Interactive open source information systems for fostering transboundary water cooperation

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The world is undergoing a historic transformation with the explosion of new information and communication technologies (ICTs) which have drastically changed methods of international cooperation through the development of intra- and inter-electronic networks. The use of new web-based technologies for regional networking and distance cooperation presents an opportunity to face challenges in a new way.

The case of internationally shared water resources management and governance is of particular interest, because it combines physical, technical, environmental, economical and political issues on regional, national, international and multicultural scales, and because it requires a multidisciplinary approach at every level. The United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair/International Network of Water-Environment Centres for the Balkans (INWEB) has developed and maintains on its website different geo-referenced open-source cooperative information systems, with the principal aim of facilitating cooperation and exchange of experience between scientists and stakeholders working in different socioeconomic environments, on the management and governance of transboundary water resources.[1]

Open source cooperative information systems

The world is witnessing a revolution in the way information is shared and how communication takes place. With the recent exponential progress of science and technology and the global communications revolution spearheaded by the Internet, innovations in organization, operational methods and communication have been adopted by the vast majority of economic activities. New materials, products and software all appear on the market so fast that it has become difficult to keep up to date.

In the late 1970s, when software became independent from the hardware that had been used to create the first IBM computers in the early 1950s, different groups initiated the 'open source' software movement. In the 1990s, the well-known Unix and Linux open source operating systems clearly differentiated open source licenses from commercial ones. Open source software makes the source code available for anybody to use or modify and it is very suitable for promoting cooperation, learning and understanding. With open source software such as Open Office, users are granted not only the right of functionality, as in the use of Microsoft Office, but can also own and modify the methodology. Examples of popular open source software products include Mozilla Firefox and Thunderbird, Google Chrome, Android and the Apache Open Office Suite. Google is one of the biggest companies supporting the open source movement and has developed more than 500 open source projects.

In the international environment, cooperation among scientific communities and countries is vital for the protection and management of shared water resource systems that cross national boundaries, to safeguard against pollution and floods, and to plan major infrastructure works for the development of internationally shared water basins. Successful regional cooperation requires that all participants understand the importance of sharing information and knowledge at the appropriate time.

An inventory of transboundary non-Danubian surface waters in SEE

Source: UNESCO Chair/INWEB

Information systems for water cooperation

The UNESCO Chair/INWEB is an international network of experts that aims to facilitate the exchange of information in the field of transboundary water; develop and maintain online inventories, information systems and databases; promote training and professional education possibly by using new media and distance learning; and contribute to public education and sensitization in the field of water-environment.

One of INWEB's early activities was to develop inventories of transboundary surface waters in South-Eastern Europe (SEE). Transboundary river and lake basins

located outside the Danube watershed were identified. The Mesta/Nestos River, shared by Bulgaria and Greece, and the Prespa Lakes, shared by three SEE countries, were two cases aimed at enhancing cooperation that gave promising results.

The main difficulties arising in transboundary water resources management and governance are a lack of:

- political willingness for cooperation from countries on one or both sides of the border and limited or non-effective exchange of data and information
- communication and understanding between scientists, water professionals, decision makers, stakeholders and the general public.

The principal aim of the developed georeferenced systems and platforms was to provide the appropriate tools needed to strengthen the capacity of water management institutions in the SEE region to implement sustainable forms of utilization, management and protection of transboundary water resources.

The structure of the information systems, and the technologies used for their construction and design aim to:

- facilitate water users to retrieve data related to transboundary water resources
- enable the national experts responsible for a country's water resources to use the system's capabilities to update in real time information about the water bodies available on the platform
- support public participation by allowing users to provide comments (either general comments or those related to a specific geolocation) on the shared water basins that appear on the base map
- automatically generate e-mails to the workgroup whenever comments are made.

During the project implementation, an interactive map using Google Maps and Google Earth technologies was initially developed. This was based on existing maps indicating basic geographic information on transboundary water basins (location, boundaries, extent) (Version 1 of the georeferenced information system). After collecting and working on the data and the descriptive questionnaires submitted by the national experts of the countries participating in the project, the initial georeferenced information system was updated (Version 2 of the system). The final version couples a Google cloud database, in which all the relative information is stored, with Google Fusion Tables technology, in order to spatially distribute the information on the total study area. JavaScript and the HTML5 programming languages were used for the creation of the platform. Furthermore, both these languages were used for sending requests and exchanging data asynchronously between browser and server to avoid full page reloads. Geographic information systems tools were used for the homogenization of the different vector files representing the aquifers (namely shape files) and for their projection to a common projection system (namely WGS 84).

The final version of the system incorporates all the attributes and characteristics of the second version as well as including:

- presentation of a summary of the main data on each basin (excerpts from questionnaires)
- option to download descriptive information on the basins in pdf format (questionnaires)
- option to download the national reports on each aquifer in pdf format
- pop-up box with attributes for each country participating in the project
- integration of a 'search' module
- selection between four different background thematic Google maps
- visualization of the spatial extent of the basins
- demonstration of a comprehensive legend tool
- ability to leave comments, either of a general nature or related to a specific geolocation
- automated e-mail notification to the identified project recipients whenever comments are made.

Case study: the Prespa Lakes

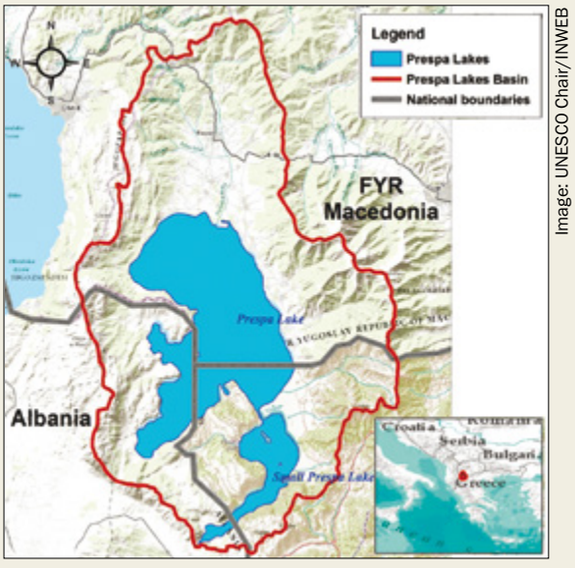

Image: UNESCO Chair/INWEB

Geographical location of the Prespa Lakes

Prespa Park is situated on the borders of Albania, Greece and the Former Yugoslav Republic of Macedonia (FYROM). The area of 2,519 km^2 consists of two lakes: Micro Prespa and Macro Prespa, and the surrounding forested mountain slopes. It has no surface outflow, but a subterraneous water flow brings water from the Macro Prespa into the Ohrid Lake basin, and from there to the Adriatic Sea. It is best known for its natural beauty, its great biodiversity and its populations of rare water birds –including the largest breeding colony of the Dalmatian pelican in the world. The area is also remarkable for its cultural sites, including Byzantine monuments and examples of traditional architecture.

The Prespa Lakes provide an excellent example of how transboundary environmental issues and conflict can be the way to encourage international cooperation among neighbouring nations[2].

On World Wetlands Day on 2 February 2000, the prime ministers of Albania, Greece, and FYROM decided to make the Prespa Park the first transboundary protected area in SEE and declared it a Ramsar Protected Site. The declaration has been followed by enhanced cooperation among competent authorities in the three countries with regard to environmental matters. In this context, joint actions have been considered in order to:

- maintain and protect the unique ecological values of the Prespa Park
- prevent and/or reverse the causes of its habitat degradation
- explore appropriate management methods for the sustainable use of the Prespa Lakes water
- ensure that the Prespa Park becomes and remains a model of its kind as well as being an example of peaceful collaboration among the three countries.

The main features of an open source interactive information system are detailed below.

Data catalogue (data layers)
The data catalogue is a listing of available datasets including information about the layers which are overlaid on the map. The specific module enables the activation and deactivation of layers related to the extent of the river basin and the project countries.

View window (thematic maps)
The specific module is the viewer of the mapping interface. It includes the four different types of base maps: standard, satellite, hybrid and terrain maps. These are supported by the Google Maps web mapping service application and technology provided by Google. It also includes navigation tools (zoom in, zoom out and the pan arrows) and a scale bar both in kilometres and miles. Moreover, the mapping interface supports the overlaying of the countries' boundaries and extents as well as the overlaying of the identified aquifer's extent.

Information window
The window also integrates links with synoptic and detailed summary information, descriptive information and country reports on the river basins.

Search tool and feedback menu
The feedback menu, appears when users click on the button 'Click here to give feedback'. In order for a comment to be sent to the project participants, the person making the comments has to provide their full name and e-mail address. There are two types of comments: general comments and comments referring to a specific geolocation. In the latter case, users should click on the map, so that the coordinates of the specific location are automatically integrated into the comments form.

Different georeferenced information systems for transboundary waters are hosted on the UNESCO Chair/INWEB portal under the 'Databases' menu tab. This menu contains similar interactive databases on transboundary surface and groundwater in SEE, Northern Africa and the Middle East.

Collaboration is the key to transcending and crossing boundaries between countries or between different administrations, institutions and groups of stakeholders within the same country. When rivers, lakes and aquifer systems cross political boundaries, the issue of having good governance for water resources management becomes very complex and difficult to attain. Again the key for resolving such problems is collaboration between institutes, decision-making authorities, water professionals and stakeholders.

Modern ICTs can facilitate distance dialogue between the above parties, by providing interactively on the Internet spatially distributed data and distance-based collaborative tools. New tools and interactive maps can be put together by using open source software such as Google Maps, Google API and Google Fusion Tables technologies.

The progress made in developing such collaborative tools is shown in the case studies from SEE. By using specially tailored collaborative information systems, the data collected from different countries were communicated to stakeholders at a local level in such a way as to facilitate their involvement in the decision-making process. Different aggregations of conflicting multiple criteria can help in producing alternative solutions for sustainable groundwater resources management.

Case study: the Mesta/Nestos River

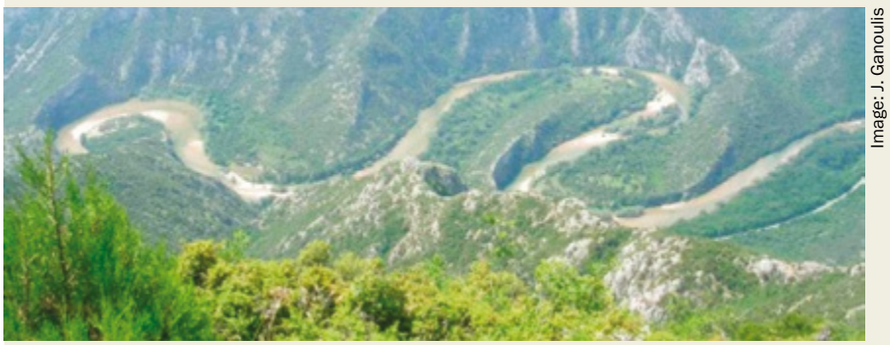

Image: J. Ganoulis

The Mesta/Nestos downstream gorges in Greece

Image: UNESCO Chair/INWEB

The Mesta/Nestos river basin

The transboundary Mesta/Nestos River watershed extends over Bulgaria and Greece. The Mesta River springs out from the Rila and Pirin mountain ranges and flows into a graben plain bordered by the granite formation of the Rhodopes mountains. Changing its name into Nestos when crossing the border between the two countries, the river cuts its gorges through the vast marble karstic formation of the Lekani. Its course finally ends in a highly irrigated deltaic plain before reaching the Agean Sea. The Mesta/Nestos Basin extends over 5,751 km^2, of which 2,314 km^2 are situated in Greece.

The Bulgarian part of the basin is primarily a mountainous agriculture region, although there are several urban areas and the recent development of ski resorts. Being one of the few high-quality freshwater resources in South-West Bulgaria, the Mesta river basin is the site of storage dams and water diversions, both in the present and planned for the future. On the Greek side, there are several large and recently constructed hydropower dams in the Upper Nestos River. Further extensions of this dam complex are under study as part of an irrigation development project which could serve the areas of Drama, Xanthi and the Nestos Delta.

In the past, Bulgaria and Greece signed a bilateral treaty regulating the amount of water used for serving their national interests. Both Greece and Bulgaria are obliged to apply the European Union (EU) Water Framework Directive as they are EU member states, Bulgaria having joined in 2007.

Good cooperation exists between the two countries and several water-related projects have been developed in the basin, which is one of the UNESCO/Hydrology, Environment, Life and Policy programme's demonstration basins.[3]

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This article is the opinion of the author and does not necessarily reflect the MRC member countries' views on the issues discussed. The author would also like to acknowledge the input of Ton Lennarts of the BDP and Lieven Geerinck of NAP.

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