Results

Differentiation of the Trnava district was based on a diverse anthropogenic change which is documented by the calculated value of the coefficient of territorial-generated element (K_s). This coefficient reflects areal proportion of particular territorial-generated elements and their landscape ecological signification to the total cadastral area. We consider residences located in the northern part of the district in the Carpathian Mountains as a residences with the least anthropogenic changed residences. Residential places Lošonec, Dobrá Voda, Naháč, Buková, Horné Orešany, Dolné Orešany, Trstín, Smolenica and Dechtice are areas with the highest presence of ecological valuable elements (forests, permanent grass areas and so on), value of the coefficient has been closest to the reference point 1. On the other side residences with the lowest quality of spatial structure are located in the central part of the Trnava district: Trnava, Zavar, Jaslovské Bohunice and Bohdanovce nad Trnavou. This residences are characterized by a high percentage of settled areas and areas with very low landscape-ecological value. The highest number of villages with the value of coefficient in the interval 0,140 – 0,258 are concentrated in the central part of the district with intensive agricultural production and very low eventually none percentage representation of forests or permanent grass areas with very high landscape-ecological value.

On the quality of the residence environment several factors has negative influence for example polluted atmosphere, noise, waste dumps, seismicity and so on. On the other side the quality of the environment is positive influenced by the presence of high quality water resources or sufficiency of greenness. According to these facts we decided to extend the quality evaluation of residences to the evaluation of secondary and inherent stress factors and to the evaluation of positive socioeconomical phenomena. Based on the occurrence and frequency of every phenomenon, but also on the importance and significance of their impact, we determined, based on the mentioned matched comparison of all evaluated parameters, within the Fuller triangle. The highest values of calculated coefficient of the structure of stress factor achieved residences Biely Kostol and Opoj. Followed by the district town Trnava and villages Zeleneč, Dolné Lovčice, Križovany nad Dudváhom and Horné Dubové. In this residences concentrates the highest number of stress factors with very negative impact on the quality of the environment. Areas located in the central part of the area of interest, were ranked to the second group – Hrnčiarovce nad Parnou, Cífer, Boleráz, Špačince, Majcichov, Brestovany, Šúrovce, Suchá nad Parnou, Zvončín, Vlčkovce and other. Residences charged with low amount of stress factors – Trstín, Buková, Smolenice, Lošonec, Horné Orešany, Dolné Orešany and Bučany. Last group is formed by residences which are charged very low with stress factors – Dobrá Voda and Naháč. Similar to the previous group we could see relation between utilization and charging of the landscape, residence in the central part of the region with intensive industrial and agricultural production. These residences are the most charged residences of the district. On the contrary the least charged residences are located in the northern part of the district. Residences in the northern part of the district are the residences with the highest amount of positive elements. These are the residences Smolenice, Dechtice, Buková, Lošonec, Dobrá Voda and Horné Orešany are bound to the protected area Malé Karpaty, which is characterized by a high cumulation of ecostabilizing elements, natural protection elements, forest elements and water resources. On the contrary we count to the residences with the lowest value of positive phenomena these villages: Zvončín, Šelpice, Radošovce, Ružindol, Horné Dubové and Borová. These residences located in the central part of the district are characterized by a high level of agricultural production, which caused expressive liquidation of natural ecosystems. Association with the grade of significance to the partial positive elements and calculation of the coefficient of the significance of the positive elements (K_{vvp}), these villages fall into the group with the highest values: Biely Kostol, Križovany nad Dudváhom, Dechtice, Smolenice, Opoj, Buková and Lošonec. On the other side these villages belong to the group with the lowest value of the coefficient between 1,19 and 1,72 – Ružindol, Šelpice, Trnava, Zvončín and Malženice. The higher is the representation of positive socioeconomical elements in the cadastral area of the residences, the higher is the increase of the quality of the environment. On the contrary the quality of

the residence was negatively influenced by the representation of stress factors in the cadastral area of the evaluated residences. Final evaluation of the residence came out from the difference in the final values obtained from the evaluation of the positive and negative socioeconomical phenomena in the cadastre of every evaluated village. These results, we obtained from a calculation, verified the theorem, that the evaluation of the quality of the environment should be based on the evaluation of secondary and inherent stress factors, because these factors have influence on the quality of the environment of the residences and this is not deliberated enough by the evaluation of the changes in the landscape structure based on the impact of human activities. Because in the present days we increasingly meet with the requirements to perceive, accept and involve the local community to the planning and decision process, our ambition was to compare the results from landscape-ecological evaluation with the opinions of survey participants gathered from the sociological survey. Final evaluation of the quality of the environment – spatial synthesis of all entry indicators. Gathered information can be used for protection of attributes of the environment and for proposal for area management. Environment quality, from the perspective of the answers of the respondents, has positive influence on the nature potential used by villages. It is concerned to green area representation in the village residential area and rural zone of the village. From the mayor point of view 45% of villages have middle natural potential, 23% of villages have high natural potential, 18% very high and 14% low natural potential. From the mayor point of view very high natural potential have the villages Borová, Buková, Dobrá Voda, Dechtice, Dolná Krupá and Trstín located in the northern part of the district on the foothill of protected area Malé Karpaty with high representation of forests ecosystems. But also the mayors of villages Hrnčiarovce nad Parnou and Slovenská Nová Ves located in the southern part of the district evaluated very positive the natural potential justified by high quality of soils within Slovakia. On the other side mayors of the villages Zvončín, Zavar, Majcichov, Hroné Dubové, Bohdanovce nad Trnavou and Biňovce evaluated natural potential as low.

From the results of how the respondents perceive the natural potential of the area we can see that for the most distinguished resources, located in the selected area, are water resources, forest and resources of soils. From the respondents point of view quality of the environment of the villages can be increased by good quality of services (kindergarten, educational facilities, health centre, post office, pharmacy and markets). Responses are showing that there are major differences in offering different types of services among villages. Satisfaction with the services in the villages stated 64 % of mayors in the villages Zeleneč, Voderady, Vlčkovce, Trstín, Šúrovce, Špačince, Šelpice, Suchá nad Parnou, Smolenice, Ružindol, Radošovce, Opoj, Naháč, Majcichov, Križovany nad Dudváhom, Kátlovce, Jaslovské Bohunice, Horné and Dolné Orešany, Dolné Lovčice, Dolná Krupá, Dobrá Voda, Dechtice, Cífer, Boleráz, Brestovany, who qualified service offerings in their villages as good. 34% of the mayors qualified the service offerings in their villages as low. In the negative responses predominated technical aspects of the environment. For example missing canalization, absence of gas and water lines, illegal waste dumps, noise, missing sidewalk and local roads, absence of public vegetation, insufficient home building and missing sports facilities etc. But also socioeconomical problems of the environment are causing decreasing of the quality of living in villages. To these problems we are counting bad human relations, insufficient residents involvement in common activities, missing job opportunities, missing cultural and social events etc. Final evaluation of the results is showing that several residences with the highest level of service accessories are located in the areas of strongest negative impact of the socioeconomical activities on the elements of the environment. On the other side smaller residences with lower quality of service accessories are often located in the environment with minimum of negative interventions. Socioeconomical activities and their impact is displayed in the area in the lines (for example in the surrounding of polluted water courses, transport roads with intensive traffic and high level of noise). Planer areas under influence of industrial and agricultural activities creates areas of negative influence of industrial air pollutants, polluted subterranean waters and etc. Based on the evaluation of natural and socioeconomical elements of the environment from the point of view of the quality of the environment we aggregated residences in the Trnava district into three subregions:

a) Subregion Trnava and its vicinity

The subregion is limited on the basis of negative impacts of cumulated human activities following from the

development of industry, agriculture and traffic directly in Trnava and their influence on its surroundings. Besides the district town Trnava also the municipalities Opoj and Biely Kostol belong here. The following municipalities Pavlice, Majcichov, Zeleneč, Borová, Ružindol, Zvončín, Suchá nad Parnou, Šelpice, Bohdanovce nad Trnavou, Dolné Lovčice and Radošovce belong also to this group. We are talking about residences with a convenient technical infrastructure, good traffic connections, and suitable availability of energy sources, on the other side it means increased cumulation of stress factors that have negative impact on the quality of the environment in the residences.

The protection of the immediate environment in these municipalities depends on the optimum organization of buildings and activities in the area and ecological optimization of the technologies of industrial branches. Therefore it is necessary to plan the technological measures, prefer pure production and wasteless technologies and to minimize the impacts of negative factors as noise, production of wastes etc.

b) Northern subregion

It concludes the settlements with less density of people, lower concentration of industry and lower load of traffic lines. The most significant negative impact is the mining of minerals. Other impacts of anthropogenous activities are mainly of point character. Agriculture is less developed, slopes are used mainly for winegrowing. Forest has a dominant position in the cadastre of the settlements. Forest ecosystems are the part of the Protected Landscape Area Malé Karpaty. Significant is also the representation of protected areas in the 4th and 5th protection grade, elements of the regional system of ecological stability, areas of genetics resources with occurrence of protected species of plants and animals, as well as occurrence of water resources. With regard to frequentation the areas with recreation activities have not more striking impacts on environmental components. Tourism is a proposed activity suitable for this type of subregion. Above all in this area we have favourable conditions for the development of agricultural tourism. Potention for development of viticulture and traditional folk handicraft. To this group belong the settlements of high environmental quality - Buková, Lošonec, Smolenice, Dechtice, Horné Orešany, Dobrá Voda, Dolné Orešany and Naháč.

c) Subregion of the wider surroundings of Trnava

It is created by the settlements with prevailing agricultural production. Soils with the highest quality together with suitable climatic conditions mean high potential for plant production. There is good accessibility and good conditions for the development of economical activities with application of modern technologies. In settlements is necessary to more intensively use the measures for improving the ecological stability of the area by planting of hedgerows and line verdure in the agriculturally intensively used landscape. This category includes the settlements Dlhá, Boleráz, Brestovany, Bučany, Dolná Krupá, Kátlovce, Košolná, Slovenská Nová Ves, Voderady, Vlčkovce, Biňovce, Špačince, Jaslovské Bohunice, Malženice etc.

Conclusion

The evaluation of the impacts of human activities is very complex and difficult. It requires an interdisciplinary approach, from evaluation of environmental factors through the evaluation of socio-economic and social ones. It is very important to pay proper attention to the evaluation of subjective factors, evaluation of comprehension of human impacts on the landscape structure by local people. It is necessary to elaborate the methods of stakeholders, evaluation, methods of evaluation of inhabitants' perception and behaviour to their environment as well as the methods of communication with public and methods of improvement of public participation in decision making processes. To understand the mechanisms of the life of the inhabitants of the Trnava district is not possible without good local knowledge and therefore this research requires new approaches in the field of geography, environmentalistics as well as landscape ecology. First of all it is necessary to accept also the opinions of local people and uniqueness and individuality of rural settlements. To propose development conceptions not only on the basis of scientific knowledge but to take into account also the opinions and standpoints of local

people.

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