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EVALUATION OF THE DEVELOPMENT POTENTIAL IN OPTIMISATION OF THE AREA USING

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Abstract

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Rational use of the landscape system influences the entire ecological stability and quality of the territorial structure of the area. This requires a knowledge and evaluation of those factors, which have a positive or negative influence on its territorial or functional use. Negative influence of anthropogenic activity can be partially avoided or reduced by providing for the ecological optimisation of the territory.

In this contribution is presented methodology, based on multi-criteria analysis, which evaluate the development potential of the area. There were assigned databases of main indicators modified for evaluation of the development potential of the area to localisation, selective and realisation assumptions with the emphasis to technical and civil facilities. Development possibilities of the territory are impacted by natural and anthropogenic factors that significance is expressed by value of index of environment quality.

Above mentioned methodology was applied in condition of Hnilec valley (Hnilčík) for three alternative variations of land using. Total index of environment quality (U) presents potential of the model territory for needs of its future development and it allows choice of optimal solution.

Key words: development potential, index of environment quality, function of benefit

Introduction

Ecological optimisation of the territory and functional structure of the area represents creating such a system of economics, which represent the natural conditions of the area. Its main task is solving the present environmental problems by control of anthropic activities damaging the area. The basis of this process is in balancing the potential of the area with

the requirements of society for the development of the territory. After analysis of each area we can discover which form of use will optimise potential and recommend suitable activities (Švecová, Muchová, 2002).

Prior to the carrying out of the suggestion for optimisation of the area use, there should be a landscape-ecological evaluation and assessment of technical and socio-economic standards of the area. For identification and evaluation of the potential and social, socio-economic and environmental problems of the area, including a qualitative and quantitative point of view, suitable criteria and indicators have to be chosen. Afterwards, on the basis of the results of the evaluation, environmental propositions of revival and development can be established regarding requirements for sustainable development (Drdoš, 1999). Only by using well managed solutions for the area as a whole will the appearance of the area be retained, which is the result of economic activities of people in the past and securing of its cultivated use at present, and suitable urban planning in the future.

For the research and evaluation of the landscape required by regulations, at present there are more methodologies. For example: Landscape Ecological Planning (Ružička, Miklós, 1982), Environmental Impact Assessment (Kozová et al., 1995), Methodology of the Evaluation of the Ecological Carrying Capacity (Hrnčiarová et al., 1997), Landscape Structure Quality (Miklós, 1992), Total Index of Environment Quality (Říha, 1987), Mariot's Evaluation of Suitability for Tourism (Mariot, 1983) etc. The target of these methods is to provide the information, which will allow decisions regarding the use of the landscape in such a way to avoid causing irreversible changes in its structure. The above mentioned methods of evaluation depend upon input of information and the method of classification. It has to be said that these methods mostly monitor the cultural-historical conditions of the landscape but much less attention is paid to evaluation of technical equipment of the area, which is one of the very important signs of the quality of the area and assumption of its further development.

The aim of this contribution is to present methodology of evaluation the development potential of the area for requirements of analysis and synthesis information about practical potential of the landscape. This methodology was applied in specific condition of Hnilec valley (Hnilčík) and was proved its applicability in practice.

Material and methods

The starting point for suggested methodology of decision-making was Landscape Ecological Planning (Ružička, Miklós, 1982), Total Index of Environmental Quality (Říha, 1987) and Mariot's Evaluation of Suitability for Tourism (Mariot, 1983). For the needs of evaluation, the Catalogue of evaluating criteria and indicators was made. This catalogue is divided into three files (I., II., III.), which represent localisation, selective and realisation assumptions of the territory. These files include ten basic indicators (A–J) that represent environmental and anthropogenic characteristics of the area (Table 1). Fifty-five partial indicators contain the specifics of benefit for each particular indicator. Files, indicators and partial indicators are written in Table 1.

T a b l e 1. Classification of indicators for the evaluation of the development potential of the area

Files	Indicators	Partial indicators
I. Localisation assumptions	A. Abiotic components	1. Relief and topographic character 2. Water potential 3. Land potential 4. State of atmosphere
	B. Biotic components	5. Plant communities 6. Animal communities
	C. Elements of current landscape structure	7. Water areas 8. Forest areas 9. Agriculture soil
	D. Character of the landscape	10. Nature reserves and protected zones 11. Historic significance 12. Scientific significance 13. Cultural significance 14. Educational significance 15. Elements of supregional population`s interest 16. Perception 17. Compositional organisation 18. Incorporation of technical work to the landscape 19. Medical significance 20. Recreational value 21. Recreational potential
	E. Stress appearances and sources	22. Air pollution 23. Water pollution 24. Soil erodibility 25. Noise loading 26. Traffic systems 27. Waste management 28. Mining devastation
II. Selective assumptions	F. Urban conditions	29. Urbanisation 30. Protection control 31. Residential building 32. Building for administration, business and services
	G. Demographic, socio-economic and other conditions	33. Population density 34. Employment opportunities 35. Living conditions
III. Realisation assumptions	H. Communication potential	36. Transport 37. Accessibility to the travel resorts
	I. Material and technical potential	38. Residential environment 39. Stock of accommodation 40. Catering establishment 41. Sports facilities 42. Educational and medical facilities, social sphere 43. Cultural and other activities 44. Water supply 45. Sewerage 46. Heat supply 47. Other networks 48. Tourist traffic
	J. Investment and service requirements	49. Economic effectiveness 50. Productivity 51. Costs 52. Building 53. Energy demands of operation 54. Reliability and safety of operation 55. Developing ability in time

Methodology is based on multi-criteria analysis, using criteria and transformation functions for particular partial indicators (Říha, 1987). The target of the evaluation is the selection from various variations including a zero point (present state). Optimal solution has to have the highest value of the expected benefit.

The steps of the evaluation using the methodology for particular variations are as follows:

1. for particular indicators P_j – 1 to 55 related criteria of the indicator $P_j^{(y)}$ will be chosen and on the basis of the scale of validity the value will be added
2. one dimensional functions of benefit U_j will be counted for each $P_j^{(y)}$ as a quality multiplicator $U_j = f_j (P_j^{(y)})$
3. the system of the weights of significance will be specified w_j – in this case by the method of dual comparison (Fuller's triangle)
4. each indicator will be counted and evaluated

$$U_i = U_j \text{ x } w_j, \tag{1}$$

where U_i – the value of index of environment quality
U_j – the function of benefit
w_j – the weight of indicator's significance

5. the value of the total index of environment quality the will be counted as a summary of environment quality for each indicator

$$U = \sum_{j=1}^{n} U_j \times w_j, \tag{2}$$

where U – the total index of environment quality – value of the expected benefit, maximum is 1

6. all of the particular variants including the zero variant will be compared and evaluated according to total indexes of environment quality for each of them.

The selected partial indicators (P_j) – 14, 34, 44 from assumptions files with certain scales of validity and function of the benefit for each criterion, which were used for the evaluation of the model territory, are shown in Table 2.

The success of the evaluation will depend upon analysis and synthesis of the input data and reliability of the information about the territory. Introduced methodology was applied in the model territory of Hnilec valley in the area of Hnilčík and Dedinky. The evaluation of Hnilčík is presented in the following.

Results or knowledge achieved

The analysis of current state of environmental and anthropic conditions in the model territory Hnilec valley in the area of Hnilčík (Fig. 1) was produced on the basis of the latest available materials e.g. Pre-feasibility study (SRRA, 2002) and others, and recognisance of the model territory.

Environmental ability

The model territory in geomorphology terms, belong to region of Slovenské Rudohorie. Relief is influenced by varied geological structure and altitude. This territory has moderate cold climate, with average summer temperatures 12–16°C above zero and average winter temperatures 5–6°C below zero. Average aggregate rainfall is between 800–1000 mm. Average snowfall has maximum height 40–50 cm. Landscape structure and its changes are inducing by two factors. Geomorphology of the territory and climate altogether determines

T a b l e 2. Selected evaluation indicators and criteria

Files	Indicators	Partial indicators P_i	Criteria of indicator	Scale of validity	One dimensional function of benefit U_i
I. Localisation assumptions	D. Character of the landscape	14. Educational significance	No educational significance	$P_{14} \in \langle 0;2 \rangle$	$U_{14} = 0.5 - 0.5 \times \cos(36 \times P_{14})$
			Partial educational significance	$P_{14} \in (2;3\rangle$	
			Considerable educational significance	$P_{14} \in (3;5\rangle$	
II. Selective assumptions	G. Demographic, socio-economic and other conditions	34. Employment opportunities	No industry	$P_{35} \in \langle 0;0.25\rangle$	$U_{35} = 1 - 0.5 \times (P_{35}^3 - P_{35}^2)$
			Light industrialisation	$P_{35} \in (0.25;0.5\rangle$	
			Medium industrialisation	$P_{35} \in (0.5;0.75\rangle$	
			High industrialisation	$P_{35} \in (0.75;1\rangle$	
III. Realisation assumptions	I. Material – technical potential	44. Water supply	Ecological water management	$P_{45} \in \langle 0;0.25\rangle$	$U_{45} = \left(1 - \frac{P_{45}^3 + P_{45}^2}{2}\right) \times [0.5 + 0.5 \times \cos(180 \times P_{45})]$
			Water pipe in the whole area	$P_{45} \in (0.25;0.5\rangle$	
			Water pipe in the part of area	$P_{45} \in (0.5;0.75\rangle$	
			Without water pipe	$P_{45} \in (0.75;1\rangle$	

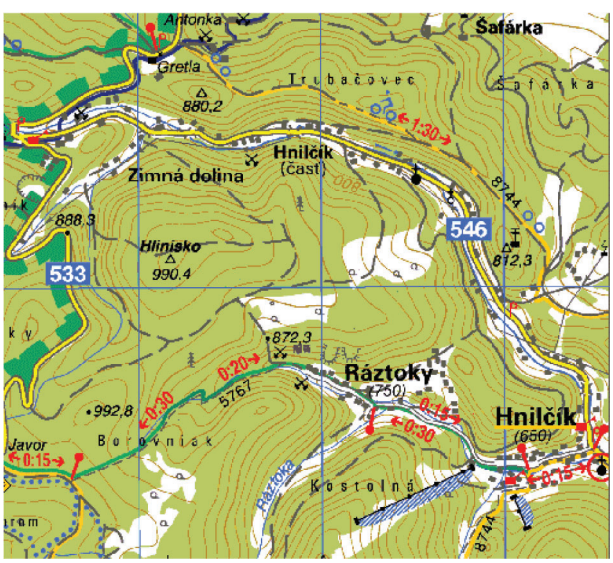

Fig. 1. The area of Hnilčík.

character of the vegetation overlay that also with geomorphology subsoil determines qualities of soil. Vegetation, mainly forest (73.5%), makes relevant component in the landscape scene of the investigated region by its biomass and functionality. Complexes of coniferous monocultures supplemented with areas of artificially planted broadleaved species are predominated. There are frequent meadows and pastures and contour ordered fields (arable soil 0.85%). Železný potok brook with its tributaries drains larger part of the territory and flows to the river Hnilec (Kminiak, 2003).

When considering the quality of the environment, Hnilec valley can be identified as a very valuable territory. Thankfully, due to a hilly terrain and the differences in altitude, climatic conditions, geological surfaces and soils, a variety of species of flora and fauna remain, ranking amongst the most valuable of the territory. The area of aluvia of the river Hnilec is a typical of wetlands with many rare and protected plants.

Demographical ability

The area ranks amongst the least populated in the Slovak Republic, with a high number of the inhabitants in pre-production age, which is caused by a high increase in the Roma ethnic population. The low education level is characteristic and there is a high level of long-term unemployment.

Area of Hnilčík, from the administrative aspect, belongs to district Spišská Nová Ves. It consists of settlements Hnilčík, Bindt, Roztoky, Cechy and Štolvek, the whole area is 2223 hectares. This area has 498 inhabitants. The number of inhabitants continually decreases, it has decreased about 750 inhabitants compared with year 1961, and it means 60%. There are 276 houses in the model territory and 152 of them are permanently inhabited.

Economical ability

The area does not have enough tradition in the field of enterprise, representing a non-balanced structure of industry, with a high level of heavy industry.

Agricultural activities are influenced by the incorrect structure of land division and insufficient use of the pasturing method for breeding animals. Generally we can discuss the low productivity of work. On the other hand, there is a relative amount of free, qualified manpower.

Infrastructural ability

Technical equipment in the territory is insufficiently developed. Sewerage, wastewater treatment and a gas network are missing, and only approximately 50% of the population is connected to the public water supply. There are constant problems with the waste management. Also, the majority of the road infrastructure is old and the area is isolated from the Slovak motorway network and the roads of the international importance. Parking capaci-

ties are missing in almost every location. The area is characteristic by a non-complex tourist infrastructure (touring paths, cycle paths, etc). The state of electrical energy supply and telecommunication networks as well as television and broadcast signals can be marked as adequate. The network of shops and services does not sufficiently cover the requirements, and advice services for small and medium enterprises are missing. Division of housing is mainly old and under-utilised, with signs of dilapidated folk architecture. At the same time, Hnilčík has few quality sports and leisure facilities e.g. Mraznica, which has potential for the future for summer and winter sports as well as for agro-tourism.

Cultural and other ability

The area is located in wider vicinity of middle Spiš, where the national park, Slovenský Raj, with eleven national nature reservations, is located, eight nature reservations, two national nature memorials, two nature memorials and one protected area. Cultural-historical potential is represented by seventeen castles, sixteen large farm houses with attached land, architecturally important town hall buildings, townhouses, a nice park and well maintained surroundings. There are also eighty-seven places containing sites of sacred character with a high historical value. In the villages of Hnilec valley, folk traditions and customs are kept. Also traditional crafts are presented at folklore festivals (SRRA, 2002).

Analysis of this area gave us enough knowledge for its evaluation. The main factor for development and economic prosperity of the area appears to be tourism and leisure forms as follows:

- for health: mountain tourism, skiing, fishing, mountain cycling, horse riding
- for culture, sights or leisure: architecture, museums, folklore, crafts and agro-tourism.

After the analysis of the environment state, the following three variations of solution were suggested, for optimisation of the land by the use of tourism (environmental propositions). Zero variation involves keeping the current state of the model territory, variation 1 and variation 2 presents various stages of the territory development. The framework for suggested activities for development of the area; support of tourism and country holidays in Hnilčík is shown in Table 3.

The evaluation of the development potential of the area was provided for three variations of solution.

Discussion or evaluation

As have been mentioned, the applied methodology takes advantage of worked out Catalogue of evaluation criteria and indicators. Following Table 2, criteria with scales of validity and function of benefit have been assigned to the partial indicators.

Table 4 documents calculation of indexes of environment quality (U_i) that are defined by product of the one-dimensional function of benefit (U_j) and the weight of indicator‘s

T a b l e 3. Suggested activities for each variations of the solution

Variations of solution	Zero variation	Variation 1	Variation 2
Suggested activities	Keeping the current state of the model territory	Suggested activities: • building of basic infrastructure in the field of water management • finishing of road and tourist infrastructure • development of telecommunication infrastructure • reconstruction in the division of housing (refurbishment of the folk buildings) and its use for accommodation and/or enterprise • revival of traditional crafts • creation of touring road and information system • security of restoration of the natural environment and the local system of the ecological stability	Extension of the activities of Variation 1: • building of a sports facilities and a holiday resorts • finishing of catering establishment and accommodation facilities • revival of historical wooden bridge constructions and the remains of the mining activities • revitalisation of the river beds and small ponds • removal of dumped waste material • establishment of a system of separating waste and alternative energy sources

T a b l e 4. Evaluation of Hnilčík by selected partial indicators

Indicators P_j	Criteria of the indicator	Scale of validity	Weight of significance w_j	Function of benefit U_j	Index of environment quality U_i
Zero variation					
14. Educational significance	Partial educational importance	3	0.0145	0.3455	0.0095
34. Working opportunities	Light industrialisation	0.3	0.0236	1.0096	0.0222
44. Water supply	Water pipe in the part of area	0.7	0.0266	0.5812	0.0320
Variation 1					
14. Educational significance	Partial educational importance	3	0.0145	0.6545	0.0095
34. Working opportunities	Medium industrialisation	0.6	0.0236	1.048	0.0168
44. Water supply	Water pipe in the whole area	0.3	0.0266	0.0405	0.0199
Variation 2					
14. Educational significance	Considerable educational significance	4	0.0145	0.9045	0.0132
34. Working opportunities	High industrialisation	0.8	0.0236	1.0703	0.0100
44. Water supply	Ecological water management	0.2	0.0266	0.0405	0.0235

significance (w_j) according to equation (1). Indexes in Table 4 are calculated for each of selected partial indicators, for each single variation of solution.

By counting all partial indicators 1–55 and after determining the value of the total index of environment quality (U) according the equation (2), it is possible to evaluate the suggestions of variations for development of the modal territory as follows:

Zero variation U = 0.557

- does not represent any basic changes or any interference to the environment
- from an economic point of view, it takes into account the stagnation of tourism and development of the countryside
- from an ecological point of view, it looks like the most suitable variation.

Variation 1 U = 0.640

- suggested activities are focused upon the increasing of region wide importance of particular holiday resorts and their year round use, building a new catering establishments and accommodation and increasing the standard of existing facilities
- the variation is from an environmental and economic point of view – optimal and actual.

Variation 2 U = 0.745

- from an ecological point of view, this represents an interference with the environment and changing of the countryside in a relatively short space of time
- it is financially demanding
- from the point of view of using the potential of the region, it is promising.

The above mentioned shows that zero variation is the least suitable for the area development. Suggested activities for variation 1 are optimal from the point of view of sustainable development and revival of the model territory. Although variation 2 is financially and environmentally demanding, it fulfils targets of revival and development of the territory and it could finally in long-term view improves demographic structure of inhabitants and their living conditions, gives new employment opportunities and business activities and also allows development of technical, social and tourist abilities of the territory.

Conclusion

This methodology – evaluation of the development potential of the environment presents guideline to the solution of revival and development of the area mostly in condition of the rural settlements. It is concentrated to achieving the general prosperity of the territory and its inhabitants under the condition of sustainable development. It is based on multi-criteria analysis using criteria and function of benefit for each of partial indicator. After the analysis of the present state of the rural territory in Slovakia have been specified 55 partial indicators ordered to the Catalogue of evaluating criteria and indicators. This Catalogue defines criteria of partial indicators, scales of validity for each of them and one-dimensional functions of benefit, which enable us to calculate the total index of environment quality.

Partial indicators 1–21 allow assessing the natural conditions and character of the landscape. Indicators 22–28 characterize stress appearances in the territory and they allow assessing the impacts of the anthropogenic activities to the particular compounds of the environment. Next indicators involve data that describe the quality of urban and socio-economic abilities 29–35, technical equipment of the territory 36–48, and economic demands of suggested activities 49–55.

The aim of the evaluation is selection of the best alternative of suggested variations of the territory development, including variation zero, so the optimal solution has the highest value of the expected benefit. The results show that variation zero (U = 0.557) keeps the current state and expects stagnation of development. The highest value (U = 0.745) achieves the variation 2 though in condition of the noticeable change of the countryside. Variation 1 (U = 0.640) represents optimal solution as it satisfies assumptions of the sustainable development of the area and it is possible to recommend this one for the needs of Hnilčík.

The evaluation of the development potential of Hnilec valley - Hnilčík gives us frame vision of its state and qualities, and allows us to suggest a main ecological and environmental basis of use for partial areas of the territory. The result is the basis for decisions and realisation of partial ideas in practice, mainly studies and suggestions for the remaining, changing or revival of real elements of the rural environment with an emphasis on cultural-historical and aesthetic values of the landscape. On this basis, it is possible to give the most important suggestions for the future development of the area.

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Muchová S., Švecová A., Pavličková K., Zeleňáková M.: **Hodnotenie rozvojového potenciálu pri optimalizácii využívania územia.**

Racionálne využívanie krajinného systému ovplyvňuje celkovú ekologickú stabilitu a kvalitu priestorovej štruktúry územia. To vyvoláva potrebu poznania a hodnotenia faktorov, ktoré či už pozitívnym, alebo negatívnym spôsobom ovplyvňujú jeho priestorové a funkčné využitie. Negatívnym vplyvom antropogénnej činnosti možno čiastočne predchádzať, príp. ich eliminovať, a to zabezpečením krajinnoekologickej optimalizácie územia.

V práci prezentujeme metodiku hodnotenia rozvojového potenciálu územia, ktorej podstatou je multikriteriálna analýza. K navrhovaným súborom lokalizačných, selektívnych a realizačných predpokladov boli priradené databázy základných ukazovateľov, modifikovaných pre hodnotenie rozvojového potenciálu prostredia s akcentom na technickú a občiansku vybavenosť. Rozvojové možnosti územia ovplyvňujú prírodné a antropogénne faktory, ktorých význam je vyjadrený hodnotou ukazovateľa kvality prostredia.

Uvedenú metodiku sme aplikovali na podmienky Hnileckej doliny (Hnilčík) pre tri varianty návrhu využívania územia. Totálny ukazovateľ kvality prostredia (U) prezentuje potenciál modelového územia pre potreby jeho ďalšieho rozvoja a umožňuje voľbu optimálneho riešenia.