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Environmental Risk Assessment for Landscape - ecological Planning in the City Vranov nad Topľou

Zuzana Rusičová, Magdaléna Bálintová

Technical University of Košice
Faculty of Civil Engineering, Institute of Environmental Engineering
e-mail: zuzana.rusicova@gmail.com, magdalena.balintova@tuke.sk

Abstract

Pollution of the environment components in many cases presents unacceptable risks to human health and the environment. Risk analysis is one of the tools which help to find a socially acceptable level of the environmental quality. Evaluation of the environmental impacts can be the base for the optimal spatial arrangement and functional use of territory - landscape optimization. In Slovakia, LANDEP methodology based on the principles of sustainable development, is very often used for landscape planning.

The paper deals with environmental risk assessment of components of environment (air, water, soil, waste, etc.). The results are used as a base for design of the optimal spatial setting and functional utilization of the land – landscape optimization.

Key words: environmental risk, risk assessment, landscape planning, land optimization

1 Introduction

Landscape plan is a result of a landscape optimization, which is elaborated as a support of the region and local planning [1,2]. Environmental assessment and spatial planning documentation mention the risks of the environment and the agents, which exist in the area. The regional level itself seems to be predetermined for examination of the spatial and temporal cumulative effects, because the region represents an adequate space unit and regional plans based on their coordinating role are in many regions the place of the sector plans conflicts [3,4].

Impact assessment in the region may also contribute to finding the most suitable locality to location, e.g. for the new industrial areas [5,6]. The assessment informs which kind of environmental risks is associated with which sphere of interest. For example, location is not suitable when it is situated in the floodplain and there is the possibility of building damage by flood or a given location affects the biodiversity of the country or is relevant in terms of

cultural succession. For this type of counseling, the information provided through landscape planning is needed [7].

The comparison of environmental aspects in the risk assessment can identify the range of the possible environmental conflicts [6]. Based on these results an optimal area with the least environmental conflicts (clashes between land use) can be chosen from the considered alternatives. The result is that there are alternatives to their applicability which are compared in order to optimize the area and to improve the planning process for its use. The Rural Development Plan considers not only the likely impacts of individual projects but also probable cumulative impacts and synergic effects in the whole region. Based on these facts it can suggest reducing the burden and the extent of their development [7,8,9].
The paper deals with a process of environmental risk assessment in the components of environment and deals with exploitation of its results as a basis for design of the optimal spatial settings and functional utilization of the land. In the paper is used a new proposal methodology for optimizing the based landscape and environmental limits and its application for the city Vranov nad Topľou.

2 A proposal of methodology and characteristic of the area

2.1 The methodology for the landscape optimization of the area

As a processing methodology for optimizing the design of landscape areas were selected the methods of risk analysis and landscape planning - assessment of conflicts of interest, ecological carrying capacity and load urbanized countries on the basis of landscape and environmental limits and constraints, and methods of perception of urban environment. Projections for future land use is based on environmental setting limits the use and development of land and its potential for individual [10,11]. However, these were modified and supplemented.

The individual steps in the design methodology have been identified by the methods of landscape planning steps LANDEP [12].

The proposed methodology characterizes environmental limits in the use of the selected area and its potential as characteristics of the territory for its use with the final result of finding the most suitable land use, its optimization. The resulting value of the area (rating value) is based on determination of its potential and the limits and implementing and selective factors are included to its evaluation.

The issue is about the assessment of areas in terms of its suitability for current and future land use in relation to the recognized risk locations and confrontations in the use of the area. The aim is also to integrate and strengthen the research results relating to risk assessment for risk management and optimization areas.

The proposed methodology for optimization of land using the results of environmental risk assessment can be described by six steps:

1. Creation of the assessment´s GRID network - a virtual working environment for assessment of selected area;

2. Risk identification - documentation of local risks and information about selected sources of pollution which have a decisive influence on the pollution of the area, often the raw data for the next step - risk assessment;

3. Environmental risk assessment - risk analysis of current and future land use (for building factories, roads, houses), design of risk maps for vulnerable sites (factories, contaminated sites), determination of the sources of contamination of air, surface and groundwater, soil, etc. and incorporating the results of the master plan;

4. Rating assessment of the area - environmental risk assessment where the inputs are partial results of the environmental risk assessment of environmental components in the area serves as an instrument of landscape optimization. In this work GIS-based multi-criteria analysis was applied to develop a risk dispersion maps showing the risks of the method with the aim to use multi-level analytical method and ArcGIS 9.3 for evaluation and risk assessment;

5. Proposal of the measures for eventually risk reduction in the area - a proposal of measures to reduce risks for current and future land use after the implementation of the measures and areas potentially suitable for future land use;

6. Proposal of landscape area optimization - optimal choice of socio-economic activities in the area and design of measures to improve the quality of the territory.

2.2 Characteristics of the area city Vranov nad Topľou

The area of the city Vranov nad Topľou was selected for environmental risk assessment for the purpose of landscape optimization.
The immediate vicinity of the city was also included to the assessed area because there are localized structures and activities having a substantial impact on risk assessment of the site.

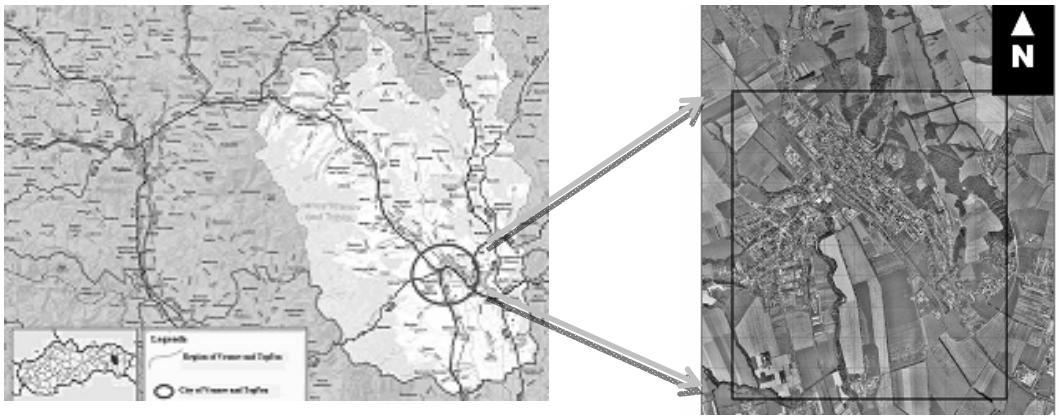

Figure 1: Location of the city Vranov nad Topľou

Area of interest (Figure 1) is located near two rivers Topľa and Ondava and localized in the Topľa valley that passes through the northwestern tip of Eastern lowlands on the eastern part in the altitude of 132 meters above sea level. It is therefore a lowland area. The number of inhabitants in the selected area is 22,972. The assessed area has 22.5 square kilometers.

Evidence of pollution sources were collected by using the results of analyses of pollution over a period of at least last five years.

3 Results and discussion

During the reporting period the pollution of all environmental media: air, water and soil. Subsequently were assessed the environmental risks from air pollution, noise, pollution of water, the occurrence of floods and soil pollution was analyzed.

From these components is as an example presented the environmental risk assessment of air pollution and its rating.

3.1 Environmental risk assessment and rating assessment of the selected area

Reduced air quality of the area constitutes a health risk for populations and increases the vulnerability of ecosystems. For the purposes of risk assessment in the city Vranov nad Topľou were used meteorological data from weather stations Čaklov and data about the air quality from automatic measuring station (AMS), located in the center of the city.
Sources of air pollution in the city:

• Stationary sources especially in industrial activities (wood and paper industries) which produce mainly ash, dust, sulfur oxides, nitrogen oxides and carbon dioxide and waste disposal - incineration of municipal and industrial waste, landfills, waste water treatment plants, animal sanitation facilities.

• Traffic - this group is dominated by automobile traffic. The vehicle releases into the air fuel mixture combustion products - carbon dioxide, hydrocarbons, nitrogen oxides, soot particles containing halogen compounds, lead and other substances, vapors of fuel and lubricants, tires and abrasion of brake linings.

• Small pollution sources - local heating.

• The supply of public heat - the boiler, which produces large amounts of sulfur dioxide, nitrogen oxides and carbon dioxide.

• Building activity - produces dust and waste. In this group of air polluting exhaust gases from internal combustion engines.

• Agriculture and forestry – wind erosion and transport of soil particles, industrial and natural dispersal of fertilizers and plant protection products, emissions from livestock buildings, silos and dunghills.

Effects of pollutants are reflected not only in local and regional scale but also globally.
Atmosphere of city Vranov nad Topľou can be characterized as moderately polluted. Area of the city Vranov nad Topľou belongs to the load area of the Zemplin and it is a part designated as air quality management area for the pollutant - particulate matter PM_{10}, due to long crossing of the 24 - hour the limit. Because of low average annual wind speed of 1.1 m. s^{-1} the area of the city has very unfavorable climatic conditions in terms of dispersion of pollutants. All potential sources of air pollution were marked to the map and are subject to the subsequent risk assessment.

The risk assessment took place under the Methodological guideline of MoE SR from October 22, 1998 No 623/98-2 on Risk Assessment and Management. The procedure for risk assessment and management and the degree of risk from the pollutant PM_{10} was generated from the ArcGIS 3.9 in the form of a dispersion risk map is presented in Fig. 2.

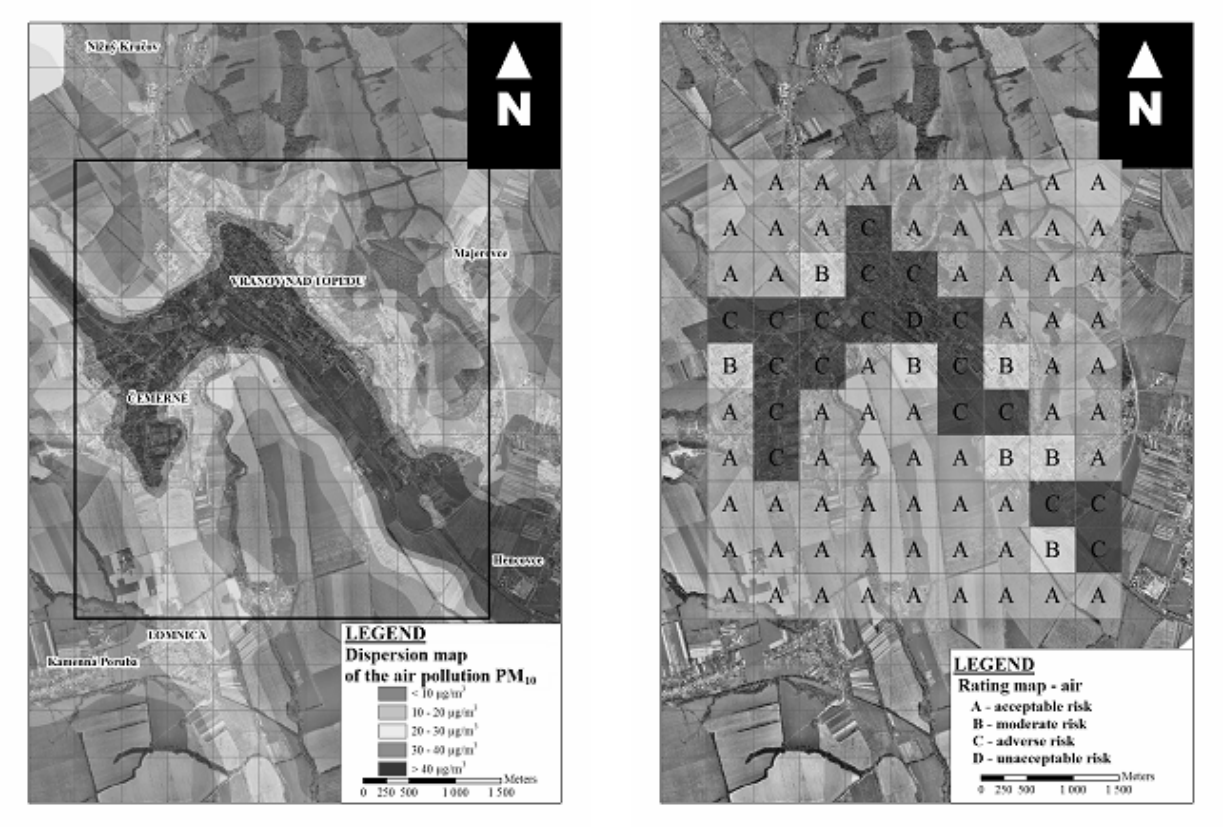

Figure 2: Dispersion map of the environmental risks from air pollution and rating map

Based on this map was determined the rating credit of area in the form of rating map. Environmental risk assessment and the rating credit of area were carried out under the proposed methodology for the optimization of landscape areas as described in Chapter 2.

From the results of the environmental risks assessment- air resulted that the assessed area belongs mainly to the areas with acceptable risk ("A"). Areas with moderate ("B") and adverse risk ("C") cover the northwestern and south-eastern part of the assessed area. Most vulnerable area is the center of the city. The ratio of each type of the areas is as follows: acceptable risk ("A") 71.11%, moderate risk ("B") 7.78%, adverse risk ("C") 20.00% and unacceptable risk ("D") 1.11% of the assessed area.

The same way of the environmental risk assessment was used for evaluation of noise (Fig. 3), water (Fig. 4), floods (Fig. 5) and soil (Fig. 6).

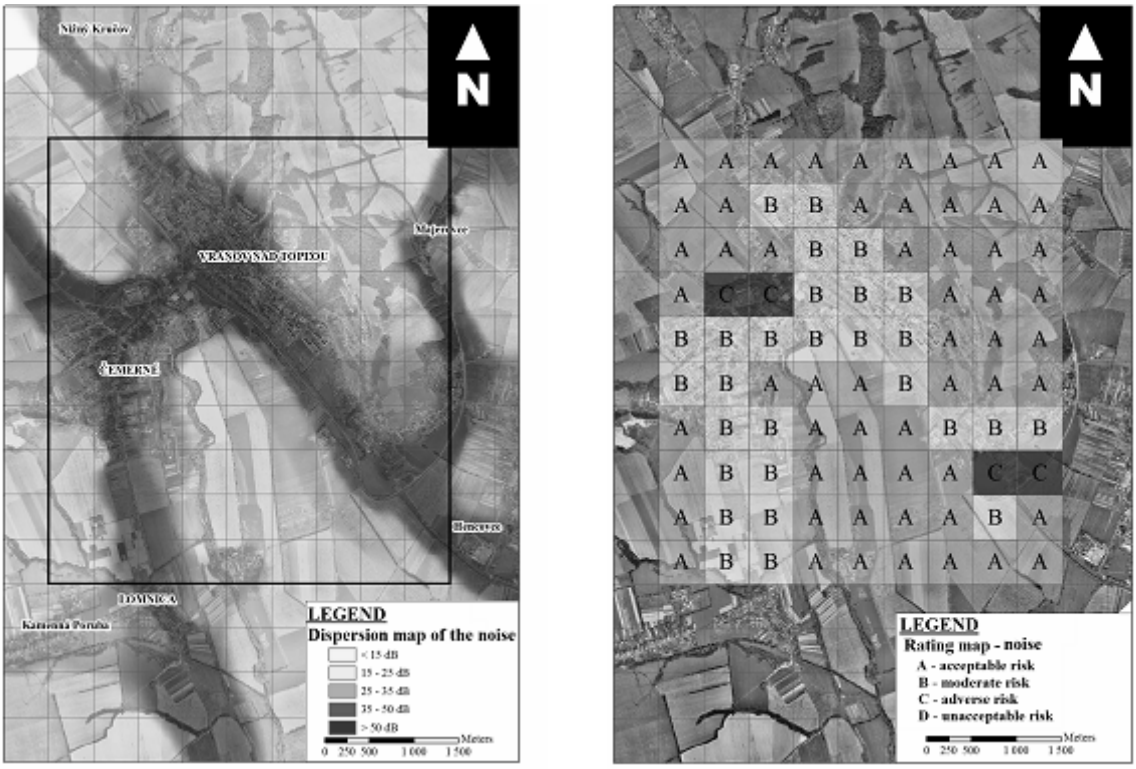

Figure 3: Superimposed maps for risk assessment and rating assessment - noise

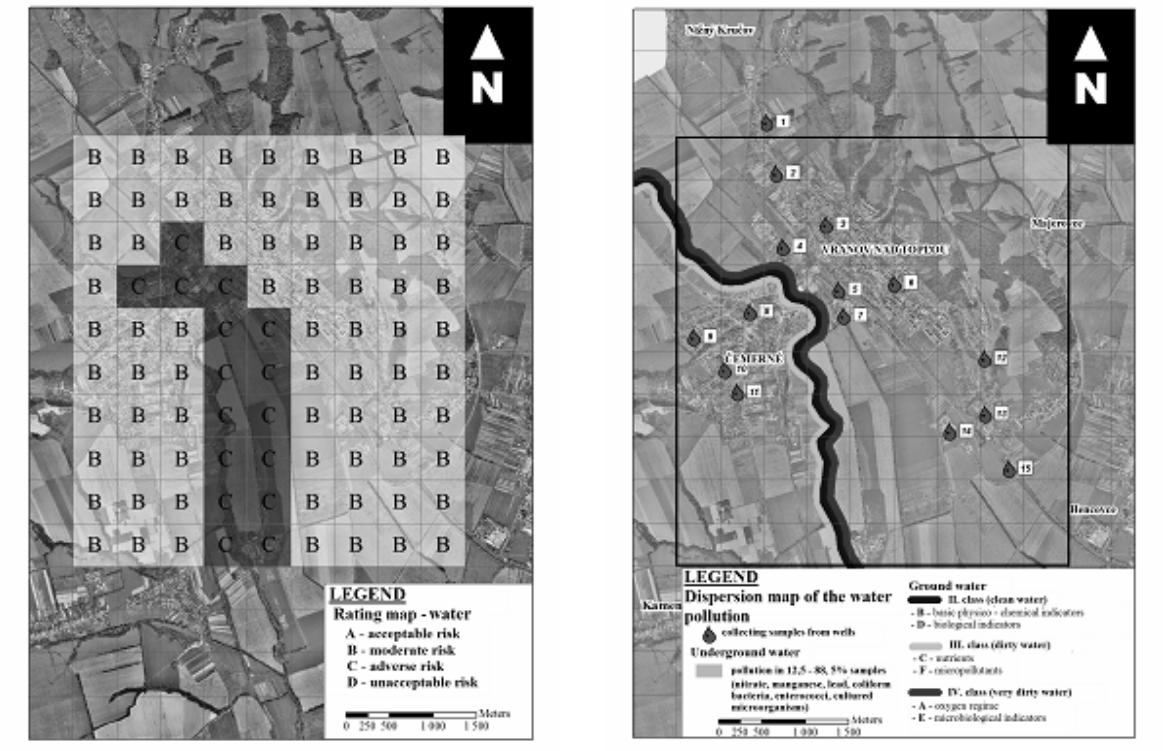

Figure 4: Superimposed maps for risk assessment and rating assessment - water

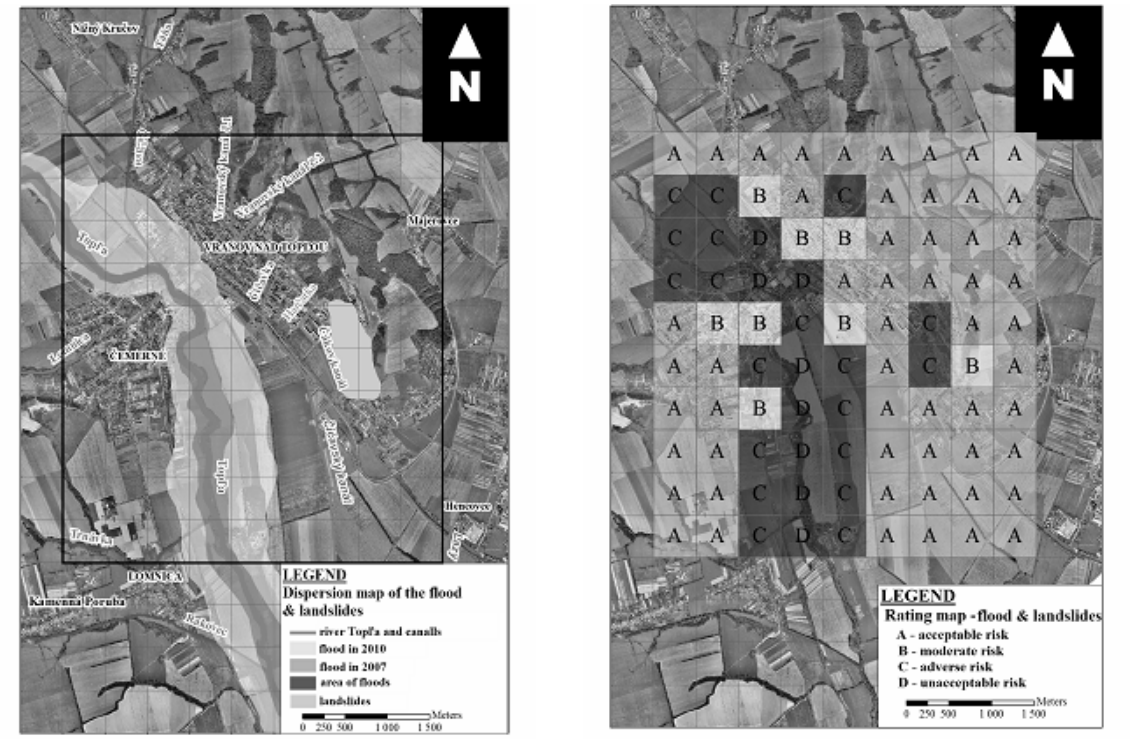

Figure 5: Superimposed maps for risk assessment and rating assessment - flood & landslides

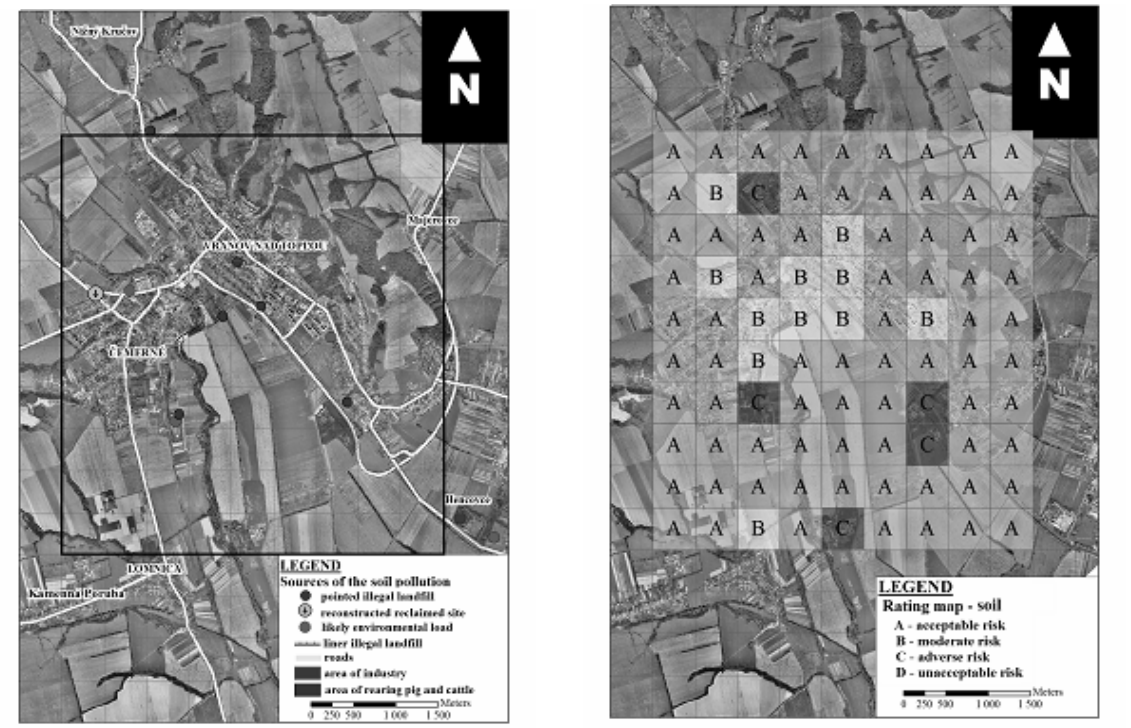

Figure 6: Superimposed maps for risk assessment and rating assessment - soil

3.2 The synthesis of environmental risk assessment and rating assessment

The result of the partial rating assessment is evaluation of each grid cell and hence the rating of area. The results can be used as a base for design of optimal land use and landscape optimization.

The synthesized results of the environmental risks and their assessment (Fig. 7) showed that the most of area is evaluated as an acceptable risk. Rating value of the area in Figure 8 in order to assess the environmental risks of pollutions is: air, noise, water, floods and soil.

Areas with moderate and acceptable risk cover the northern and eastern part of the assessed area. The synthesized areas' ratio is as follows: acceptable risk ("A") 56.44%, moderate risk ("B") 28.00%, risk adverse ("C"), 13.56% and unacceptable risk ("D") 2.00% of the assessed area.

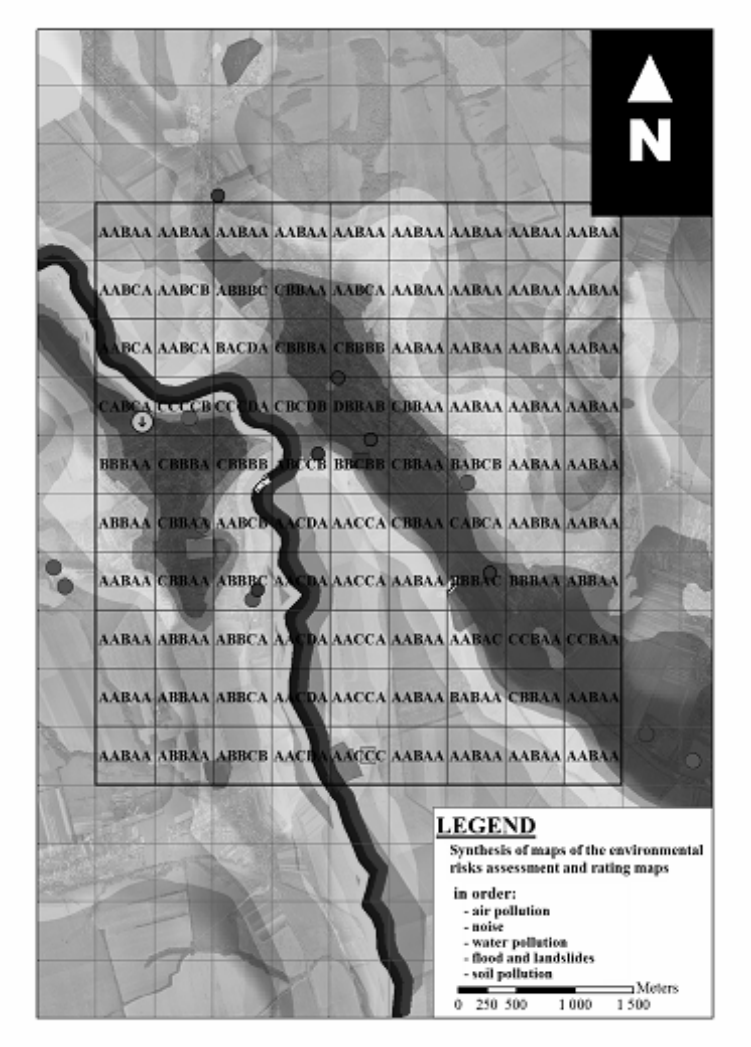

Figure 8: Synthesis of maps of the environmental risks assessment and rating maps

Synthetized results are transferred to the orthophoto base - "interactive map" where clicking on the grid - cell, it is possible to obtain detailed information about the area, which deals with the rating assessment, basic information about the area, the existence and extent of environmental risks and their sources. It may also include data about current and future land use and photo areas. This interactive map can be used for preparation of the landscape plans and spatial plans, for designers as well as for public information.

4 A proposal of measures for optimization of landscape

The ultimate goal of eliminating environmental risks for the optimization of landscape area is to improve the quality of the components of the environment in the way they do not exceed the limit values according to legislation on environmental protection. Based on the results of environmental risk assessment, it is necessary to adopt measures that would help to reduce the risk of pollution of the environment:

1. measures to reduce risks and improve air quality and reduce noise exposure (in the field of public works, in transport and tourism);
2. measures to reduce risks and improve water quality, elimination of floods and landslides (measures to improve the status of water bodies, measures in agriculture to improve the hydro morphological conditions and measures for flood protection);
3. measures to reduce risks and improve the quality of soils (in agriculture, the economic conditions of soil and waste management).

5 Conclusion

The quality of the environment is becoming increasingly paramount concern and an indicator of living standards. The incidence of risk in environmental media affecting the quality of the landscape and human health is a concrete manifestation of urbanization and economic activities of man. The uncoordinated and unsystematic exploitation of natural resources, pollution of air, surface and groundwater and soil and traffic loads with all the negative consequences in the assessment city Vranov nad Topľou caused the penetration of contaminants into the environment and hence the food chain, ending with a man. The deterioration of the environment also contributes to the accumulation of unorganized industrial and municipal waste and general infrastructure and technology obsolescence. Deforestation, land consolidation and drainage of the country have necessitated a total disruption of function and structure of the country with an adverse impact on biodiversity and gene pool. All this ultimately affects mainly the life expectancy and health of human populations in the area.

The paper aimed to provide information on the proposal environmental assessment methodology and assessment of impacts of human activities on the environment with regard to reduction of risk factors with the result of optimization of landscape area. The paper presents possibilities of using the results obtained from the evaluation of environmental risks in the process of landscape and spatial planning in order to achieve optimization of landscape areas, including proposals for measures to eliminate environmental risks and to improve the quality of the environment.

Acknowledgements

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