

WP7 Testing the National Adaptation Geo-information System by determining the vulnerability to climate change of the pilot areas Sárvíz River Valley and the region of Aba city

**Executive Summary of the
Research Study**

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1 RESULTS OF THE TEST OF NAGiS AS A DECISION SUPPORT TOOL, BASED ON THE CLIMATE CHANGE VULNERABILITY ASSESSMENT OF THE SÁRVÍZ RIVER VALLEY

The complex vulnerability assessment of the Sárvíz River Valley pilot area, based on data available in NAGiS **provided numerous concrete and general conclusions on the usability of the system**, the characteristics of data layers in it, and the connections between the layers. However, the conclusions detailed below **illustrate the usability of NAGiS only in one field out of the many potential uses of the system**. In this research we only investigated how NAGiS may support **making strategic decisions and elaboration of strategic plans related to climate change issues in a Hungarian microregion**.

The complex vulnerability assessment of the Sárvíz River Valley **included five fields**:

- public health vulnerability against heat waves;
- local vulnerability against the risk of forest fires;
- vulnerability of arable crop production against drought and drying ;
- vulnerability of agriculture against changes of groundwater level;
- climate change impact on the the risk of flash floods (impact assessment).

The first chapter of the **final research study presented the vulnerability assessments done in the fields listed above in detail**. One subchapter for each of the fields **presents the conclusions and recommendations on further development of NAGiS layers**. Instead of summarizing all the conclusions in the investigated fields, **the general conclusions and recommendations for further development of the professional content of NAGiS will be highlighted below**. Moreover, the experiences gathered during the elaboration of the regional development concept of Aba are presented here.

The general conclusion on the databases used is that **the exceptionally rich data content of NAGiS creates a wide range of possibilities** to support investigating, evaluating and analysing the potential impacts of climate change in nearly all affected areas and sectors of Hungary. A great value of the system is that data based on two regional climate models (Aladin-Climate; RegCM) are presented parallel to each other. Our research study recommends **to elaborate exposure indicators for all fields, based on both regional climate models, independent from each other**, in order to have unified data contents. It is important **to include new fields in NAGiS** to develop the system. Furthermore, it is substantial to support a special use of the system, the regional decision-preparation by **making data available for the smallest possible territorial units**, preferably having **the same spatial resolution**, suitable for use in settlement and regional level of planning.

NAGiS should include assessments on damages caused by inland water inundation – this further need was articulated at the debate of professionals, involving the Sárvíz River Valley local stakeholders. Besides that we recommend to **include assessments on the expected, increasing**

frequency of forest fires into NAGiS as a new data layer group, because of the expectable change of climate parameters – primarily the summers getting hotter and drier.

Moreover, it can be stated that NAGiS may provide a suitable input for local and regional decision-makers and planners for determining the local level of risk of flash floods, and for planning and implementing the necessary measures.

We recommend to complement the list of article 1 §, paragraph (3) of the 94/2014 (III.21.) Hungarian governmental decree on the detailed rules of operation of the National Adaptation Geo-information System with a provision that **NAGiS should support integrated water management planning.**

Hydrography is one of the spatial databases of the basic spatial data themes of NAGiS, but in our opinion this theme should be **supplemented by the georeferenced delineation of river basin districts and flood risk management planning units.** Furthermore it is important to review the definitions used, and include the risk of drought among them. **A special selection control option should be created** for the system, which makes it possible to gather thematic spatial data for getting a complex picture of all water management issues of a certain area (a river basin district, a settlement, a small region etc.). Furthermore, algorithms should be included, which enable the analysis (of temporal changes) of these information.

2 REGIONAL DEVELOPMENT RECOMMENDATIONS FOR ABA AND ITS REGION BASED ON THE CONCEPT OF SUSTAINABLE WATER MANAGEMENT

Two groups of development ideas based on the use of waters were elaborated for Aba city: proposals on the **settlement level and regional water management** measures:

I. Settlement level water management

- 1. Elaboration of an adaptive water management plan for the city, which should be a part of the assessments establishing the settlement development plan**
- 2. Elaboration of a rainwater-management plan for the city of Aba, that should include**
 - 2.1. creation of a rainfall-runoff model
 - 2.2. creating stormwater management ponds in deeper areas
 - 2.3. increasing the area of public green spaces
 - 2.4. supporting best practices of rainwater management of citizens
- 3. Hydrological modelling of Aba and its region, mapping, delineating areas exposed to excess water, negotiations with local farmers**
- 4. Organizing local communities of farmers for establishing local ecological focus areas**

II. Regional water management

- 1. Making regional water management systems capable of water retention – adapting the experience of the Makó pilot project in the region of Aba**

A new element of the EU Common Agricultural Policy regulations is greening, that means from 2014 farmers must ensure five per cent of their arable land is set aside from farming as an Ecological Focus Area (EFA) to receive their full payment under the Basic Payment Scheme. (The compulsory set aside land must be seven per cent from 2017.) In certain cases it may cause a significant loss of income for the farmer. A 2013 study of the Regional Energy Research Institute (REKK, Hungary) showed that a local ecological focus area 'market' between farmers could lower the total adaptation cost in a region. This model should be applied here too. Operating this market could decrease damages of excess water in the area as well. The researchers of REKK stated that land use (agriculture, forestry, wetlands) has a direct effect on the ability of an area to provide ecological services. This way the regulation of land use may help to reach a desired state of environment too. Auction, as a special type of markets may be a cost-effective method to foster land use change.

This system could be advantageous for each farmer. It is good for the owner of a land of a worse quality, because in case he/she offers to set aside more than seven per cent of it, than the

owners of the better quality lands will not be interested in decreasing their production, but in 'buying set aside' by paying compensation for the owner of the land with weaker profitability.

The local municipality and the Hungarian Chamber of Agriculture could play an important role in organizing a community of farmers, and the competent local water directorate could provide professional support by delineating the areas frequently inundated by excess water. Delineating and using areas for these purposes could be advantageous for the directorate too, because it would ease excess water control to a great extent. New farming methods could be introduced in the temporarily inundated areas, for example reed management, or even an effective method of forestry by planting high water demand trees. It is worth considering to create fish ponds in the permanently inundated areas, which could be used by fish farming, fishing and tourism.

2. Development of irrigation possibilities in the Aba region

Climate models predict that the region of Aba city will be affected by longer drought periods than today, which will seriously damage the profitability of arable farming. Therefore, it is unambiguous that the extent of irrigated areas have to be increased.

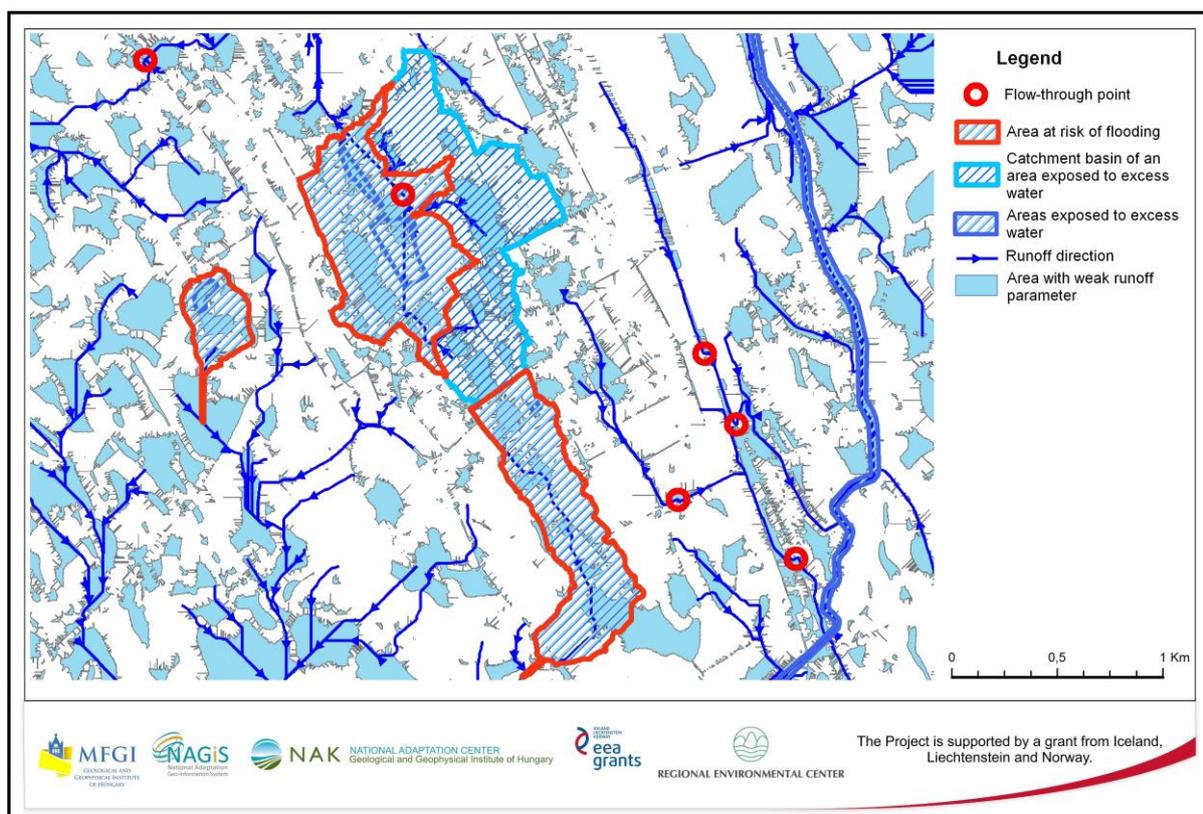
For the sake of this cause we recommend the following:

- 2.1. Surveying and specifying irrigation capacities and demands in the Aba region.
- 2.2. Investigating how reasonable the irrigation demands are – economic analysis of the return of the use of irrigation possibilities.

3 IMPACT ASSESSMENT OF POTENTIAL FLOODING FROM INTENSE RAINFALL IN THE CITY OF ABA

The first step for the delineation of areas at risk of flooding was the identification of those points of the rainfall-runoff model, where water is accumulated in a deeper area until the water may flow through at that location. These are thresholds in the terrain, above which water may be accumulated. It is important, that the presence of such a flow-through point does not mean in itself that the nearby area is at risk – other important factors for the determination of risk are the height of the threshold, whether it is urban area or not, how large area the water may come from and what size is the area affected by sedimentation.

Therefore we selected those water catchment territories of the urban area, which are exposed to water, or are permanently covered by water, and delineated those areas, where water can not flow out from, i.e. gets stagnant. The delineation of the areas at risk took into account all these aspects. The results show spectacularly, that calculated water flows and those known from empirical evidence are identical within the areas exposed to water. The water flow directions are not in contradiction with the location of the upper outflow point (i.e. the water really *can* flow in the modelled direction).



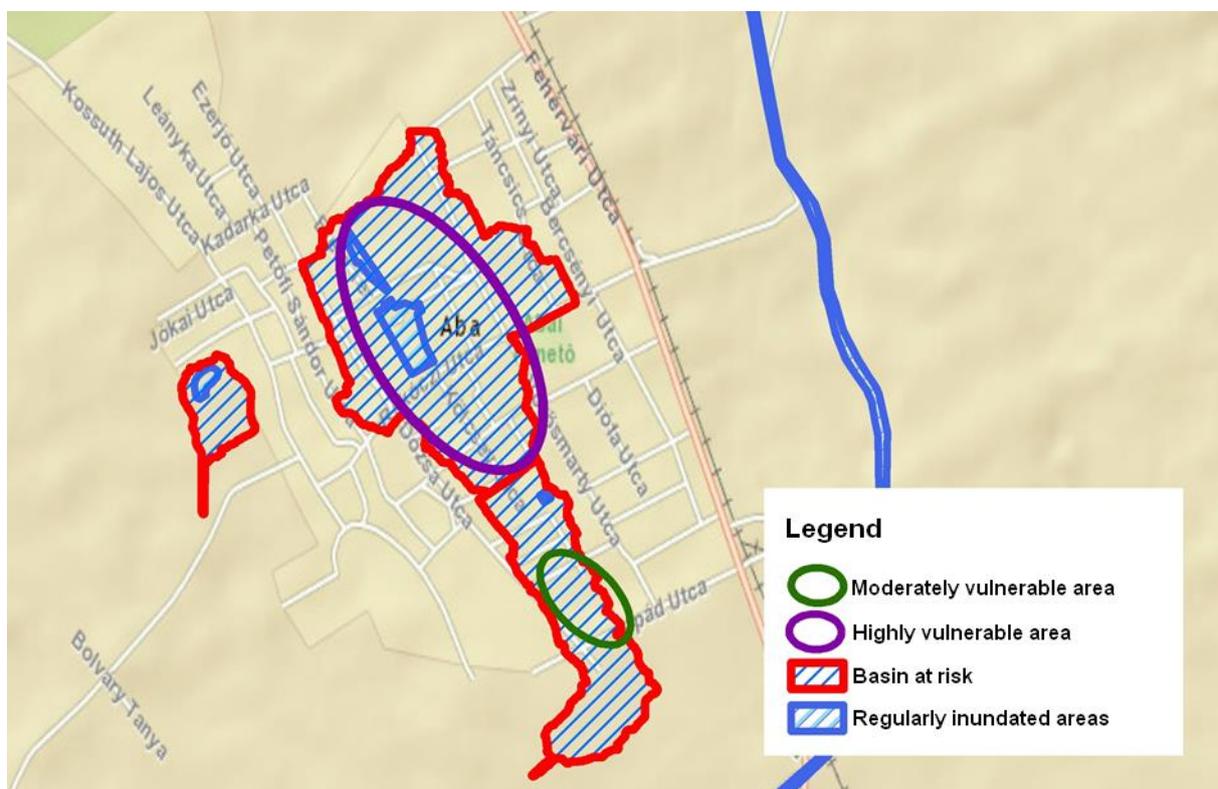
Delineation of areas at risk of potential flooding (source: Datakart Kft., edited by the author of this study)

Based on the combined analysis it can be stated, that **those water catchment areas are at risk of potential flooding, which include large areas with weak surface runoff, collect water from a larger basin, and have such a flow-through point, which may cause significant backwater.**

Besides the runoff analysis based on the digital terrain model, **geophysical measurements were carried out too**, in order to support the integrated assessment of vulnerability against potential flooding from intense rainfall in the city of Aba. The geophysical measurement results were compared to the results of other field impact assessments during the integrated evaluation, so a more exact delineation of areas at risk could be made.

During this work process **we identified the zones delineated by ground-penetrating radar measurements, where slow infiltration of the rainfall water may be expected** due to the geophysical structure (because of high clay content, what is indicated by the radical decrease of electromagnetic waves of the georadar). The areas where these zones overlap with areas at risk identified by hydrological, slope, land cover and other analyses are highly vulnerable against potential flooding from intense rainfall.

According to our analyses, **the northwest third of the area at risk is highly vulnerable**, while the southeastern part has good vertical drainage capacity (good penetration capacity, high amplitude, low remission), so it is moderately vulnerable from a geological aspect.



Qualification of vulnerable zones according to the geophysical research

4 RESULTS OF THE IT TESTS OF NAGiS, RECOMMENDATIONS FOR THE DEVELOPMENT OF THE IT SYSTEM

Our fundamental and general impression of the IT system, based on the tests, is that **it was established adequately for the planned load**. As it is a new kind of web application, the expectable intensity of use is difficult to predict. The number of active users may grow from disinterest (5-10 users per day) to the level of portals considered to be popular (100-200 users per day). In light of all these, **we aimed to overload the system during the tests to determine the limits of its capacity**.

The tested environments are capable to safely serve 100 users at the same time (same second) running the same process (e.g. loading a certain page). Simpler pages (e.g. the basic portal) work problem-free with even 500 concurrent users. The map portal has the highest resource need. This may be the first component of the NAGiS IT system where development, capacity increase may be necessary, according to the growth of use.

The NAGiS portal system was tested before making it accessible for the public. Therefore, two out of three of its components (basic portal, map portal) were tested in the environment, which was intended to be the final, while the third component (database portal) was tested in an internal, development environment. The development of the map portal and uploading data into it was carried on, even after the testing. In summary, **it is recommended to repeat testing after the public operation started**. Testing parameters and methodology necessary for that were attached to the report.

General safety settings of the server ensure protection against collapse for all three components of the NAGiS. Owing to these, operation will not stop even in case of continuous load, at most it may slow down.

Though, the present state of the system may be called oversecured, **it is absolutely necessary to establish a system for monitoring user activities** of all the three components. Such monitoring is only available for the basic portal now. On the one hand, the systematic observation would help fine tuning for later user needs, and determining directions of development. On the other hand, in case of overload, it could clearly show the points, which have to be developed.

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