

NATECH RISK AND MANAGEMENT: AN ASSESSMENT OF THE TARNAVELOR PLATEAU'S SPECIFIC HAZARDS

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Abstract. Industrial facilities are vulnerable to natural disasters. Companies located in densely populated areas might release high quantities of hazardous material. Even so, companies do not conduct systematically analysis and assessment of NATECH risks and they are not always in a position to draw lessons from past NATECH events – and to modify their process or safety features in order to reduce their vulnerability. Climate changes play an important role in prevalence and NATECH triggering mechanisms. Projections under the IPCC IS92 a scenario (similar to SRES A1B; IPCC, 1992) and two GCMs indicate that the risk of floods increases in central and eastern Europe. Increase in intense short-duration precipitation is likely to lead to increased risk of flash floods. (Lehner et al., 2006). The present paper brings together information about natural disasters and technological accidents that occurred across Tarnavelor Plateau (Transylvanian Depression) in recent years and their impacts on the environment and society. The most dramatic of these events are brought alive through case studies, based largely on local information, which detail their chronology and consequences. Natural disasters and technological accidents are not always singular or isolated events. This analysis indicates that NaTech disasters have the potential to trigger hazmat releases and other types of technological accidents.

Introduction

The Tarnavelor Plateau shows a relative homogeneity of landscape. Three distinct sub-units are found in terms of Tarnavelor Plateau territorial structures and functionalities: Hills of Tarnavei Mici, Plateau Hârțibaci and Plateau Secas (V. Sorocovschi, 1996).

1. Natural and technological hazards

Floods risk. In Târnavelor Plateau flood contributes to the highest percentage of natural disasters (70%), and has affected the largest population, with the highest economic loss.

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In the Târnavelor Plateau most of the floods are generated by rain. Over the past 38 years floods affected an estimated area of 80-90 square kilometers. During this period, the area suffered about 26 significant damaging floods, causing 12 fatalities, the displacement of about 43 people and at least 25 billion euro in economic losses. The impact of floods on the economy varies from site to site, but is highly significant, especially because of the many priorities which have to be addressed in a relatively short time.

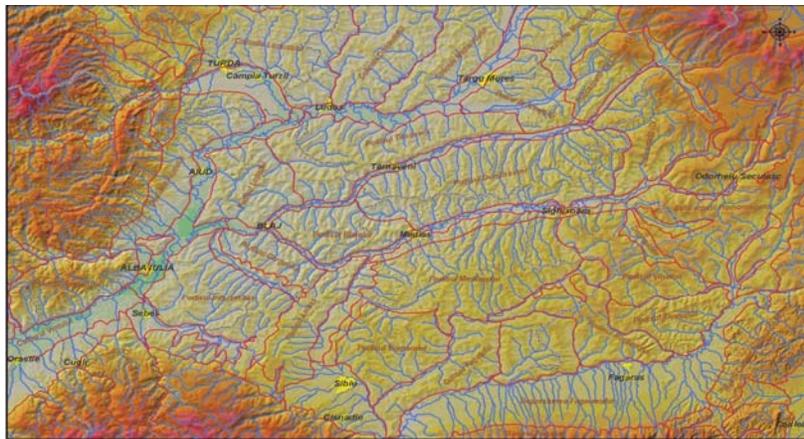


Fig. 1 – Târnavelor Plateau

The most important floods in the Tarnava basin occurred in May 1970, 1973, July 1975, May 1978, 1980, March 1981, May 1984, December 1995-January 1996, June 1998, April 1999 and 2000, May and August 2005. Floods vary according to seasons, the most frequent in spring (30% -50%), less in autumn (6% - 10%). The maximum frequency is in April and March, the melting snow combined with abundant rainfall in the spring, followed by June with the rainfalls recorded after periods of wet soil and strong ability of water absorption decreased.

The frequency of high floods will be increased by the general intensification of rainfall events and by earlier melting of snowpacks.

Increasing flood risk determines an increased impact as a result of excessive urbanization and changing the degree of soil coverage with vegetation. It is also noted an increase in flood risk areas in the embankment. The increasing volume of floods and peak discharge would make it more difficult for reservoirs to store high runoff and prevent floods.

Figure 2 presents the percentage of area exposed to floods from the total area for each administrative unit of the Tarnavelor Plateau.

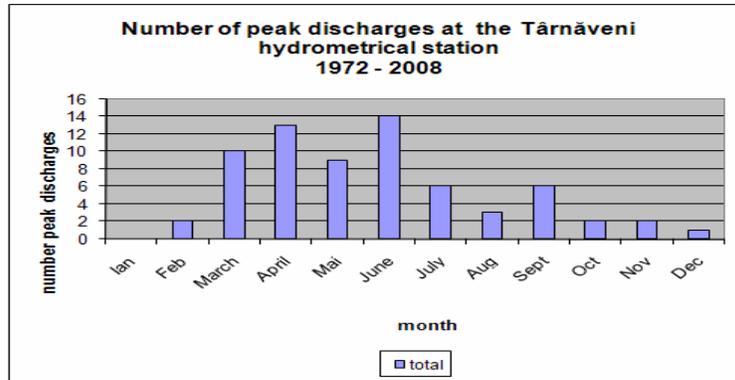


Fig. 1 - Number of Tarnava river flow peak discharges 1972 - 2008

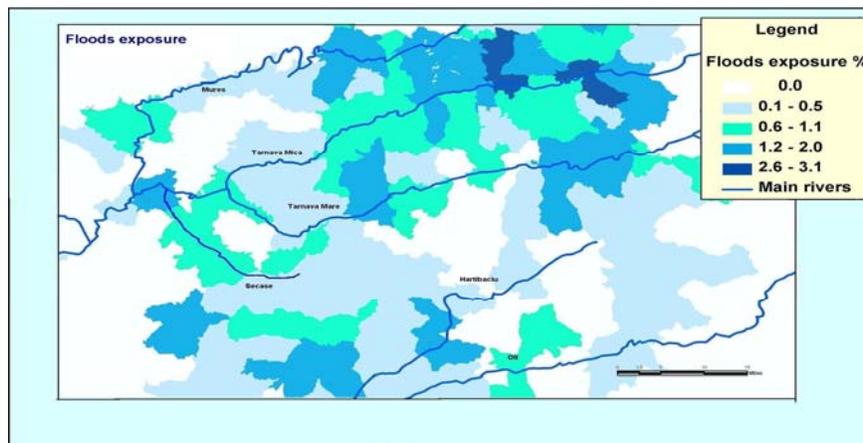


Fig. 2 – Floods exposure

In the Tarnava river basin most of the floods are generated by rain. The flood analyses from the period of 1972-2004 at the hydrometric post from Tarnaveni of Tarnava river shows a major flood in July 1975, when at 5 pm on 3 July 630 m³/s were recorded a value 60 times higher than the average discharges characteristic of July at this post.

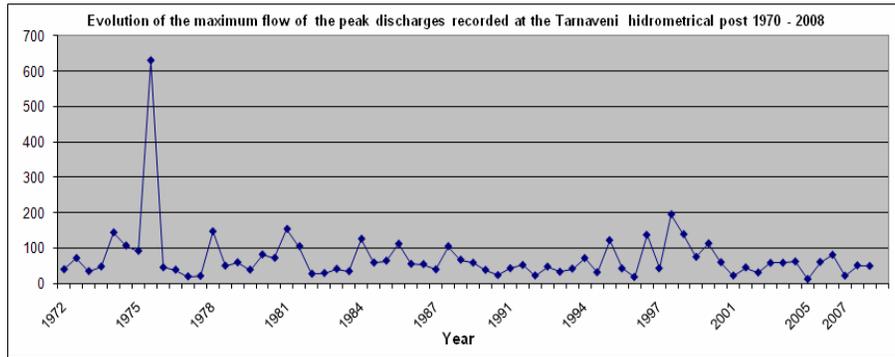


Fig. 2 – Evolution of the maximum flow of the peak discharges recorded at the Târnăveni hydrometrical post 1970 – 2008

Year 2005 can be considered a year of flooding in Romania. The 2005 floods affected 32 localities, 131 houses were destroyed, 10 bridges and footbridge were damaged, 50 kilometers of national and county roads were affected and 350 hectares of farmland were flooded.

The high water overrun that produced the 2005 floods has been generated during the first months (from February to April) of the overlap with rain melting snow, then, between June to September floods were caused by flash rain with a increased intensity in very short periods of time, that is 2-3 days.

Landslides. The crystalline basement of the Tarnavelor Plateau is covered by Tertiary sedimentary rocks. The relief fragmentation, the composition of rocks least resistant to erosion, mainly agricultural land use and unprotected slopes facilitate dynamic modeling processes, mainly sheet and surface erosion (affecting all deforested slopes). This area is affected by extensive land erosion, also because of the massive deforestation or the improper use of land for agriculture. Landslides increased substantially during the second half of the 20th century, mostly because of urbanization and agricultural land abandonment

The impacts of landslides are usually underestimated, partly because most events are relatively small and also because damage often tends to be subsumed under the more general impacts of flooding, with which landslides are frequently associated.

Figure no.3 presents the percentage of areas exposed to landslides from the total area, for each administrative unit of the Tarnavelor Plateau.

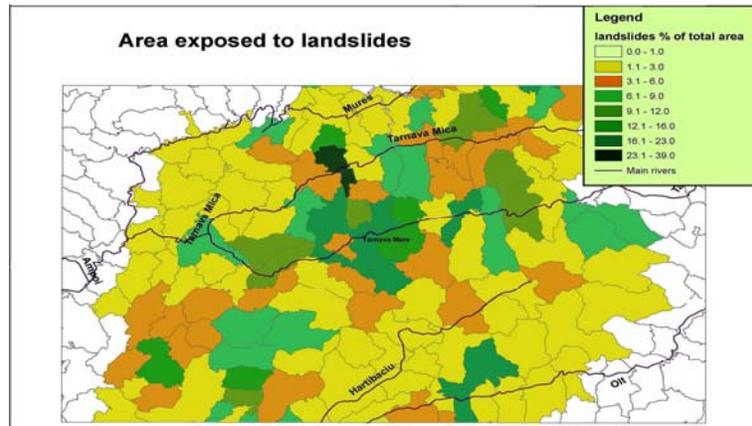


Fig. 3 – Areas exposed to landslides

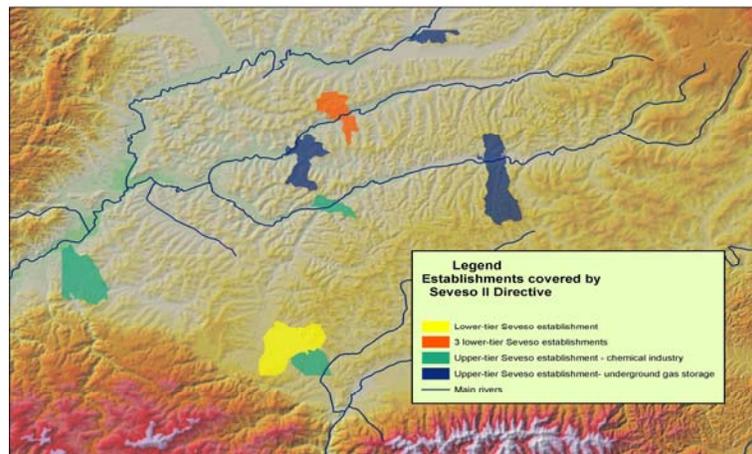


Fig. 4 – Seveso establishments

The process is quite widespread, but does not produce casualties.

Soil degradation as a result of anthropogenic activities is notable in some areas such as Copșa Mică, Medias. Atmospheric emissions of heavy metals (Pb, Zn, Cd, Cu) deposited on soil and vegetation resulting in a degradation of land areas, i.e. approx. 3400 ha of agricultural land heavily polluted and approx. 7600 ha environmental polluted. Experts have said that in the '80s, powerful landslides

were recorded at Copsa Mica, the local soil composition and morphology favoring such processes.

Earthquakes. The geological setting shows no real danger of destructive events involving earthquake, associated landslides and / or their complementary disasters. In the Târnavelor Plateau earthquakes can occur up to magnitude of 4-6 degrees on the Richter scale.

Technological hazards. There are about 10 establishments covered by Seveso II Directive in the area of Târnavelor Plateau, and 6 of those establishments are included in the upper tier.

Natech events are not included in ordinary hazard analysis. However some Natech prevention and mitigation strategies are implemented due to legislative restrictions. In some industrial plants, affected by particular natural risks, special measures are implemented to prevent Natech hazards.

Above those Seveso establishments there are also two very important sites with a great vulnerability to natural hazards with potential of releasing dangerous substances.

During 1972 – 1978, on the chemical platform Tarnaveni, three ponds were built for depositing hazardous-waste disposal result of the manufacture of sodium bichromate, inorganic salts, sludge from waste water purification and filtration, wet gas production from carbide. The ponds are located on the right bank of the river Târnavă Mica at a distance smaller than 35-50m from the defense dams against flooding and the total amount of toxic waste stored in the three ponds is about 128 tons expressed in hexavalent chromium.

The contour of the dams' ponds is strongly damaged in many places, their safety is jeopardized by leakage and sliding slopes. The upstream dam has an increased failure risk. The safety coefficients in this section are under the allowable limit, both in static applications, and the earthquake. The risk of failure due to gradient downstream slopes of dams that are nearing 1:1, is very high. This gradient can not ensure the stability of dams of local materials, at heights of 10 feet. The risk becomes high in case of heavy rainfall, floods or an earthquake.

An industrial waste landfill is located at Copsa Mica, in an area exposed to floods. The waste contains furnace slag resulting from processing zinc and raw metallurgical lead. The characteristics of a storage module are: 60000 mc storage capacity, 3600mp area occupied, 8 m total high of the deposit.

2. Natural hazards triggering technological risks

Considering the existing data one might believe that Natechs have been relatively rare events. In fact those events were not recorded properly, so we hardly could found data about events development, pollutant releases, environmental impacts, economic losses. There is a lack of information regarding the potential

impact of Natech disasters in the Târnavelor Plateau and as a result there is a minimum capacity to respond to these types of events.

Seveso establishments are mostly located in urbanized areas. Higher population density, frequent industry and important infra-structures contribute to significant impact of eventually Natech events. The hazmat releases jeopardize the lives and health of large amounts of people.

The 1970's floods affected the chemical platform Târnaveni. Water entered the warehouse where 800 tons of carbide was stored in wooden barrels. The exothermal reaction with producing acetylene combined with the presence of benzene vapors in the atmosphere resulted in a powerful explosion, which destroyed all buildings within a radius of 200 m around the warehouse. Fortunately, casualties were not recorded, just material losses.

Tailings ponds spills are among the most vulnerable targets technology to natural disasters. Technological accidents such as those in Maramures County (from January to March 2000) had an important international echo. Extreme weather phenomena, like those in the winter of 2000 in Baia Mare, and other natural disasters such as floods or earthquakes, may cause a similar disaster in Târnaveni, Mures County. Although this problem is well known locally, regionally and nationally, the resources necessary for safely storing dangerous residues were not identified.

Conclusion

Natural disasters and technological accidents are not always singular events. They can occur in complex associations and / or in rapid succession, triggering multiple adverse effects of major discharges/spills of substances and hazardous waste into the environment.

Natural disaster may have a forcing effect over technological establishments containing significant quantities of hazard materials. Many of the utilities expected to be available e.g. water, power, and communications, may not be available, chemical safety personnel are likely to be preoccupied, and mitigation measures e.g. containment dikes or foam systems, may not function as anticipated.

It is emergent to assess the risks due to NATECH events in a framework, starting with the characterization of frequency and severity of natural disasters and continuing with complex analysis of industrial processes, to risk assessment and residual functionality analysis.

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