Title: Integrated method for identification of irrigable sites in the transnational Tisza river basin in Central Eastern Europe

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Detailed Abstract:

The Tisza river basin is a transnational catchment shared by 5 countries (Hungary, Romania, Slovakia, Ukraine, Serbia). Together with its tributaries, the Tisza River drains the largest catchment area in the Carpathian Mountains before flowing through the Great Hungarian Plain and joining the Danube River, and by far the most important crop and vegetables producing region in the Carpathian basin, and even in Central Eastern Europe (Figure 1.). (In Hungary, the rate of the agricultural sites is about 60%, which is by far higher than the global average.) Though, since the Carpathian basin is one of the most isolated basin in Europe and even globally, the average water shortage of the agriculture is about 200-300 mm/year in the basin.

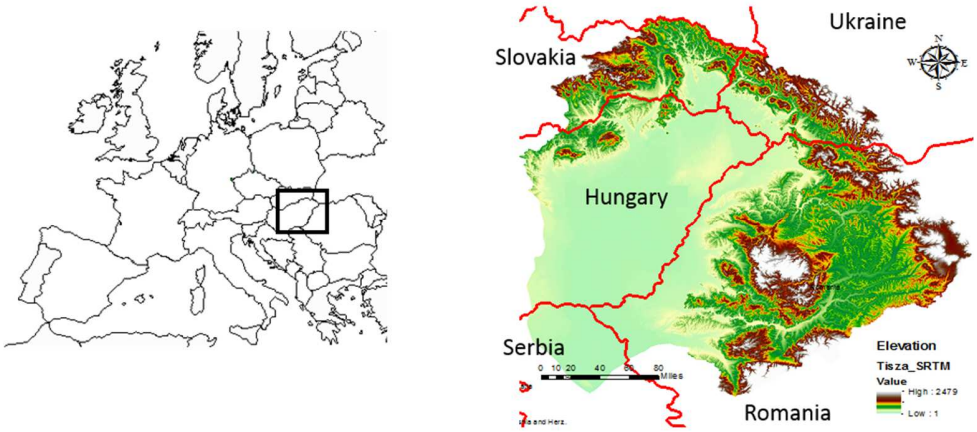

Figure 1. Tisza river catchment, shared by 5 countries in the Central Eastern Europe

Further more, based on climate scenarios, the climate will be warmer and is getting more and more arid in the Tisza valley, especially in summer, when the probability of the heatwaves will highly increase as well. Thus the occurrence of the drought risk situation will increase in July and August (and in June) and the effect of agricultural drought will become more permanent and significant in agricultural production as well (Figure 2).

In contrary to the high risks, only a few agricultural sites are is irrigated (2% of the agricultural sites, in Hungary). However, one of the mitigation possibilities is the irrigation. Carpathian basin (based on the survey on 68 sub-basins) is rich in surface water resources with good water

quality, though there are not appropriate water governance possibilities, implementations and adequate irrigation infrastructure for the agriculture, which could supply the spread of irrigation. Further more 43,026 farmers were surveyed on their irrigation demands in Hungary. 39,702 farmers replied covering 1,234,807 ha. Out of these agricultural sites 143,073 ha has already irrigated and 377,027 ha would like to be irrigated. Another issue is the transnational character of the Tisza river basin. For instance, 95% of the available surface water resources are incoming from abroad in the case of Hungary, and flows through the country without significant water withdrawal. Therefore the optimization of the irrigation development strategies for the countries in the Tisza river basin should be based on the sustainable use and distribution of the available water resources, satisfying the water demand of not only the agriculture, but also, urban, industrial, recreation etc. purposes. Furthermore, Tisza river is the largest tributary with the largest sub-basin of the Danube River Basin, affecting its water flow.

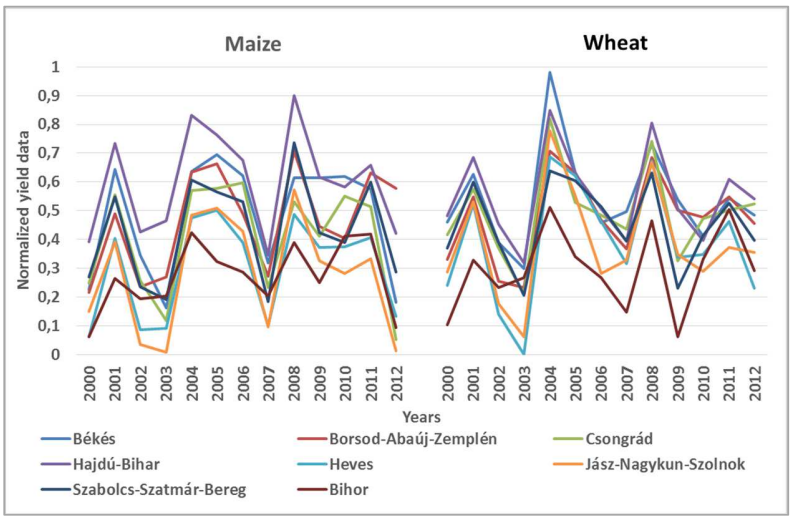

Figure 2. Yield changes of maize, wheat, 2000-2012 (based on KSH and INSSE data)

In this study authors present the method for identification of possible irrigable sites as the partial results of the development of the Integrated Tisza River Basin Management Plant as the part of JOINTISZA project. In this study a model process was developed, which provides information for estimating the relevant sites for most effective irrigation. Our study focused on determination of sites with high yield possibilities on the watersheds. The model process identifies those available and most appropriate remote sensing data and GIS transformation, calibration tools, with which remote sensing based identification of irrigable sites can be implemented. These steps are synthesized including surface water supply, land use, soil physical (Figure 3), soil water holding capacities (Figure 4) meteorological and satellite data integrating them into a model, which can be a feasible tool for plant specific drought risk evaluation. Based on the model results, those agricultural sites were able to be identified, where surface water is available, soil conditions are good with moderate or higher waterholding capacities, the remote sensing based average yields are higher than the region averages. This information can reduce impacts of drought if delivered to decision makers in a timely and appropriate format and if mitigation measures and preparedness plans are in place.

The results corresponds with the recently developing crop and drought monitoring system till 2020 with 600 agrometeorological stations, using the latest Hungarian Drought Index (HDI) in monitoring.

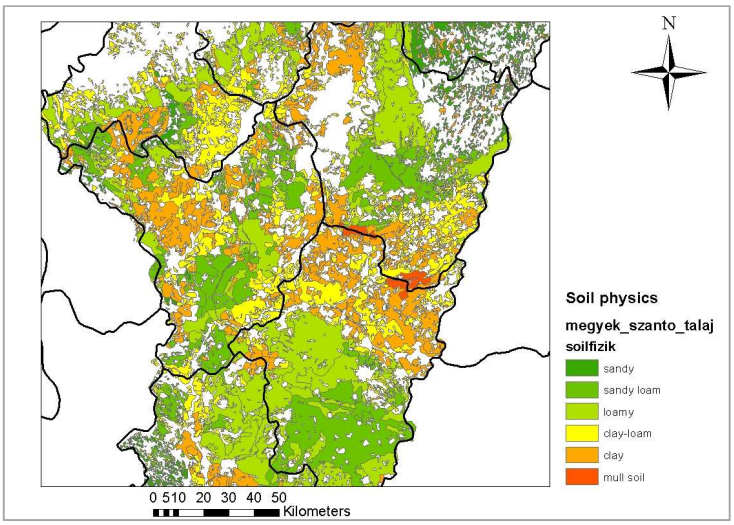

Figure 3. Soils of the concerned counties in Tisza river basin (based on the agro-topographic map of Hungary)

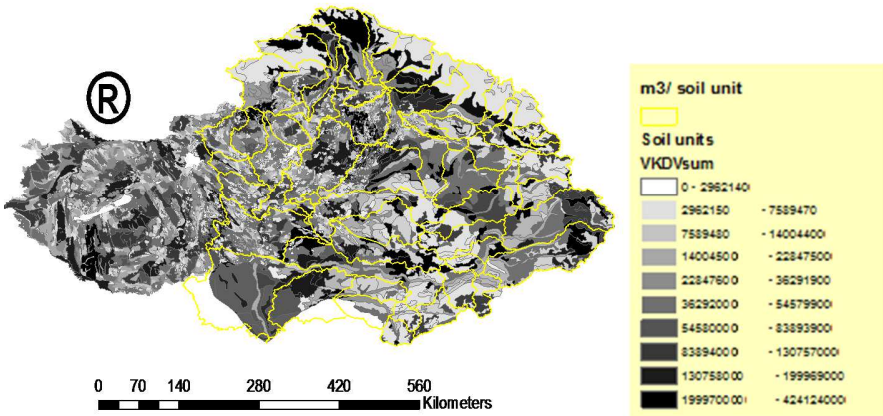

Figure 4. Available soil water content in 2 m depth soil layer

The results ensure better embedding of flood and drought risk management planning into the RBM planning process and will also encourage the involvement of relevant sectors (such as flood risk management, water resource management, urban hydrology management, drought management) and interested stakeholders. In long term, the project results initiate the change of better contribution to the implementation of the Flood Risk Directive and Water Framework Directive. The International Commission for the Protection of the Danube River (ICPDR) serves as the platform for coordination in the implementation.

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