

Implementation of a Water-related Information System Supporting Integration and Dissemination of Information for Transboundary River Basin Management Plans

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Abstract

Aufgrund der 1999 in Kraft getretenen Donau-Schutz-Konvention und der kommenden EU-Wasserrahmenrichtlinie gewinnt die Sammlung und Auswertung der relevanten wasserbezogenen Informationen im Donau-Einzugsgebiet an Bedeutung. Die fehlende gemeinsame Basis für Datenstruktur und Validierung der Daten im Zuge des Donau-Umwelt-Programmes und des „Danube Pollution Reduction Programme“ erschwert den Vergleich und die Auswertung der geographischen und thematischen Informationen. Der Prototyp für ein Donau-Informationssystem der Internationalen Kommission zum Schutz des Donau-Raumes, das im Jahr 1999 von der Internationalen Gesellschaft für Umweltschutz entwickelt wurde, baut auf einer interdisziplinären Datenbank auf. Die erfassten Themenbereiche beinhalten sozio-ökonomische Daten, Gewässerqualität, punktförmige und diffuse Emissionsquellen, Projekte zur Reduktion der Gewässerbelastung, Finanzierungs-Mechanismen und Gesetzgebung. Für die Zusammenstellung eines FlußgebietsManagementplans müssten zusätzlich geographische Charakteristika des Donau-einzugsgebietes und Schutzgebiete erfasst werden. Zur Umsetzung einer auf das Donau-Einzugsgebiet bezogenen Datenerfassung ist eine Fortsetzung der diplomatischen, organisatorischen und technischen Maßnahmen auf nationaler und internationaler Ebene erforderlich.

Objectives

The River Danube - flowing over 2,800 kilometres from its source in the Black Forest of Germany through the Romanian and Ukrainian Delta to the Black Sea – is the most international European river. The Danube and its tributaries support the supply

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of drinking water, agriculture, industry, fishing, tourism and recreation. Moreover, it is used for power generation and navigation, and it is often the final destination of waste water disposal. The intensive water use has created problems of water quality and quantity, related health problems and reduced biodiversity in the River Danube, its tributaries, as well as the adjacent floodplains.

In order to effectively address the environmental problems in the Danube River Basin, twelve countries situated in the basin signed the Danube River Protection Convention in 1994. Two of these states (AT, GE) are members of the EU, and others are candidates for accession (CZ, BG, HU, RO, SK, SI). After ratification by the majority of the Danube Basin countries, the Danube Convention entered into force in October 1998. The second important legal instrument for the protection of water resources is the proposed Water Framework Directive of the European Commission which will presumably enter into force in October 2000. Under the Water Framework Directive Member States will be required to assign an international River Basin District, implement the rules in their territory and endeavour to establish appropriate co-ordination with the relevant non-member states.

The objectives of the proposed Water Framework Directive of the European Commission (COM(97)49, COM(97)614, Art. 4) are to "draw up and make operational within a comprehensive River Basin Management Plan the programmes of measures envisaged as necessary, in order to:

- a) prevent deterioration of ecological quality and pollution of surface waters and restore polluted surface waters ...
- b) prevent deterioration of groundwater quality, restore polluted groundwater, and
- c) ensure a balance between abstraction and recharge of groundwater and
- d) comply with all standards and objectives relating to Protected Areas ...
- e) eliminate pollution of the waters by certain pollutants ...
- f) comply with all requirements in other Community legislation for territorial and marine waters ..."

The River Basin Management Plan will have to provide a large amount of information concerning the quality of waters and steps taken for their improvement in a unified way.

In spite of detailed work during the Environmental Programme for the Danube River Basin since 1991 and the Danube Pollution Reduction Programme since 1994, the available information sources have not been standardised or integrated. Sources include a Transboundary Analysis and National Reviews within the Danube Pollution Reduction Programme, reports and recommendations by expert groups of the International Commission for the Protection of the Danube River (ICPDR), national reports on water quality, and monographs by the European Topic Centre for Inland Waters of the European Environment Agency. As the information structure and cartographic basis for these sources were different and the verification status of data was largely unknown, comparison of results has proved to be difficult. Therefore

standardisation and integration of the existing resources to create one common resource for the Danube River Basin is considered necessary for comparable, verified and integrated results.

Results

In 1999 the International Society for Environmental Protection developed a prototype of an information system for the International Commission for the Protection of the Danube River in a UNDP/GEF funded project. At the end of the first project year, the Danube Information System (DANUBIS) has acquired a basic level of water-related information from the countries situated in the Danube River Basin. The important results of the Danube Pollution Reduction Programme have been made available in textual form for the International Commission for the Protection of the Danube River and its Expert Groups. Further reports from related programmes and projects (e.g. Environmental Programme for the Danube River Basin, technical assistance projects supported by the PHARE programme) can be found in the updated Danube Environment Library at the Permanent Secretariat of the ICPDR in Vienna (Hoebart et al. 1999).

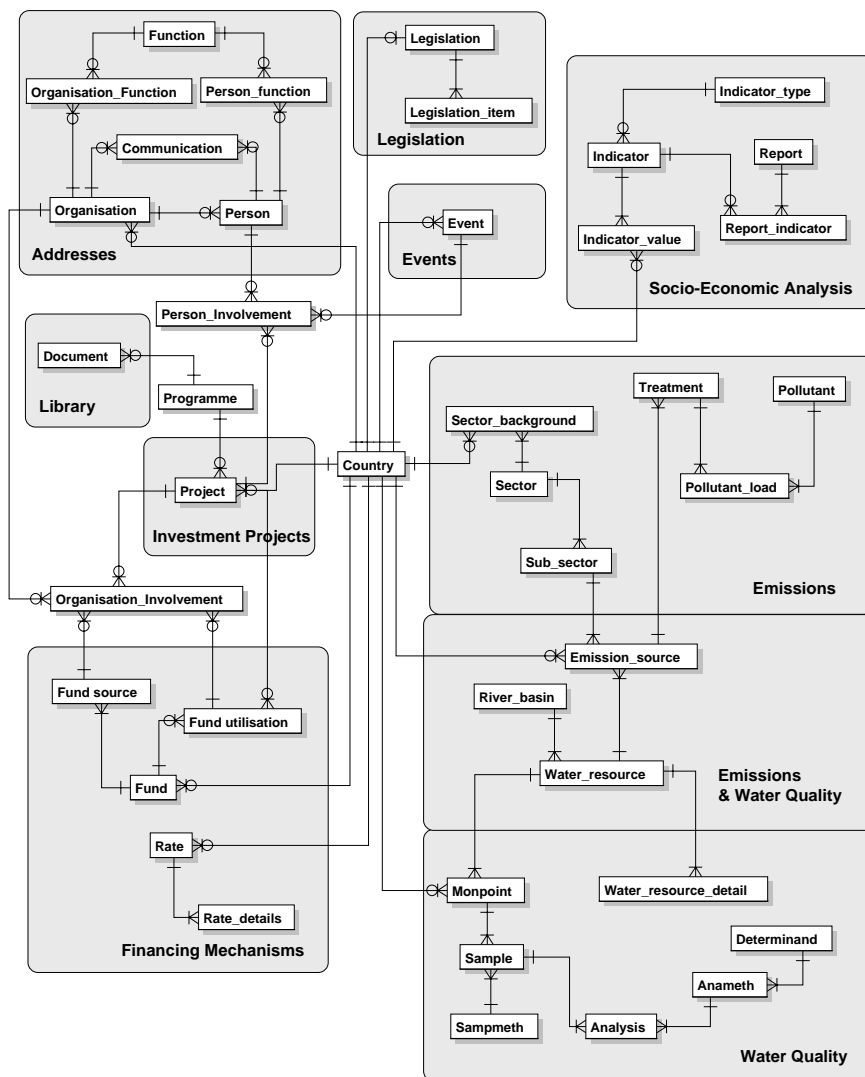


Figure 1: Structure for an interdisciplinary Danube River Basin database

The information structure of the National Reviews resulting from the Danube Pollution Reduction Programme in 1998 (National Reviews 1998a, b, c, d, e, f, g, h, i, j, k) has been analysed and used for the conception and implementation of an interdisciplinary database for water-related information (Danube River Basin Database, see figure 1). The database is focused on socio-economic information related to the im-

part of water pollution, including legislation, financing mechanisms for projects implementing pollution reduction measures, ambient water quality, diffuse and point source pollution and investment projects for pollution reduction measures. It also contains information on addresses of involved institutions and relevant meetings of experts. Available results from the current work of the Expert Groups were also integrated into the Danube River Basin Database. The system was implemented with an Oracle 8 database with Oracle WebDB as Web listener and Web database development tool in order to minimise the programming effort.

Furthermore, the Danube Information System has become a workgroup server for the daily work of the Secretariat and the Expert Groups of the ICPDR. Documents can be uploaded and downloaded from all experts who are registered users of the Danube Information System of the ICPDR and have access to the Internet at their workplace. Local problems with Internet connections in some institutions still need to be solved.

For the WWF wetland study (WWF 1999), an example of a recent scientific study using a large amount of geographical information covering the entire Danube basin, it was necessary to combine historical topographical maps (in order to have a consistent base map within the river basin) with the CORINE land-cover data and additional project data. Numerous different topographical and thematic maps were collected and some digitised in connection with this project. The analysis of geological, geomorphological and pedological maps resulted in the boundaries of the former floodplains of Danube and its main tributaries. In a second step the information on embankments and dams was included to obtain the extent of the recent floodplain. In a GIS application a specific evaluation algorithm was used to compute the ecological value and the restoration potential for each floodplain segment (with special attention given to nutrient removal in the floodplains).

A concept for the collection and integration of digital vector and raster data for the entire Danube region (maps from different expert groups, the wetland study and the "Thematic Maps" publication) has been a first step towards pooling consistent mapping activities and implementing a central map server to complement the existing DANUBIS information system in the foreseeable future (Schwarz 1999).

Discussion

Under the Water Framework Directive, Member States will be required to assign river basins lying within their national territory to individual River Basin Districts and assign the responsibility for them to a competent authority. Where the river basin covers more than one country, an international River Basin District must be created. If, as in the case of the Danube, the River Basin District extends beyond the territory of the Community, the Member States must ensure that they implement the rules in their territory and endeavour to establish appropriate co-ordination with the relevant

non-member states. A River Basin Management Plan will have to be drawn up for each river basin district lying entirely within a Member State's territory. Where the River Basin District is beyond the boundaries of the Community Member States shall endeavour to produce a single River Basin Management Plan.

River Basin Management Plans shall cover the following elements:

- a list of the Member States' competent authorities and of the competent authorities of all the international bodies in which they participate
- a summary of the environmental objectives of the Directive
- a summary of the analysis of the characteristics of the Member States' River Basin District (geographical and geological characteristics, hydrographic characteristics, demographic characteristics, land use and economic activity)
- a summary of the review of the environmental impact of human activity on the status of surface waters and on groundwater (estimations of point source pollution, estimations of diffuse source pollution, estimations of water abstractions, analysis of other anthropogenic influences on the status of water)
- a summary of the economic analysis of water use within the River Basin District taking into account historical trends and future projections (the volumes, prices and costs of the abstraction and distribution of fresh water and the collection and discharge of waste water for different sectors including long-term forecasts of supply and demand, estimates of investments in infrastructure by the public and private sectors)
- a summary of the register of Protected Areas (abstraction of water intended for human consumption, areas designated for the protection of economically significant aquatic species, bodies of water designated as recreational waters including bathing waters, nutrient sensitive areas, areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection)
- a summary of the results of the monitoring programmes (ecological and chemical status for surface waters, quantitative and chemical status for groundwaters)
- a summary of the programmes of measures, including an identification of the individuals or organizations responsible for undertaking the various measures and a timetable for their intended implementation, consisting of:
 - a) measures required to implement Community, national or local legislation for the protection of water, including a description of the European Community, national or local legislation from which the measures derive,
 - b) measures taken for the implementation of the charges for water use (full cost recovery for all costs for services provided for water uses overall and by economic sectors)
 - c) measures required to meet the environmental quality standards for waters intended for the abstraction of drinking water

- d) measures taken for bodies of water with a chemical status below "good".
- e) details of the controls over the abstraction of fresh surface water and groundwater, including a register of water abstractors and a requirement of prior authorization for abstraction and where such controls have not been adopted, reasoned justification for the exemption
- f) details of the requirement for prior authorisation or registration based on general binding rules of all process discharges liable to contain significant quantities of any pollutant or other activities having a potentially significant adverse impact upon the status of water
- g) details of the supplementary measures adopted to achieve the environmental objectives of the Directive
- a summary of the measures to reduce the impact of accidental pollution incidents

The River Basin Management Plan shall contain a summary of the results of the public consultation undertaken on the draft Plan together with a summary of the changes made as a result.

In order to compile a Management Plan for the Danube River Basin, the required information will have to be collected in a standardized way from all countries in the Danube River Basin. The best means for the necessary integration of information would be the collection of selected information in a central database which can be accessed from all competent national authorities.

The implemented concept of the Danube River Basin Database has focused on water management and related topics which form the major part of the topics of the Water Framework Directive (see figure 1). For the integration of all topics the database has to be extended to include information on the characteristics of the Danube Basin (geographical and geological characteristics, hydrographic characteristics, demographic characteristics, land use and economic activity) and an overview of the register of Protected Areas. Experience of structured data collection in these fields is available from the CORINE programme of the European Union (for CORINE land-cover: Heymann et al. 1994, for CORINE biotopes: Moss et al. 1991), the WWF Wetland Study, the Danube Information System project and several national initiatives.

One existing example of a comprehensive mapping system on a comparable scale is the German Hydrological Atlas (Hydrologischer Atlas von Deutschland (HAD)) (BfG 2000). This atlas is divided into seven topics and can serve as an example for a future geodata structure in reduced form for the Danube basin including all main topics of River Basin Management Plans. This atlas will also be available on a map server with Web interface (planned for the end of 2000). According to the German Hydrological Atlas the following geodata structure can be proposed for the Danube Information System:

- Basic data: geology, hydrogeology, river density, pedology, vegetation, land-use (according to CORINE), socio-economic characteristics
- Hydrometeorology: climatological stations (all kinds of precipitation, evapotranspiration, statistics of arid and humid periods)
- Surface waters: river basins, lakes, hydrography (statistics of different discharges, hydrological regime, (extreme) low and high water stages, long-term runoff statistics)
- Soil water: seeping water rate into the ground water, field capacity
- Groundwater: hydrometrical stations and statistics, groundwater quantity and quality, regeneration, vulnerability to pollutants
- Water household: precipitation per river basin, runoff per river basin, winter reserve and summer consumption per river basin, discharge balance per river basin and for the entire Danube basin
- Hydrology-ecology-human impact: Protected areas (according to CORINE), water supply, sources of pollution, waste water management, flood control, polder, irrigation, waterways, water quality, impact on discharges and river morphology, water management organisation grid, further water related planning

Geographical information can be integrated as features with geographical representation into a relational database system (e.g. water resources, protected areas). Using a geographical information system the information can be visualized on a desktop computer or used for the production of thematic maps.

A design for an information structure integrated with geographical aspects is shown in figure 2. Geographical characteristics are represented as feature classes (hydrogeological zones, soil types, land-use areas, protected areas) which can be analysed and summarized for each water resource or river basin. Information related to water quantity (hydrometrical statistics of surface and ground water bodies) is stored together with water quality information for each monitoring point. A general description of human impact on a water resource (e.g. dams, polders, flood control) can be included in textual form (water_resource_detail table) and as GIS features. Important point or diffuse emission sources can be described in detail (see emission_source and related tables).

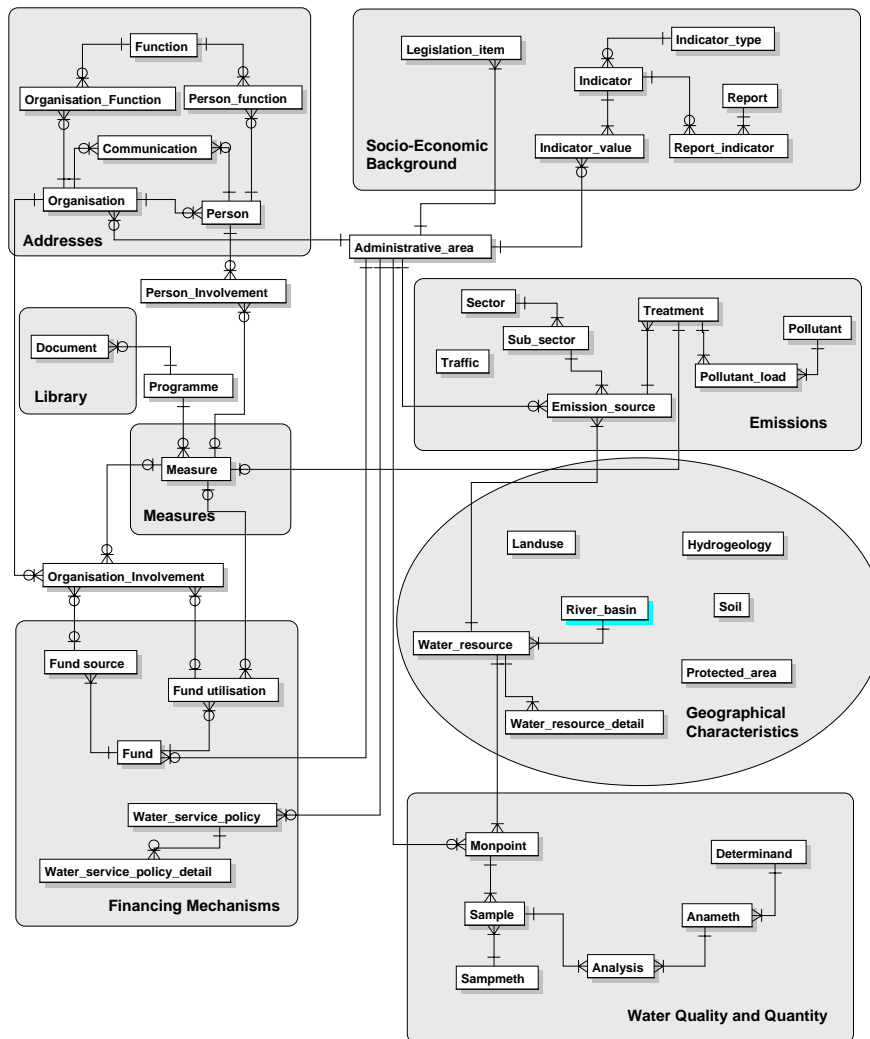


Figure 2: Extended structure for an interdisciplinary Danube River Basin database

All in all geodata management (procurement, collection, preparation, structuring) for the entire Danube Basin is a long term challenge. Some central and eastern European countries have developed national surveys with a digital data output on a high level compared to EU countries but many thematic maps are only available in “historical” versions in paper form or national atlas releases.

Conclusion

The integration of national information has to be supported by the ICPDR and national authorities. Countries participating in the Danube River Protection Convention will have to designate competent national institutions in the field of water. Like similar institutions within the European Union (National Focal Points of the European Environment Agency) they will have the task of collecting the necessary data within their country. In this context the European Environment Agency's Monitoring and Information Network for Inland Water Resources (EUROWATERNET) has been extended to selected eastern European states and has started collecting information on the status of water bodies and pressures by land-use and point sources.

On the one hand the collection of aggregated information in a central database will increase the overview of information within the ICPDR, on the other hand it can be used as a means to fulfil the countries' reporting obligations to the ICPDR and on a River Basin Management Plan. The integrated information base covering all thematic and geographical aspects of the River Basin Management Plan for the Danube River Basin will constitute an important basis for the co-ordination of the respective national parts of the Danube Basin Management Plan by national authorities at international level. It will facilitate the work of experts by providing a standardised structure and basic information.

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