THE NECESSITY OF FLOOD RISK MAPS ON TIMIŞ RIVER

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Abstract

In this paper the necessity of risk reduction in flood prone areas along the Timis River is clarified. Different methods to reduce risk in flood prone areas are analyzed as well.
According to the EU Flood Directive it is mandatory for the European countries to develop flood maps and flood risk maps. The maps help to assess the vulnerable zones in the floodable (i.e. flood prone) areas. Many European countries have produced maps, which show areas prone to flooding events of known return periods. In Romania maps showing areas at risk are not yet produced but Romania is starting to implement the flood risk maps at the national and regional level.
Banat Hydrographical Area was affected by severe floods on Timis River in 2000, 2005 and 2006. The 2005 flood was the most devastating one with large economic damage. As a result of these catastrophes the need for generating flood risk maps along the Timiş River was clearly shown. The water management experts can use these maps to identify the “hot spots” in Timis catchment, give the people better understanding of flood risk and help to reduce the flood risk more effectively especially in vulnerable areas.

Keywords: *flood, flood prone zones, flood return period, flood maps, flood risk maps, Banat Hydrographical Area.*

1 GENERAL PRESENTATION

Banat Hydrographical Area is positioned in the South Western part of Romania; the Serbian border limits the South and West of the area. The Northwest is limited by the Hungary. Banat occupies an area of 18.320 km^2, which represents 7,7% of the Romanian territory.
Two counties are located within Banat Hydrographical Area: Timiş County and Caraş-Severin County. Banat Hydrographical Area also lays partially in three other counties (Arad, Gorj and Mehedinți).
Banat Hydrographical Area is characterized by the presence of all forms of relief, whose altitude decrease from South-East to North-West.
Banat Hydrographical Area has a moderate continental temperate climate with Mediterranean influences as a result of Atlantic and Mediterranean air circulation. This type of climate generates the moderate character of the thermal regime: warmer periods in wintertime as well as high multi-annual precipitation, between 600-1400 mm/an.

Figure 1: Banat Hydrographical Area
Source: Banat Water Directorate Archive

Banat Hydrographical Area includes the following river basins:

- Aranca R. B. L= 389 km F= 1201 km
- Bega R. B. L= 1418 km F= 4470 km
- Timiş R. B. L= 2434 km F= 7310 km
- Caraş R. B. L= 502 km F= 1280 km
- Nera R. B. L= 574 km F= 1380 km
- Cerna R. B. L= 524 km F= 1360 km
- Danube R. B. (partially) L= 455 km F= 1319 km

The Timiş River with river basin surface of 5.673 km^2 and a main stream length of 241,2 km, has the largest extent of all rivers from the Banat Hydrographical Area. It course represents the main drainage artery of the rivers found in the catchment of the Banat-Godeanu-Tarcu and Poiana Rusca mountains.
Timiş River springs from the eastern slope of the Semenic Mountains, from the Piatra Goznei summit, on an altitude of 1.135 m. The upper course has a typically mountainous character, with a slope of 20 m/km. The situation changes radically in the lower course (from Lugoj to Graniceri) where the slope decreases up to 25 cm/km.

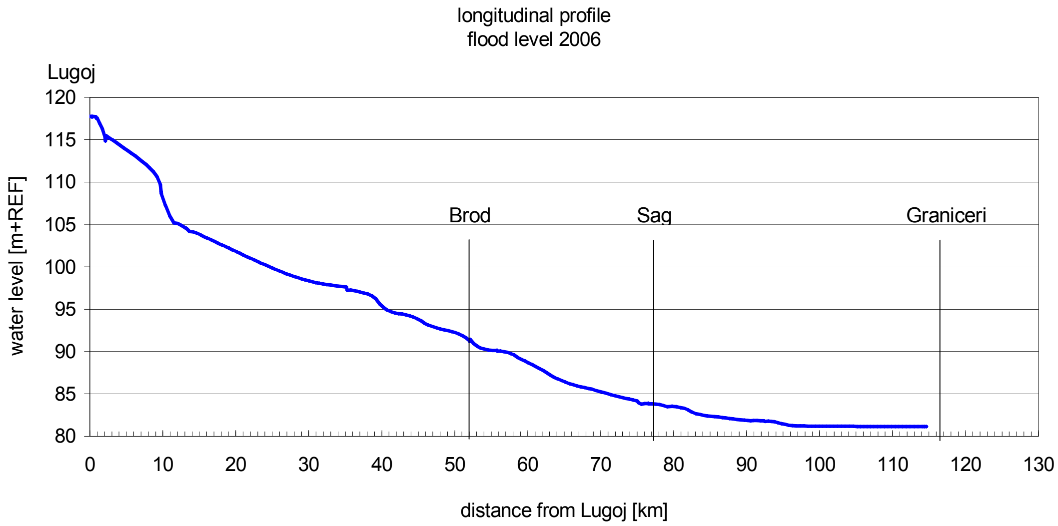

Figure 2: calculated longitudinal profile during the 2006 flood
Source: Job Udo, HKV Consultants

2 HISTORICAL FLOODS

In 1966 a catastrophic flood occurred on Timis River when a dyke breach occurred on the left bank of the Romanian part of the river near the Romanian Serbian border., After a period of 30 years with low waters important flood waves occurred in February 1999 and April 2000. The 1999 flood wave passed without any inundations. However the 2000 flood wave caused breaching of the left embankment on Romanian territory flooding 17.500 ha of protected land in both Serbia and Romania, similar to the situation in 1966.
Due to snow melt combined with rainfall in the upstream catchment, in April 2005 at the middle of the month an extraordinary flood wave appeared was generated on Timis River. In Serbia and Montenegro a normal flood defence was declared on 16.04.2005, which increased to an extraordinary flood defence the next day. This resulted in applying the necessary operative flood defence measures. On 19.04.2005 the Romanian side informed about the heavy rainfall with a forecast of very high water levels on Timis River, similar to the ones in the catastrophic year 2000. On 20.04.2005 the Romanian territory was flooded through three breaches in the right embankment (km 6+700, 6+900 and 8+250 upstream of the Romanian – Serb Montenegrin border), flooding 30.000 ha and several villages in both countries.

In order to protect the Timis River vicinity area several defence measures exist: a linear defence system consisting in general of dykes, water retentions and a network of drainage channels with which the flood water can be diverted back into the Timis River. The dykes are located along the river course in the lower part of the river. On Serbian territory, in Tomaşevăț-border sector, the dyke on the left bank along Timis River forms a defence line together with the Danube-Tisa-Danube canal dykes. The right bank is also protected; the dyke is built from the border with Romania to the intersection with Danube-Tisa-Danube canal at Botos where inundation is not possible due to high grounds.
Water retentions areas and polders are located on Romanian territory. Some of these are placed near the river course in order to retain the water from Timis River; other reservoirs are built on tributaries in order to attenuate the flood waves and to prevent simultaneous flood waves on Timis River and its tributaries.
On Serbian territory a channel network is built within the Danube-Tisa-Danube (D-T-D) Hydro technical System, which improves the flood defence conditions in Banat Hydrographical Area. A unique system, classical, formed by interior river courses and the D-T-D canal, insures the possibility of levels redistribution function of discharge size on each river course and the level coincidence in Danube and Tisa emissaries.

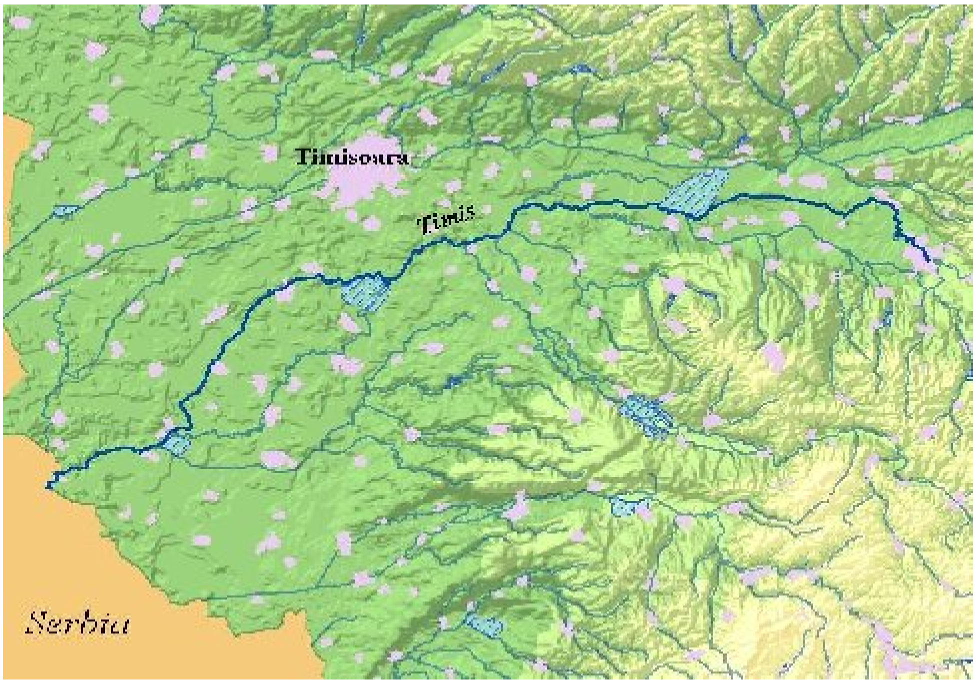

Figure 3: Timiş River catchment in Lugoj-Graniceri section
Source: Job Udo, HKV Consultants

The classical method of reducing flood risk consists mainly of structural measures like linear defence systems (dykes), water retention areas and drainage channels. However raising the dikes do not necessary reduces the flood risk. On the contrary, it can even increase the risk. Therefore vulnerable zones in floodable areas should be identified. Combined with floodplain maps and flood maps, flood hazard maps, flood damage maps

and flood risk maps can be produced. These maps so called non-structural measures can help to reduce flood risk as well.
On January 18th 2006 the European Parliament and the EU Council issued a proposal for a Directive on the assessment and management of floods that hereafter is referred to as the "draft EU Flood Directive". The draft EU Flood Directive considers all elements of flood risk management (i.e. prevention, protection, preparedness, emergency response and recovery). The draft EU Flood Directive proposes that all EU member states should prepare flood risk maps and flood risk management plans.
The draft EU Flood Directive states that flood maps and indicative flood damage maps (or flood risk maps) should be prepared by EU member states for river basins, sub basins and stretches of coastline. These flood maps should be prepared for different probabilities of occurrence or return periods (T):

- Frequently occurring flood events (T = 10 year);
- Less frequently occurring flood events (T= 100 year), and;
- Extreme flood events (T >> 100 year).

In order to assess vulnerable zones from the floodable areas non structural measure to reduce flood risk can be taken into account. The non structural measure that this paper focuses on is the development of floodplain maps, flood maps, flood hazard maps, flood damage maps and flood risk maps.

3 FLOOD RISK MAPS

Floodplain maps. A flood plain map shows the area that will be flooded during a particular flood event, having a certain probability of occurrence (or return period). Basic information depicted on a flood plain map is the inundation depths. In addition flood plain maps might contain information on maximum flow velocities.
Flood hazard maps. a flood hazard map aims at providing information on the danger level of a certain flood prone area. Parameters of interest that might be depicted on a flood hazard map are for instance:

- maximum water depths,
- maximum flow velocities,
- maximum speed in which water levels can attain certain flood depths, including associated flow velocities.

Flood damage maps. A flood damage map provides information on the potential damage invoked by a particular flood event, having a certain probability of occurrence (or return period). Damage is usually expressed as the total number of casualties and the total amount of Euros lost.
Flood risk maps. A flood risk map provides information on the flood risk, expressed as the probability of flooding multiplied by its potential damage. Flood risk is usually expressed as the number of casualties per year and the amount of euros lost per year.

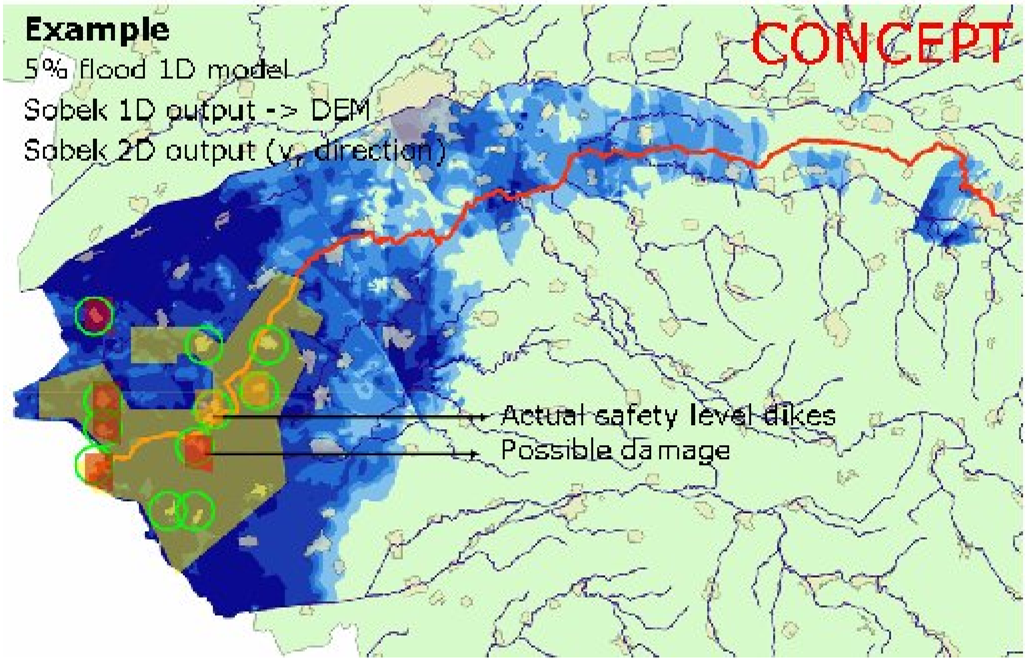

Figure 4: Possible: Flood Risk Map
Source: Job Udo, HKV Consultants

In order to draw flood maps a *large* amount of data is necessary: historical flood data, hydro-meteorological data, geographical data, socio-economic data.
The following data on historical floods have a great importance in drawing up flood maps:

- The probability of occurrence (or return period) of the flood,
- The extend of the flood,
- Observed discharge hydrographs, preferably as function of time,
- Observed flood levels, preferably as function of time,
- Maximum flood depths,
- Observed or estimated local maximum flow velocities,
- Dikes (or other water barriers) that can be overtopped,
- Details on possible dike breaches or collapsed water retaining structures,
- The effectiveness of evacuation procedures,
- The effectiveness of flood mitigation measures,
- Number of casualties,
- The loss of life-stock,
- Economic damage (agriculture, housing, industry, infrastructure, etc),
- Environmental damage (destroyed eco-systems, deposition of toxic agents, etc),
- The loss of historical and cultural values
- Indirect economic damage (i.e. loss of economic productivity).

The following hydro-meteorological data is required:

- Location of gauging stations, including gauge-zero and list of observed parameters,

- Location of meteorological stations, including list of observed parameters,
- Observed water levels at river gauging stations,
- Observed discharges at river gauging stations,
- Stage-discharge relationships, including stage-discharge data and the cross-sectional profile of the measuring section (preferably covering the river, including its floodplain areas),
- Hydraulic characteristics of structures (culverts, weirs, reservoirs etc); characteristics such as structural details and structure equations,
- Bathymetric data (i.e. river bed elevations),
- Type of river bed material (silt, sand, gravel etc) and type of vegetation in floodplain areas,
- Information on floods (observed flood levels and maximum flooding extend),
- Precipitation data.

Following geographical data is required:
- Digital elevation models,
- Location and elevation of vertical line elements, that can act as water barriers (i.e. dikes and (rail)roads),
- Location of culverts in vertical line elements,
- Land-use maps.

At last the socio-economical data present a special importance:
- Number of inhabitants,
- Number and value of life-stock,
- Investments in agriculture, housing, industry, etc.
- Investments in infrastructure (dikes, (rail)roads, communication-lines etc.),
- Location of toxic depots as well as the type and quantities of chemicals stored,

The preparation (or determination) of flood maps, requires the involvement of various fields of expertise. The fields of expertise that actually should be involved in developing flood maps for particular areas can for instance depend on:
- The type of hydro-meteorological phenomena, that result in floods,
- The complexity of the hydraulic phenomena occurring in the river basin,
- Type of water retaining structures in the flood prone area,
- Degree of influence of flood mitigation measures effected in riparian states,
- The population density in the area (needs for evacuation).
- Type of investments in economic properties and life-stock,
- The presence of toxic depots,
- The presence of environmental, historical, and cultural assets.

The experts that may be involved in preparing these floods maps could be GIS experts, hydraulic engineers, hydrologists, structural engineers, environmental experts, chemical experts, institutional experts, socio-economists, statisticians. The expert list is of course incomplete and can change.

4 CONCLUSIONS

As a result of the catastrophes mentioned the need for generating flood risk maps along the Timiş River was clearly shown. The water management experts can use these maps to identify the “hot spots” in Timiş catchment, give the people better understanding of flood risk and help to reduce the flood risk especially in vulnerable areas.

In order to prevent or reduce floods all tools and means for fighting them are necessary. Of course, the classical method of reducing flood risk with structural measures like linear defence systems (dykes), water retention areas and drainage channels is still needed. But nowadays experience shows that non structural measures like developing flood maps, flood hazard maps, flood damage maps and flood risk maps are of great importance to reduce flood risk. These measures will not stop floods but will increase public awareness of the danger that can occur during a flood event and will help the water manager to increase flood protection and prevention more effectively and more efficiently.

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