

Strategy of sustainable development of the Tatry Biosphere Reserve

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Abstract

The study is aimed at the presentation of the strategy of sustainable development in the Tatry Biosphere Reserve. The main objective of the study is to define existing socio-economic, landscape-ecological and environmental problems, design measures to eliminate those problems and/or to prevent new problems to arise. The ultimate goal of the effort is to achieve a situation when the management practices are in harmony with potential of the area to the largest possible extent. Thus, basic principles applied in ecological optimising of landscape organisation included protection of nature, biodiversity and landscape stability, protection of natural resources, including water, soil, air/atmosphere, forests, etc, protection of cultural-historical resources, including, *inter alia*, protection of cultural monuments, protection of historical landscape structures, etc., and environment protection.

Introduction

The issues of sustainability are coming to the fore especially in the latest period when cumulated environmental problems (such as the exhausting of natural resources, deteriorating quality of the environment, threat to biodiversity, growth of negative psychosocial phenomena etc.) outgrow a purely ecological framework and become existential. Thus the research on sustainability problems starts from pragmatic needs. Many professional and also political events deal with sustainability issues. Among them, the Rio Summit '92 belongs to the most important ones, because it gave an impetus to the solution of problems regarding sustainable development at the world-wide level. Approaches (and then definitions) to the concept of "sustainable development" (SD) on a world-wide scale are very numerous and heteroge-

neous at this time. They are based on a variety of aspects. For instance, IUCN (1973) defines SD as "...such a way of the management of natural resources (air, water, soil, mineral resources) and living systems including man, which will ensure the achievement of the highest sustainable quality of life". Later, the IUCN (1991) defined it as "...improving the quality of life of man within the carrying capacity of supporting ecosystems". Another definitions were proposed by Rifkin (1980) who considers SD as "...development that accepts the limits of the consumption and utilization of natural resources". Vavroušek (1993) perceive SD as "...life style that is approximating the ideals of humanism and harmonic relation between man and nature in a time-unlimited horizon", or Chiras (1993) "...as life within the bounds of the carrying capacity of biosphere". In Slovakia the SD was defined by Izakovičová (1995) as "...process aimed at ensuring an adequate development of all forms of life not excluding human life in a long-term temporal horizon" and by Nováček, Mederly (et al., 1996) as "...goal-directed process of changes in the behavior of human society towards itself and also towards its surroundings (i.e. landscape and its resources), which is aimed at increasing the contemporary and future potential for satisfying the human needs and those of other beings considering the possibilities (limits) of landscape and its resources". As is evident from the above given definitions, SD is used to denote such a societal development that regards and respects the natural and cultural-historical resources. Thus the fundamental goal of sustainability is to harmonize the economic development with the protection of nature, natural and cultural-historical resources, and the environment.

Methodology

The methodological procedure for elaboration of the SD strategy consists from the following basic steps (table 1).

The methodology was applied on Slovak part of the transboundary Tatry Biosphere Reserve (BR) designated in 1992. Area of the Tatry BR in Slovakia overlaps with the Tatry National Park, including its protective zone, and covers 110,685 ha. The BR encompasses the three

Table 1. The methodological procedure

Steps	Description
I. Analyses	evaluation of the resources (natural, socio-economic and cultural-historical) and potentials of the territory and evaluation of the present state of their utilization
II. Evaluations	specification of the basic problems of territory
III. Proposals	elaboration of the proposal for elimination of current problems and proposal of the SD strategy of the territory

mountain ranges of the region, the High Tatras, the Western Tatras and Belianske Tatras (the White Tatras). It has a special position within a network of protected areas in Slovakia due to its outstanding attributes, including unique high mountain relief with distinct features of former glacial activity, numerous glacial lakes (tarns) and endemic plant and animal species (Carpathian endemics), largest alpine zone in Slovakia with outstanding alpine *Larix decidua* and *Pinus cembra* forests and also well preserved natural forests in spruce forest zone.

Results

I. Analyses

Analyses represent selection, development, description and spatial definition of landscape quality indicators and quality indicators of individual landscape components. Analyses were based on assessment and homogenisation of various specialised researches for the purpose of ecologically optimal spatial organisation of landscape. Analytical indicators were acquired through excerpts from existing documents, processing of statistic data and data from various sectoral databases. Some special analyses included field tests/surveys. Perceptions of existing problems and development strategies by local population were also analysed. Analyses were split up as follows:

- Analyses of legal acts and documents regulating management of the BR area included analyses of laws, regulations and strategic documents, which have relevance to area management and nature protection in particular. These also included stakeholder analyses.

- Analyses of abiotic landscape components included analyses of abiotic natural resources represent factors determining development of life forms within a defined territory. Analyses were focused on geomorphology, geology, hydrology, climate and soils.

- Analyses of biotic conditions were based on specification, description and spatial definition of biotic landscape components. It included vegetation characteristics (both potential and actual) and fauna description. Significant species, communities and habitats present within area of BR were described. Forest habitats received major attention, since they represent a dominating ecosystem type in BR. Beside species composition, also

other characteristics of forests were analysed including naturalness (conservation status), age structure, stand density, vertical structure, etc.

- Analyses of actual landscape structure – actual landscape structure reflects actual land use in the target area. These analyses confirmed that forest ecosystems with coverage of 37.8% of the total BR area dominates here. Dwarf pine communities and meadows and pastures represent respectively 9.9% and 9.4% of the BR area. Arable land represents 13.5% of the BR territory and is concentrated in its southern part. Settlements cover 2.3% of the BR. It can be seen that structures with high eco-stabilising effects prevail in the BR.

- Analyses of positive social-economic factors included assessment of social and economic measures that are supportive to nature protection, conservation of natural resources and overall contribute to optimal use of natural resources. In the Tatro BR, there are 27 National Nature Reserves covering 37,977.13 ha, 24 Nature Reserves covering 1063.34 ha, 2 National Nature Monuments and 2 Nature Monuments. The area of the BR is important for the protection of forest and water resources. Protective forests cover 23,346 ha and are primarily designated for the soil protection. Special purpose forests cover 13,670 ha and are designated for nature protection and emission control purposes. Furthermore, there are significant sources of underground water in the BR. From rivers and streams, there are 13 respectively 26 recognised (designated) as significant for water supply and water management.

- Analyses of stress-inducing factors were based on assessments of social and economic activities negatively influencing the landscape quality and/or qualities of individual landscape components. Both primary stress-inducing factors including pollution sources, and secondary stress-inducing factors including polluted/harmed landscape components such as polluted air, contaminated soil, areas exposed to noise load, damaged vegetation, etc. were analysed. Damage to vegetation is considered to be the most serious stress-inducing factor in the BR. It is caused by natural processes, but also by anthropogenic factors. The most extensive damage to vegetation ever recorded was caused by windstorm on 19 November 2004. As much as 12 000 ha of forests were destroyed.

- Analyses of social-economic structure were focused on assessing human potential in the BR, such as demographic aspects and sectoral activities. These analyses were aimed at identification of actual status of social and economic development in BR and future development pressures. Currently recreation, tourism, healthcare and forest management dominate among economic activities. Agriculture and industry are developed in transition zone of BR, the later is concentrated in larger municipalities. Agriculture is based on production of potatoes and corns (oats, barley, rye) as well as cattle and sheep breeding. Nature conservation and environment protection laws limit development of economic activities.

II. Evaluations

The basic goal of the evaluation is the specification and identification of the socio-economic and ecological and environmental problems of the territory. Numerous problems were identified in the target area. These problems include the following:

Problems that represent threats to biodiversity and territorial stability are caused by spatial overlapping of stress-inducing factors and biologically and ecologically significant elements, such as protected areas, NATURA 2000 sites, elements of ecological network and other landscape elements that have ecostabilising effects. In the target area these problems include threats caused by tourism and recreation, and disturbances caused by natural processes.

Threats caused by tourism and recreation to ecologically significant ecosystems, protected areas, elements of ecological networks, internationally significant habitats were observed in tourist centres of Hrebienok, Skalnaté Pleso, Štrbské Pleso, Tatranská Lomnica, Zuberec, etc. Negative impacts of constructions (chalets, houses) on ecologically significant ecosystems were recorded in Podbanské, Račková Valley, Tatranská Štrba, Zuberec, foothills of Vysoké and Belianske Tatry, etc. Waste dumping is closely related with tourism (and particularly illegal waste dumping), which is particularly visible along hiking trails and tourism centres. Among disturbances caused mainly by man belong also destruction of valuable ecosystems by fire – most recently in the area between Tatranská Polianka – Smokovce, in the past in Kôprová and Tichá Valleys, on slopes below Slavkovský Peak, west from Vyšné Hágy, etc. There is also still persisting negative impact of disturbance of natural succession in alpine and subalpine zone as result of the former pasture activities; removing of mountain pine growth and spruce stands on the (former) upper forest limit.

To disturbances caused by natural processes belong disturbance of vegetation cover caused by windstorms, insect infestations, snow-breaks, ice-breaks, fall winds in Tichá dolina valley, and in area between Podbanské and Tatranská kotlina basin. Another problem is connected with secondary succession of peat bogs – overgrowing of peat bogs decreases its conservation importance and overgrowing of grasslands after land abandonment; lack of conservation management of these grasslands resulting in decreasing of landscape and ecological values on the affected sites.

Problems that represent threats to natural resources are caused by spatial overlapping of stress-inducing factors and respective natural resources, such as contamination of soils, pollution of water courses, underground water, etc.

Pollution of water courses that are designated to serve water management and water supply functions was recorded in rivers/creeks of Váh, Poprad, Biely Váh, Belá, Mlynica, Velický potok, Kežmarská Biela Voda, etc. Presumably, also other watercourses in the target area are polluted; however, water quality monitoring has not been

established in the case of these streams. Threats posed to water sources result also from processing wood in forests affected by windstorm, particularly if the forests are located in hygienic protection zones. Risk of contamination of environment by waste waters is present particularly in municipalities lacking sewage system, namely in municipalities of Hybe, Jakubovany, Jalovec, Jamník, Konská, Liptovská Porúbka, Liptovský Trnovec, Malý Slávkov, Rakúsy, Stráne pod Tatrami, Važec, Veľký Slávkov, Vitanová, Východná, Žiar, Liptovské Matiašovce, Liptovské Behárovce, Bobrovček, Gerlachov pod Tatrami. Pollution of tarns comes mainly from mountain chalets.

Risks of pollution of underground waters result mainly from inappropriate waste disposal (illegal landfills), but also from disposing manure on unpaved areas, or on paved localities with insufficient capacity, for instance along the Štrba creek, in the area between Tatranská Štrba and Štrba, west from Mengusovce, west from Mlynica, in the vicinity of Gerlachov, east from Nová Lesná, west from Stará Lesná, North from Mlynica, north-west from Veľká Lomnica, etc.

Risk of soil contamination from increased air pollution; there are 67 large and 26 small pollution sources recorded in the area. The highest concentrations of pollution were recorded in the southern part of the target area, where most pollution sources are located in municipalities of Poprad, Svit, Liptovský Mikuláš, Liptovský Hrádok, Kežmarok and Pribylina. Risk of decreasing of quality of soils due to erosion is evident particularly on steep slopes, where soils are currently stabilised by vegetation (forests in particular).

Threats to protected areas and elements of ecological network caused by increased concentration of air pollution are particularly serious in transition zone of the Tatry BR, where significant pollution sources are located. In the area between municipalities of Jalovec-Zuberec-Vitanová, increased depositions of nitrogen and sulphur were recorded. Risk of pollution of designated ecostabilising areas and soils from road transport emissions: particularly along Cesta Slobody Road and connecting roads from municipalities of Spišská Belá, Kežmarok, Veľká Lomnica, Poprad, Svit, Mengusovce, Tatranská Štrba.

Threats to designated protected areas and to elements of territorial system of ecological stability result also from increased pollution of underground waters (Pribylina, Štrbské Pleso, Hybe, Východná, etc.). Disturbed spatial stability of the area is also due to establishment of monotonous agricultural landscape with prevailing arable land and without ecostabilising elements, such as bushes, tree lines, etc. Another problem is negative impact of disturbance of natural forest ecosystems and their substitution with spruce monocultures that are extremely vulnerable to air pollution.

Problems that represent threats to environment are caused by spatial overlapping of stress-inducing factors and humans/human ambient. Threats to housing areas from emissions and noise loads caused by

intensive transportation were recorded in Svit, Poprad, Kežmarok, Spišská Belá, Poprad, Štrbské Pleso, Tatranská Lomnica, Liptovský Miluláš, Štrba, Starý Smokovec, Tatranská kotlina, Ždiar, Tatranská Javorina and Podspády. Increased ammonia load resulting from conflicting hygienic zones of farms with housing areas was in municipalities of Štrba, Pribylina, Liptovský Trnovec, Hybe, Východná, Zuberec, Žiar, Liptovský Hrádok, etc. Increased air pollution around large and medium-sized pollution sources is particularly in the towns of Kežmarok, Svit, Poprad, Liptovský Mikuláš, Liptovský Hrádok and Starý Smokovec. Flood risks are mainly in lower parts of valleys. Due to destruction of forests by windstorm the quality of spa environment decreased and there is also risk of recreation quality decrease due to higher avalanche risks. Overall, 1042 of avalanche routes have been recorded in the Tatras Mts. Threats to human health is a consequence of consumption of polluted waters (increased concentrations of iron, manganese in water sources near municipalities of Kežmarok, Veľká Lomnica and Starý Smokovec, increased concentrations of aluminium in water sources in the vicinity of Bušovce, and increased concentrations of arsenic in water sources in the vicinity of Kežmarok. Disturbance of aesthetic quality of environment is caused by establishment of intensively utilised agricultural landscape (in southern part of the area), through introduction of technical elements and infrastructure corridors into landscape, and through establishment of anthropogenic forms of relief as a consequence of minerals extraction (in the vicinity of Batizovce, Podspády, Zuberec, etc.).

Problems related to social and economic activities and area management are caused by inappropriate development activities and inappropriate practices applied in area management. They include inappropriate area management caused by overlapping and insufficiently clarified competencies in area management, particularly between the Ministry of Agriculture coordinating forest management and the Ministry of Environment responsible for nature protection. At the target area, the former is represented through forest enterprise “State Forests of Tatry National Park”, while competencies of the later are implemented by Administration of the Tatry National Park that also coordinates implementing of BR functions. However, it has no decision-making power and thus its position among various stakeholders within the area is rather weak. Problems also result from conflicting interests of stakeholders, preference to exploitation activities while neglecting conservation objectives, preference to businesses generating short-term benefits, etc. and lobbying for changes in legal acts particularly for changes in conservation regimes and zonation pattern applicable in BR in order to allow more intensive land-use. Low representation of original inhabitants results in weakened perceptions of local population for cultural, historical and natural values. The lowest representation of original inhabitants was noted in Liptovský Peter, Liptovský Hrádok, Mlynica, Svit, Vysoké Tatry. There

is also unfavourable age structure mainly in Vysoké Tatry, Hybe, Važec, Liptovská Kokava, Východná and consequently low development potential. Increased representation of Romas in local population representing low qualified work and consequently low development potential force was particularly observed in Rakúsy, Malý Slavkov, Veľká Lomnica, Stráne pod Tatrami, Gerlachov, Batizovce. Lack of job opportunities in rural settlements and consequent movement for jobs into towns is mainly in Štôla, Hybe, Liptovská Kokava and Liptovský Peter.

Propositions

Propositions include set of measures aimed at eliminating identified landscape ecological, environmental, and social-economic problems in the target area and establishment of ecologically optimal spatial and functional organisation of the target area. This step was based on definition and delineation of specific spatial units so called “ecological-functional units”. For each unit, specific recommendations were formulated that shall provide for optimum status of the respective units, i.e. status that is ecologically sustainable. Recommendations on how to address specific problems were organised into the following categories of measures:

– **Strategic-management recommendations focused** on overall coordination of management of the Tatry BR, with special attention to its national designation as national park. The recommendations aim at clarification of management competencies over the target area between Ministry of Agriculture and Ministry of Environment, implementation of compensation schemes, and development and due implementation of strategic consensus based development plan for the target area.

– **Conservation measures** focused on conservation of ecologically valuable landscape structures and their respective elements, i.e. conservation of protected areas, NATURA 2000 sites, biocentres, biocorridors, and other ecologically significant elements in consideration of their actual importance. These include implementing certain management principles in respective zones of biosphere reserve/national park, including, prohibition of any human activity in core zone of BR, restrictions on constructions in transition zone, encouragement of sustainable social and economic activities in transition zone of BR/protective zone of the national park. For the purpose of conservation of forest ecosystems it is necessary to promote site specific three species composition in forest stands, promote application of pioneer species in forest restoration, promote permanent regeneration period, stand density in the interval 0.6–0.8, secure implementing of non-production functions of forest, particularly water protection function. For the conservation of grasslands, it is necessary to control intensity of management (mowing, grazing) and exclude application of fertilisers on mountain meadows.

– **Restoration measures** focused on restoration of damaged areas, particularly areas damaged by windstorm

in November 2004. Restoration of these areas shall be implemented according to "The project for restoration of forest ecosystems in the High Tatras affected by wind-storm on 19 November 2004". Affected areas in core zone should be left for natural succession, without application of pesticides. In case of insect outbreaks, pheromone traps will be employed to control them. Other restoration measures include, for instance, restoration of access roads, restoration of riparian forests, particularly those that are recognised as biocorridors, assessment of environmental risks from log/assortment dumps and landfills and their subsequent sanitation/relocation and restoration of affected areas.

– **Spatial organisation measures** were aimed at changes in spatial organisation of land-use elements, particularly in areas where current land use is conflicting with ecological attributes of landscape. These measures include: establishment of elements having high ecostabilising effects, completion of ecological networking (development of territorial system of ecological stability), particularly in agricultural landscape present in transition zone, increased representation of vegetation in municipalities, development of buffer zones (20–50 m) along water courses in basins for the protection of waters against pollution, introduction of measures to control soil erosion and land sliding, planting vegetation belts around pollution sources, industrial objects and farms, etc.

– **Technological measures** that have potential for decreasing effects of secondary stress-inducing factors include for instance installations/improvements of filters, sewerage systems, waste disposal systems, water protection measures, introducing progressive technologies in farms, etc.

– **Diagnostic-precautionary measures** aimed at development of comprehensive monitoring system to monitor biodiversity, forest ecosystems, SO_x, NO_x, O₃, and other pollution, water quality, soils, development of territorial monitoring system.

Conclusion

The study presents the results of our research, including scientific information, arguments and standpoints. It was submitted to bodies competent to plan for further development and protection of the Tatry BR. We are convinced that application of the findings and recommendations in decisions making process should not only be possible, but also be beneficial to and necessary for meeting interests and expectations of local population, population living in regions surrounding BR as well as of international community.

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Strategia zrównoważonego rozwoju rezerwatu biosfery Tatry

Celem badań było opracowanie strategii zrównoważonego rozwoju w rezerwacie biosfery Tatry. Głównym przedmiotem tych badań była identyfikacja istniejących problemów socio-ekonomicznych, krajobrazowo-ekologicznych i środowiskowych, zaprojektowanie sposobów ich wyeliminowania oraz zabezpieczenie przed pojawieniem się nowych problemów w przyszłości. Najważniejszym celem tych działań jest osiągnięcie sytuacji, w której zagospodarowanie obszaru w najwyższym możliwym stopniu pozostaje w harmonii z jego potencjałem. Podstawowymi zasadami stosowanymi w zarządzaniu obszarem winny być: ochrona przyrody, różnorodności biologicznej i trwałości krajobrazu, ochrony zasobów przyrodniczych z uwzględnieniem wód, gleb, atmosfery, lasów itp., a także ochronę zasobów kulturowo-historycznych: zabytków i krajobrazu kulturowego itd. oraz ochronę środowiska.

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