**Milan Lehotský**, Ph.D., **Ján Hanušin**, Ph.D.

# ASSESSMENT OF THE CHANGES OF RURAL LANDSCAPE FROM THE VIEWPOINT OF SUSTAINABILITY BASED IN COMPARISON OF ITS STRUCTURE IN TWO PERIODS — EXAMPLE OF THE JABLONKA CATCHMENT

## Introduction

The concept of sustainability is becoming an urgent challenge for the ever growing number of scientists, researchers and even politicians. Sustainable development is generally understood in the sense of the UNO definition from 1983 as a development which provides for the satisfaction of the needs of the contemporary society without threatening the possibilities to satisfy the needs of the forthcoming generations. Even though this definition is one of the most frequently used, it contains certain inherent relativism. This is the reason why time and space variability and alternative character of the approach to the solution of problems connected with sustainability must be accepted.

Sustainability is a developmental paradigm the contents and notions of which are still developing (Huba, Ira, 1996). Nevertheless, we can pin down some basic principles of the concept which Huba and Ira (1996) summarised as follows:

- principle of prevention and stress upon long-term approaches;
- principle of comprehensibility and the derived principle of integrated approach;
- principle of conservation of reproductive abilities, vitality and diversity of biosphere;
- principle of equilibrium and justice.

The preceding lines suggest that the fulfillment of any project or solutions to the problems of sustainability is a demanding interdisciplinary matter requiring inter alia a large amount of background data and coordination efforts.

One of the basic methodological problems from the viewpoint of sustainability is identification of indicators of such changes, in other words evaluation of the trend suggested by the indicators of sustainability. Their choice is one of the decisive problems of a territory sustainability assessment. The question of definition and choice of sustainability indicators has not been satisfactorily solved yet. Considering the

wide meaning and application of the concept, ranging practically from the assessment of chosen properties of natural landscape up to institutional and legal aspects of society, the choice of indicators and assessment of a measuring unit are correspondingly complicated.

The UNO Commission for sustainability classified four circles of indicators:

- social,
- economic,
- environmental,
- institutional.

The single hierarchic levels of application of sustainability concept require different indicators. Besides, in the majority of cases we are limited by their accessibility, comprehensibility or other, subjective obstacles.

In reality we distinguish two kinds of indicators in a study area: social and environmental. Let us emphasise that, for example, the indicators concerning the nature and changes of land use are transitory and placed on a boundary line between the social and environmental indicators.

## Demarcation of the study area

In accordance with the physical-geographic approaches to regionalisation of natural landscape when regions are considered the spatial systems the components of which are interconnected on the basis of natural movement and flow of matter, energy and information in the whole gravitational system. When natural regions are brought to harmony with socio-economic processes we can speak of natural-socioeconomic regions. The harmonisation of socioeconomic development with natural conditions of each region represents the fundamental prerequisite necessary for the elimination of impacts endangering the environmental and ecological quality of territory and natural resources. This was the point of view we applied when choosing the basin of the river Jablonka, a natural-economic unit, for study area. It is situated in the Myjava hilly land in western part of Slovakia.

The study area is a territory limited by conceptual borders (Bezák, 1995). Conceptuality of border in our case is defined as follows:

a) by water divide as a natural border and a barrier defining the direction of the water and material movement and specific climatic conditions;
b) the geographic, marginal situation within Slovakia;
c) relative homogeneity of physical-geographical conditions and historical development;
d) sphere of influence of three central settlements — one inside, and two outside the study area.

However, the research was carried out on the basis of information from 19 spatial legally/administratively? delimited units.

## Characteristics of the territory

The study area of Jablonka (163 km$^2$) is characterised by hilly to upland relief and alternation of short, wide, and flat ridges with valleys of various types. Specific feature of this relief is a complex pattern of a dense network of dells hollowed out in the slopes of the ridges or valleys. Areas of relatively thick weathered and deluvial mantles with Luvisols and Cambisols of loamy to clayiy character developed on prevailingly flyschoid rocks. The mean annual precipitation total reaches 650–700 mm. Carpathian oak or oak-hornbeam, in elevated positions beach, in the valley bottoms of the main streams alluvial forests (Stankoviansky 1996) were the original forests in the area. It is a transitory territory outside the main developmental axis with rather distinct relief barriers in the south and the north. The barriers in the north are underlined by the state border. A relatively open hilly land in the east and the west represents a space of communication inputs and outputs of the area. The inclinations and composition of relief do not offer any special opportunities for expansion or progress of communications. The water discharge of the area is medium in national scale. The soil potential is also average the same as the underground water stocks. The production capacity of soil is not threatened by excessive erosion. There exists a considerable risk of gully erosion and landslides though. There are favourable conditions for the development of tourism, less for agriculture. There are practically no resources of minerals (Hrnčiarová et al., 1994). There is one central settlement of local importance in the study area.

The contemporary character of landscape of the Jablonka catchment is the result of less than 6 centuries lasting activity of man (fig. 1). The main stage of the settlement of the area in question is connected with kopanitze colonization. This process started as early as in the first half of the 15$^{th}$ century, but the proper kopanitze settlement fully unfolded only in early 17$^{th}$ century while its intensity reached the peak by the end of the 18$^{th}$ century. As a rule they were dispersed tiny settlements represented by groups of houses or isolated dwellings in remote places of the administrative territories of the communities. The special character of the settlement of the Jablonka catchment, consequence of economy with ever growing population number and division of land to ever smaller plots led after almost four centuries to origin of a particular land use pattern, as we know it from the period before collectivisation (Stankoviansky, 1996). Its typical feature was the prevalence of agricultural landscape represented by mosaics of narrow fields arranged in blocks oriented along the contour and gradient lines, alternating with meadows.

The last important intervention of man in the landscape of the study area was collectivisation of agriculture after the socio-political changes in 1948. The mosaics

of the original small fields was changed to large blocks of co-operative fields with a decisive impact on the natural, socio-economic and demographic structure of the area.

Fig. 1: Graphic model of territory development

| Stage | Time period (years) | Graphs of spatial structures | Environmental impact | Spatial processes |
|---|---|---|---|---|
| 1 | befory 13th century |  | without man's impact | natural landscape processes (forested landscape) |
| 2 | 14th century |  | point-very symbiotic | kopanitce colonization in eastern part of study area (I. stage of colonization) |
| 3 | 16th-end of 18th century |  | point-symbiotic | expansion of human activities and fragmentation of space and development of dispersed settlement |
| 4 | end of 18th century to 1949 |  | spatial-symbiotic | intensive fragmentation of space, development of centre and its periferium |
| 5 | 1949-1975 |  | spatial-less strong | succesive defragmentation-collectivization and development of economic and politic centre |
| 6 | 1975-1989 |  | spatial-very strong | very intesive defragmentation-development of big cooperatives with very strong economic and politic influence of centre |
| 7 | >1989 |  | spatial-with restriction of impact | new fragmentation of space on the basis of economic individualization of cooperetives and villages and land's restitution |

## The methods

As the above mentioned suggests, the choice of the study areas was influenced by the fact that it was subject to important changes in land use in the course of the last fifty years and a relatively sufficient amount of information available on the territory from the period before and after collectivisation. Data base containing information on land use in both time horizons for the whole study area was drawn from the works of Solín, Cebecauer (1998). It was processed to the level of administrative territories of communities. Demographic and socio-economic data were taken over from the corresponding year books. Bearing in mind the complexity of the sustainability subject and the question of comparison of two time horizons concerning the study area we used two classes of criteria determining the choice of indicators: criterion of land use closely reflecting the relation of man to natural landscape and the criterion of socio-economic structures. Indicators given by the properties of land use were:

1. Complexity of the pattern from the viewpoint of the individual land use forms in a particular administrative territory.
2. Share of what is called eco-stabilising land use forms (forests and the permanent grassland) in the particular administrative territory (cadaster).

Indicators ensuing from the properties of socio-economic structures were:

1. Population density at 1 ha of arable land.
2. Percentage of leaving inhabitants out of the economically active population.
3. Number of persons per one house.

The assessment was carried out based in hypothesis that the higher the complexity of the pattern, the higher share of eco-stabilising elements, the lower share of leaving inhabitants, the lower density of population and relatively lower number of persons per one house, leading to more positive evaluation of the particular community from the viewpoint of sustainability. All indicators were attributed the same weight. Each cadaster was then given a sum of positive and negative indicators, observing the binary code for both time horizons. Comparing both time horizons we determined the sustainability trend of the particular administrative territory or cadaster.

## Results

### 1. Evaluation of land use indicators

While evaluating the land use change in the light of sustainability we consider important to point at some fundamental changes in entire study areas in the years 1955–1990:

- moderate increase of built-up area by 174 hectares (from 5.5 % to 6.6 %);
- reduction of arable land area by 934 ha (from 49 %to 43 %);
- reduction of permanent grassland area by 749 ha (from 13 % to 8.4 %);
- important increase of forest area by 1488 ha (from 32 % to 42 %).

### 1.1 Complexity of pattern from the point of view of number of individual land use forms

Evaluating this indicator we concentrated on four basic land use forms (built-up areas, arable land, permanent grassland and forests), taking into account also eco-stabilising land use forms (the total of forests and permanent grassland). The area unit of the particular land use form (as proposed by Solín, Cebecauer 1998) was chosen for the basic unit of the pattern. Complexity of pattern is, in our opinion, indicating the rate of ecological stability and functionality of landscape, i.e. the more complex pattern, the stronger sustainability trend.

Comparison of complexity of built-up areas in the years 1955 and 1990 points at not very distinct deterioration of the situation. The pattern of arable land is complex with an unambiguous tendency to reduction of the complexity towards 1990 in the consequence of collectivisation, which is from the viewpoint of permanent grassland a negative phenomenon. On the contrary the permanent grassland trend is the least unambiguous one with comparably equal representation of positive and negative trends. Forests in the consequence of prevailing growth of pattern complexity (with the exception of Vaďovce and Višňové), as well as because of reduction of the mean area of elementary unit, present a very positive trend to sustainability.

The sum of eco-stabilising forms (forests + permanent grassland) shows balance where there is 5 to 5 in positive and negative trends in individual administrative territories (also in Poriadie, which was not included in evaluation of the socio-economic indicators).

The overall evaluation of this indicators shows that a distinctly negative trend, i.e. reduction of pattern complexity was in Hrachovište, Vaďovce, and Višňové, negative trend was in Hrašné and Kostolné. Distictly positive trend was in Stará Turá, positive trend is also in Krajné, Rudník and Poriadie. All in all we can state that in the "non-kopanitze" part of the catchment and from the viewpoint of pattern complexity and sustainability there was a negative trend.

### 1.2 Share of eco-stabilising land use forms (forests + permanent grassland in particular administrative area

This indicator is another parameter evaluating potential eco-stabilising functions of territory. The share of eco-stabilising land use forms did not substantially change in study period with the exception of the cadasters of Poriadie, Vaďovce and Krajné, where it grew by 7 to 11 %. The growth in the remaining cadasters was negligible —

1–2 %. It fact, considering possible errors, it may mean practically unchanged situation.

## 2. Evaluation of indicators of the properties of socio-economic structures

### 2.1 Population density for 1 ha of arable land

Trend to sustainability supposes low population density generally but for 1 ha of arable land in particular. Low population density per 1 ha of arable land needs also lower rate of agricultural production and consequently lower inputs of for example, chemicals and fertilisers in landscape. Population number in study area grew from 13,832 in 1995 to 17,084 in 1991. Just about in the same time (1955–1991) the area of arable land dropped by 934 and it means that population density per unit of arable land in the catchment as a whole should have had grown. Analysing the process in single cadasters we find out that with the exception of Stará Turá and partially also Jablonka, the population number per one ha dropped by from 0.1 to 0.6 inhabitants. In the cadaster of Stará Turá though, the indicator of density per ha increased from 2.5 to 5.7 inhabitants i.e. by more than 3 inhabitants, due to a pronounced growth of concentration of population. Regarding the size and weight of Stará Turá, the development in this settlement and its cadaster decisively influences the overall trend of the entire study area. Regardless this fact we assessed the trends of changes in population density per one ha of arable land for the individual cadasters.

### 2.2 Percentage of leaving population out of the economically active one

Low or high percentage of leaving inhabitants out of the economically active population indicate either economic self-sufficiency or the opposite. Sustainable existence requires the largest possible number of people employed in the place where they live. The contrary situations means increased mobility accompanied by all negative environmental and social phenomena.

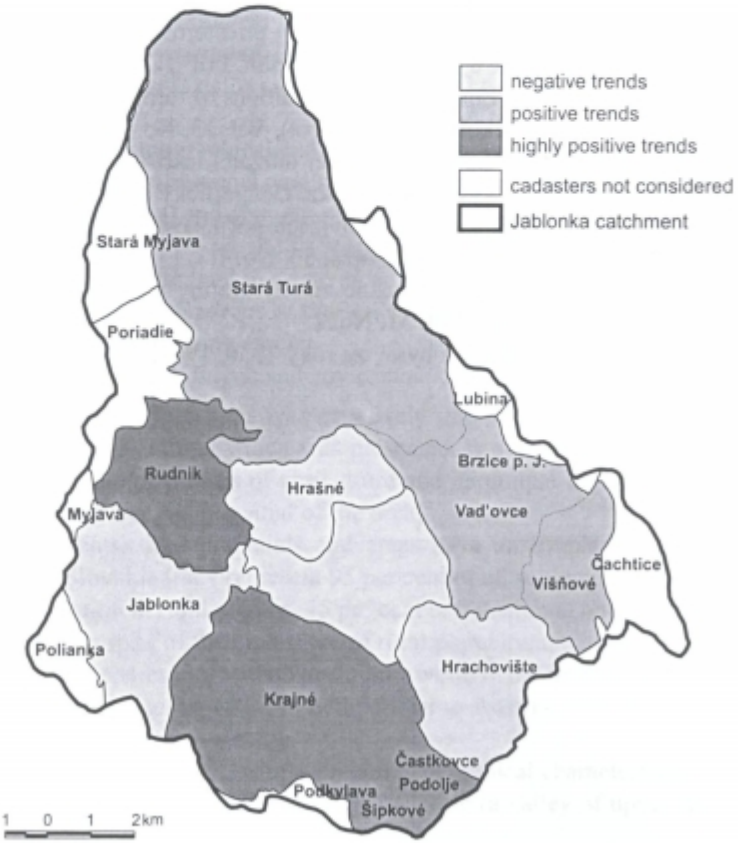
The share of commuting in study period grew from mean 49 % in 1961 to mean 70 % in 1991. Positive changes i.e. reduction of number of leaving people was observed in Stará Turá, a natural result taking into account function and importance of this settlement. Very little growth (slightly negative trend) of the share of the leaving inhabitants was observed in Krajné and Vaďovce i.e. communities with offer of jobs. On the other hand a distinct growth of the share (from 26 to 29 %), and consequently very negative trend was found in Rudník, Višňové and Hrašné.

### 2.3 Population number per one house

Indicator of population number per one house should present the living standard by expressing the rate of concentration of population in houses and within single

settlements. The lower the number of people living in one house (the lower concentration) the more positive situation from the viewpoint of sustainability. Evaluating this indicator it is necessary to take into consideration also the ongoing demographic development (natural mobility of population, migration). The phenomenon of the largest settlement Stará Turá concerning population density per one ha of arable land is manifest also in case of this indicator. It is the only settlement where the population number per one house grew (from 4.5 to 10) in the consequence of extensive construction of tenement blocks where one statistical house takes tens to hundreds of inhabitants. The population number per one house in other settlements dropped from 3.7 to 3.0 inhabitants indicating positive or sustainable trend in living standard which, however, does not mean its indication also in demographic development (it was not analysed).

**Fig. 2: Assessment of the trends towards sustainability of rural landscape**



### 3. Final assessment of the changes from the viewpoint of sustainability.

The final step was compilation of a table containing the evaluation of five sustainability indicators.Simple summing up of pluses and minuses for individual indicators showed the resulting trend pro or contra sustainable trend. The obtained results are presented in the map (fig. 2).

The most favourable situation is in the communities Krajné and Rudník, where with the exception of the share of leaving population (this is also relatively the lowest of all rural settlements), all indicators are positive. Positive development was identified also in Stará Turá, Vaďovce and Višňové, the opposite trend was found in Hrachovište, Hrašné, Jablonka and Kostolné with negative trend from the viewpoint of sustainability as assessed by the above presented indicators.

## References

Bezák, A., 1955: O dvoch koncepciach hraníc v priestorovej analýze. Vybrané problémy súčasnej geografie a príbuzných disciplín. PriFUK, Bratislava.

Hrnčiarová, T. et. al., 1994: Environmental conditions of formation and development of regions in Slovakia. Ekológia (Bratislava), Vol. 13, No.1.

Huba, M., Ira, V., 1996: O koncepcii trvalej udržateľnosti vo vzťahu k niektorým geografickým aspektom vývoja Slovenska. Geografický časopis, 48, No. 3–4.

Solín, Ľ, Cebecauer, T., 1998: Vplyv kolektivizácie poľnohospodárstva na vodnú eróziu v povodí Jablonka. Geografický časopis, 50, No. 1.

Stankoviansky, M., 1997 : Antropogénne zmeny krajiny myjavskej kopaničiarskej oblasti. Životné prostredie, Vol. 31, No. 2.

Výsledky sčítania ľudu, domov a bytov za roky 1950, 1961, 1991.