

ENVIRONMENTAL HAZARDS IN HORNAD RIVER BASIN IN CASE OF FLOOD

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ABSTRACT

Risks in river basins are close-knit with quality of water in water bodies and sources of pollution in the catchment area. Sources of pollution in river basins are mainly urbanization, industry and agriculture, which cause a threat to water resources. The negative impacts of human activities are reflected in both the contamination of water bodies and the deterioration of natural water circulation. The sources of pollution present a great hazard for aquatic environment mainly in case of flood. The flooded area within each is situated point or diffuse source of pollution deteriorated water quality in high rate. Systematic determination and evaluation of occurrence and condition of water bodies is the mission of a state, being an indispensable necessity for the provision of creation the concepts of sustainable development, for the execution of state administration and for keeping public informed.

The paper presents results of evaluation the sources of pollution in Hornad river basin in the eastern Slovakia in flooded area. Environmental risk assessment methods can be particularly useful in evaluating whether uses are threatened when a stressor of concern is not expressed as a numeric criterion in water quality standards. The risk assessment framework can add value to watershed-based management.

Keywords: environmental hazard, sources of pollution, river basin, flood

1. Introduction

The watershed, a hydrologically-bounded ecosystem, is a logical unit for environmental risk management. Watershed managers need a process for determining which environmental features in the watershed are at risk and choosing the best actions to protect them (Zelenakova, 2009). The process of risk assessment is accomplished by evaluating the likelihood that adverse environmental effects may occur or are occurring as a result of exposure to one or more stressors.

Flood damages that arose on watercourses and hydraulic structures on the territory of the Slovak Republic are the most obvious in the eastern Slovakia (Kosice), particularly in the Hornad, Torysa, and Bodrog river basins in recent years (Ondrejka Harbulakova, Hudakova, 2014). Many floods had tragic consequences and caused huge material damages.

The paper studies the impact of the sources of pollution and flooding water on the environment. Environmental impact study in Hornad river basin includes the natural condition identification as well as human activity identification which may cause environmental damages in case of floods in the river basin.

2. Study area

The Hornad watershed (Figure 1) is situated in the Hornád river valley, between the city of Kosice, which is the second largest city in Slovakia and the Hungarian border. Basic characteristics of the river basin Hornad (Ministry of Environment of the Slovak Republic, 2002; Ministry of Environment of the Slovak Republic; 2011) contain Table 1.

Table 1: Basic characteristics of the river basin Hornad in Slovakia

Area of the Danube river basin	807 827 km ²
Area of the Hornad river basin	4 414 km ²
Bordered places of the Hornad river basin:	
– the westernest point	Krahulec 49°00'N 20°06'E
– the easternest point	Maly Ziar 48°42'N 21°33'E
– the northernest point	Budanova 49°15'N 21°18'E
– the southernest point	Milhost (Luky) 48°31'N 21°18'E
– the highest point	Kralova Hola 1946 m asl.
– the lowest point	Milhost (Luky) 156 m asl.
The total length of the river Hornad	178.8 km
Long-term average flow of Hornad	28.9 m ³ .s ⁻¹
The catchment area of Bodva extends into states	Hungary
Regions	Kosice, Presov, Banska Bystrica
Cities	Kosice (233 886 inh.) Presov (90 835 inh.)
Number of villages in the basin area	337
Population	705 102 (year 2009)
Land use:	
Urban areas	6.5 %
Agricultural areas	42.5 %
Forest areas	50.7 %
Water areas	0.3 %



Figure 1: Localization of Hornad river basin in the Slovak Republic.

The land use in the area is presented in Figure 2.

The source of the Hornad is in the Low Tatra Mountains under the Kralova hola hill, southwest of Poprad. It flows through the Slovak regions of Spis and Abov, and through Hungary. It is 286 km long, 193 km of which are located on the territory of Slovakia. Cities along its course are Spisska Nová Ves and Kosice and its tributaries include the rivers Hnilec and Torysa (Presov). It flows into the river Sajó southeast of Miskolc which is itself a tributary to the river Tisza.

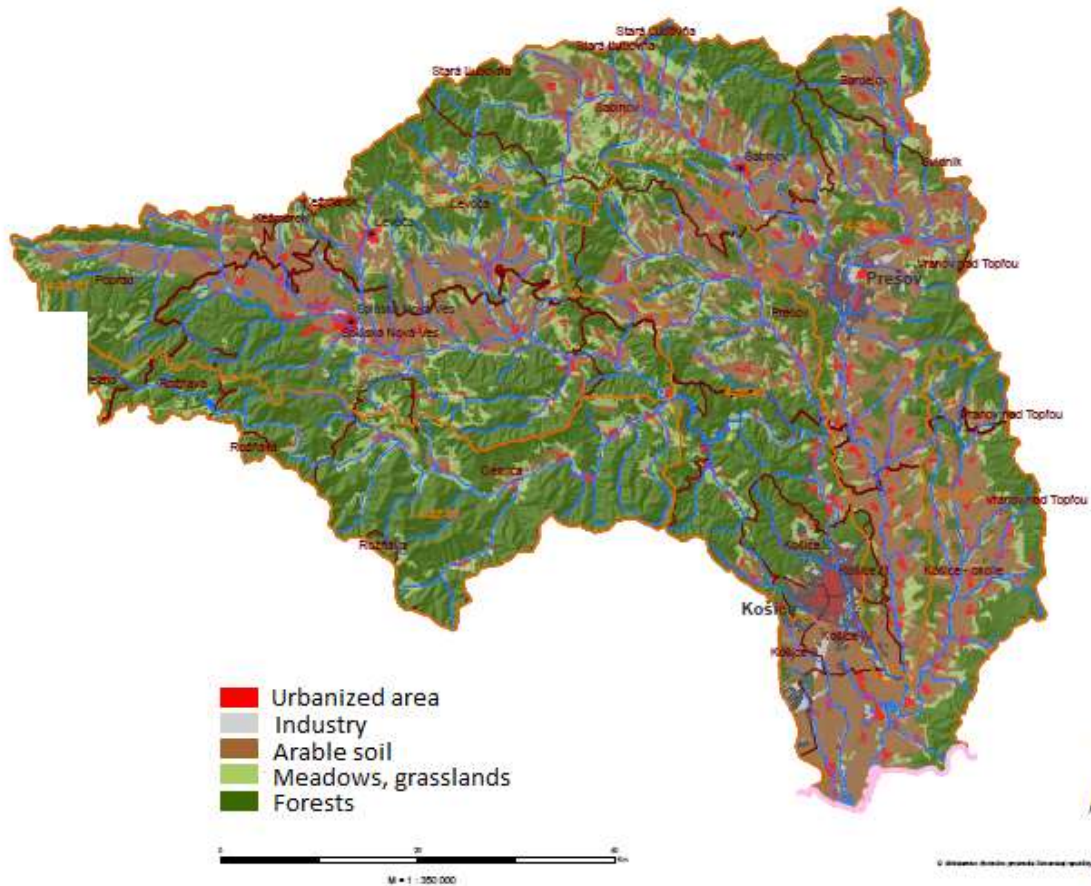


Figure 2: Land use in Hornad river basin (Ministry of Environment of the Slovak Republic; 2011).

3. Data

3.1. Flood risk in the study area

Preliminary flood risk assessment which was done in 2011 in Slovakia according to the requirements of Flood Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risks identified the geographical areas with potentially significant flood risk and geographical areas with probably potentially significant flood risk in river basin Hornad. For these areas flood hazard and flood risk maps were done in 2013 which are available at web of Ministry of Environment of the Slovak Republic for flood with return period of 5, 10, 50, 100 (Figure 3) and 1000 years.

3.2. Sources of pollution in the study area

Potential sources of water contamination are all activities in the catchment, all contaminated sites and landfills, industrial activities, agricultural activities, and other. Point sources of pollution in river basin Hornad are identified in Figure 3.

Point sources of pollution i.e. potentially also found recorded through three dedicated databases:

- KV-ENVIRO (Water research institute, 2008), which contains more than 13 004 potential point sources of pollution. The basis of this database is a database GeoEnviron, which contains 9177 potential point sources of pollution. These are 2 279 sites, 6 938 landfills and other sources of pollution.
- Register of contaminated sites (REZ), which is part of the Information System (www.enviroportal.sk) was built under the project Systematic identification of contaminated sites in the Slovak Republic (www.sazp.sk). It contains 1 819 sites, which

- are divided into 3 parts: likely environmental burdens (Part A) - 878 sites, environmental burdens (Part B) - 257 sites rehabilitated and reclaimed environmental burdens (Part C).
- Database: Integrated monitoring of pollution sources (IMMZ), which contains sources of pollution of hazardous substances, which the State Water Authority ordered a duty to monitor their impact on groundwater. This database currently contains more than 310 sources of pollution, mainly landfills (Water research institute, 2008).



Figure 3: Point sources of pollution in flooded areas of river basin Hornad.

4. Results

Flooding of mentioned sources of pollution as well as from diffuse sources of pollution may leak out pollutants and thus deteriorate the quality of surface water, groundwater, and soils, which can lead to environmental disasters, such as damage of habitats, fauna and flora as well as diseases and epidemics occurrence.

Table 2 gives information source of pollution and their classification according the degree of danger for environment, stated by authors. Each source was divided into categories according different criteria based on literature studying, consultation and experiences. The more dangerous source of pollution has the higher point classification.

The actual sources of pollution in the studied area – Hornad River (without its tributaries), situated in the flooded area are marked in bold in table 2. It is resulted as follows:

- Industrial enterprises and sewage treatment plants were identified in the area as it is stated in the Table 2;
- Surface mine area near Kosice City was identified;
- Agricultural area contains 47.0 % from whole the flooded area (by Q100);
- Percentage of population without sewerage is 24.0 as from 705 102 of equivalent inhabitants 47.0 % is connected to sewerage systems and 29.0 has individual systems of wastewater treatment;

- Environmental burden – there are likely as well as confirmed burden in the study area – according the Register of contaminated sites (REZ).

Table 2: Classification of sources of pollution

Source of pollution	Characteristic	Criteria	Point classification x number of sources of pollution
Point sources of pollution			
Industrial enterprises	Category of enterprise	unclassified	2 x 11
		A	3 x 2
		B	4
Sewage treatment plants	Number of equivalent inhabitants	< 2000	1
		2000 – 10 000	2 x 10
		10 000 – 100 000	3 x 2
		100 000 and more	4 x 1
Petrol stations	-	-	4
Diffuse sources of pollution			
Landfills	Type of landfill	for inert waste	1
		for non-hazardous waste	2
		for hazardous waste	3
Impoundments	-	-	1
Mine activities	Type	underground	1
		surface	2
Population in urban areas	Percentage of population without sewerage	0 – 40	1
		40 – 60	2
		60 – 100	3
Agricultural areas	Percentage of potentially flooded area	0 – 40	1
		40 – 60	2
		60 – 100	3
Environmental burden	-	is reclaimed	1
		is likely	2 x 11
		is confirmed	3 x 3

5. Conclusions

In the case of flood the main damages on the environment may occur as a consequence of accidents at sources of pollution. The issue of pollution sources is a key area of environmental protection. While pollution from point sources can be disposed by suitable technology, for diffuse pollution are essential proposals of preventive measures, that creating conditions to prevent contamination.

In general and as well for Hornad river basin, proposed measures to mitigate adverse environmental impacts of flood risk are at least as follows:

- The proposed activity has been done along with the regulatory approval within the territorial planning documentation of municipalities;
- Within the river stream regulations implement an adequate compensation plants rather native species in appropriate of places providing channel flow capacity;
- Technological part of the work carried out in accordance with the preparation of project documentation;
- Ensure appropriate monitoring regime and quality of surface and groundwater;
- Develop a plan of emergency measures for the disposal of any environmental damage.

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