Methodology for the preparation of hazard maps of flood and landslides caused by melting snow in the River Basin Putna-Vrancea, Romania

1. INTRODUCTION

Heavy snow in winter 2012 (from late January until February 14th) is a natural phenomenon so rarely met, that it was called "extreme weather phenomena". At least in the last three years, or in the last two decades, the Romanian winter has been milder, some of them very mild, that the subjective impression was completely different now.

Furthermore the effects of the phenomenon would have been less intense if there were a well established infrastructure, a very good management/coordination and an action plan for such situations; otherwise the consequences are disastrous.

In early spring there will be a risk of large floods, due to the large amount of snow and the rapid rise of temperature, resulting in widespread melting of snow and a possible overlap by spring rainfall.

This is possible especially on the hills with small percentage of afforestation, but also in the plain areas of the inferior area of rivers. The lack of forest will facilitate faster melting of snow, especially on southern slopes, the formation of leakage and floods on the river collector from Putna basin and its tributaries, causing dangers for people and for localities, and numerous material losses.

Unfortunately, the only feasible action under these conditions is the development of early warnings (hydrological)- warn the people to avoid dangerous areas and take prevention and precaution measures. However, due to water infiltration into soil and its saturation, there are trigger or reactivate risks of landslides as the area is known for a high vulnerability to such phenomena. Thereby, it requires quick analysis to determine the organizational and technical measures related to the action to prevent and combat the negative effects of floods and landslides.

Depending on the warming and spring rainfall scenario, the large amount of snow can cause different problems. There will be a rapid or slow melting of snow, depending on the development of the temperature. It is also expected to get very sever rain events, especially on hills with a low percentage of forest, where such phenomena occur due to sudden melting cumulated with precipitation

2. WORK METHODOLOGY

The research activities carried out within the project Monitor II led to a hazard map for leaks from melting snow, a map of areas with potential production of run-off slopes and hydrographic network. For this, the MONITORI II team has accomplished a series of analysis, interpretations and correlations on the following topics:

- Exposed and sloped areas-land, considering all has areas with a particular gradient and alignment and any sloped area causing surface runoff; sunny dispositions have greater exposure to sunlight and will more likely produce leakage;
- land-use across the territory as the leaks being higher on bare headed lands, with sunny exposure; due to the fact that areas covered with forests retain a larger amount of water, and forests - the resinous ones - delay the process of snow melting even on sunny dispositions;
- The drainage density, respectively the density and distribution of the hydrographic network; the more hydrographic network is concentrated the more water volume will reach the confluence section;
- Morphometric characteristics of the basin, such as the area, basin shape; the risk is higher in basins with a higher surface and a palmate form;
- Settlement of the localities or economic goals (high risk for those located in the confluences area, on the main or bottom of the basin).

Estimating the potential for leakage from melting snow the characteristics of the snow cover were namely: thickness, density, water equivalent. Note that the research on the flow produced by melting snow in different river basins (Nereju area) conducted during 1984-1987 period, showed that it was of 18.9% for a snow cover of 32 cm, 37.6% for a snow cover of 53.1 cm and 56.5% for a snow cover of 95.7 cm, and a water equivalent of 93 l /mp, in the basin Hurjui (Nereju), covered in proportion of 22% by forests.

In relation to the percentage of forest cover, leakage from melting snow was about three times higher in basins with low afforestation (22%) compared to a hydrographic basin with 88% of the area covered by forests (Monteoru-Nereju).

From the official data provided, the thickness of the snow cover submitted in Putna basin in February 2012 was between 60 and 110 cm and the equivalent water volume is 99.1 and 176 l /mp. These data confirm previous research results and thus can estimate that at the level of Putna basin, the average flow from snow melt will be between 30-50% of the volume of water in snow cover depending on the speed of melting snow and the precipitation that will occur during melting or immediately after, and the land or torrential hydrographic basins characteristics, including the percentage of afforestation, arrangement works of torrents.

3. RESULTS

Thus, there was differentiated the areas with potential run-off slopes and hydrographic network, including:

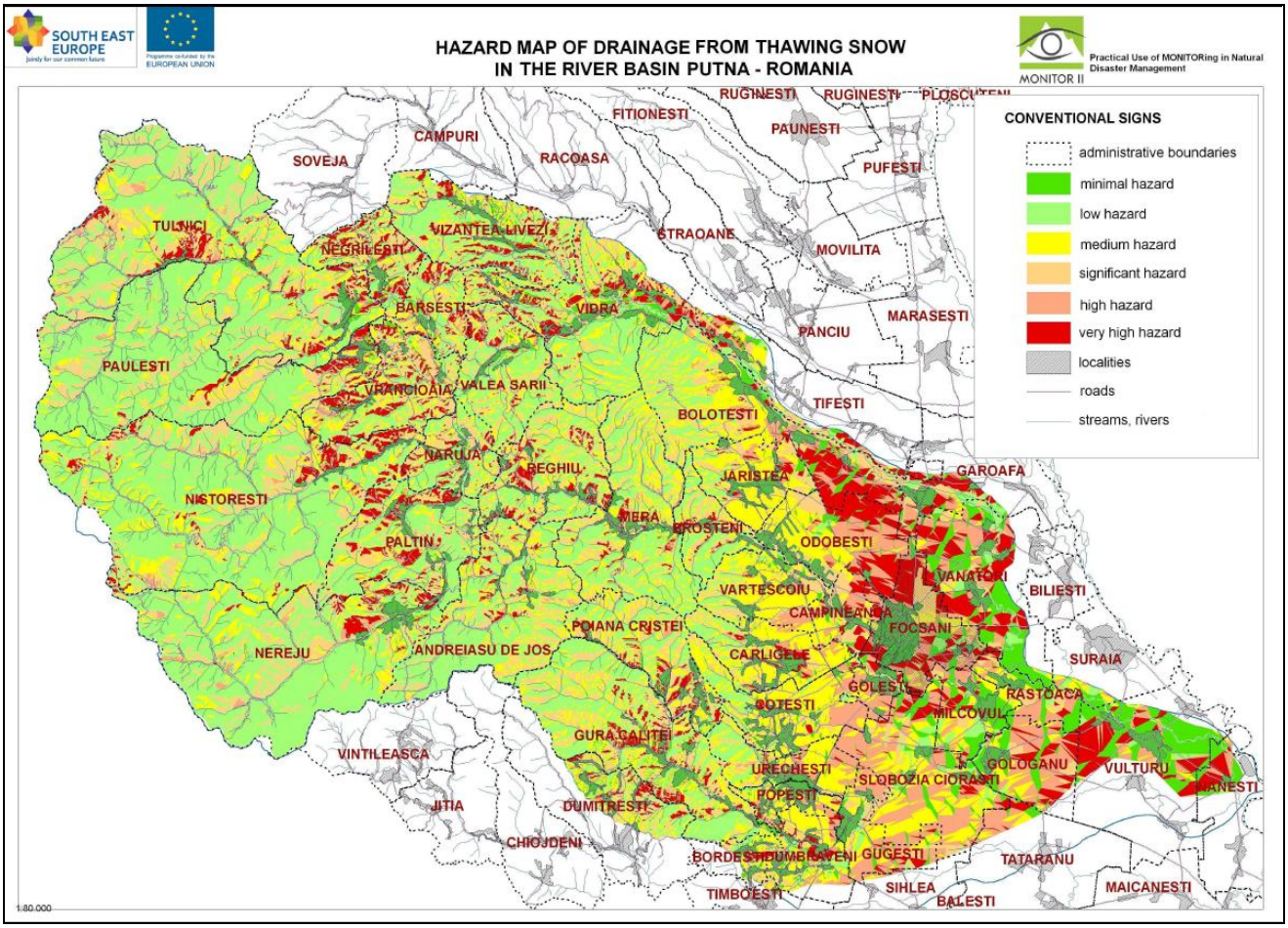
- High-potential areas, located in the confluence of several torrential hydrographic basins with southern exposure, steep and with a palmate shape (Gravelius coefficient higher than 1), high density of hydrographic network (over 1/2km), with small percentage of afforestation;

- High-potential areas, situated at the confluence of more than 2 hydrographic basins mainly with southern exposure, with small percentage (less than 30%) of afforestation or located at the confluence of major tributaries;

- Areas with significant potential located at the confluence of river basins with southern exposure, steep and with high density of hydrographic network, the afforestation rate of 30-50%, those located in the lower basin and the confluence of major tributaries;

- Moderate-potential areas, located in the lower/middle basin, intercepted by streams with northern and north-eastern disposition, with afforestation rate of 30-50% and the rate of the tributary rivers, to the confluence with the main river (Putna);

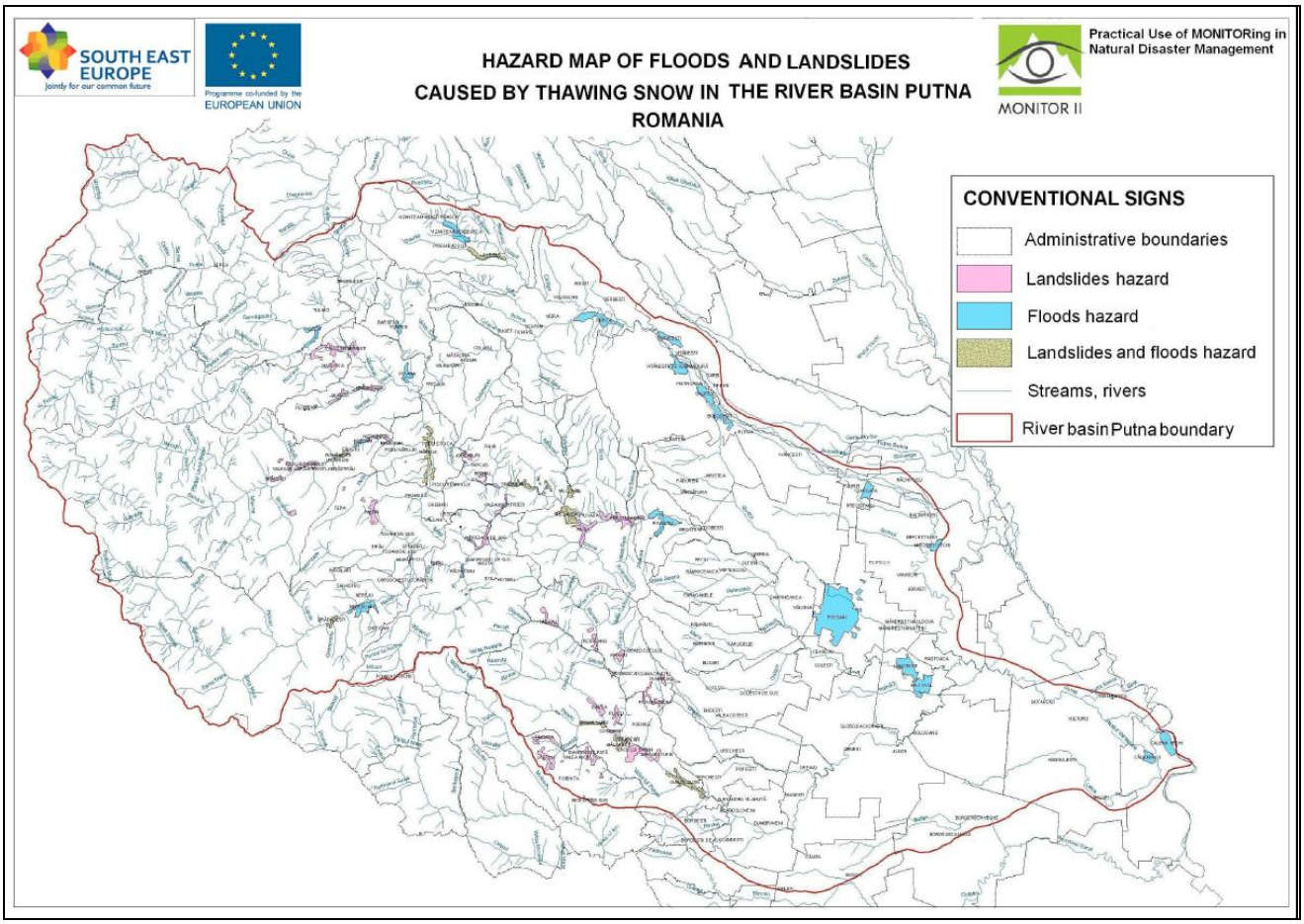
- Low-potential areas: areas and localities located in the upper area of the basin, intercepted by streams on the northern slopes, the percentage of forest is over 50%;



After the development of a map with potential run-off areas on slopes and hydrographic network caused by melting snow, a flood and landslides hazard map was developed for the river basin Putna-Vrancea.

The hazard map for flooding – flooding caused by melting snow - differs from the hazard map of floods which are caused by rain, because it focuses on leaked all over the basin, the soil is partially frozen and vegetation is incapable of retention compared to the retention capacity during the vegetation season.

By linking existing data on the snow cover with the results of research concerning leakage from melting snow and overlaying maps with different characteristics of the territory (exposure, slope, land use, vegetation type, hydrographic network, roads, localities) and concerning the leakage risk from melting snow resulted the flood and landslides hazard map caused by melting snow.



It is found that most of the localities of the hill (Subcarpathians and Vrancea Depression) located in the basin of the rivers Ramna, Milcov, Zabala, Naruja, Vaslui are exposed to combined hazards, floods (caused by rain leaks) and landslides. Also, in these areas there are localities exposed only to slide hazards, located on the direct slopes of the torrential hydrographic network, caused by soil soaking with water, combined with erosive undermining of the base of the slope. Concerning floods, caused by overflow, there are localities exposed from the lower third of the basin located on the Putna river or the confluence of tributaries with large basins with low percentage of afforestation.

Monitor II Team