DEVELOPMENT OF INTEGRATED WATER INFORMATION SYSTEM AS A SUPPORT TOOL IN WATER MANAGEMENT IN SLOVENIA

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Abstract*: The integral digital information on the waters of Slovenia is developed. This is a system of aggregated, verified and logically integrated information on the state of waters in Slovenia, the pressures on the water environments and its protection. Data sources are national information evidence and monitoring systems, managed by public service organisations and other expert institutions. The information system is a source for planning in water management, environmental state reporting, and performance indicators evaluation. It is based on catchments. The system incorporates 31 information thematic layers, that are organised in the DPSIR (driving forces, pressure, state, impact, response) system. Data for the information themes are organised with the AutoCad MAP 3 GIS tool and prepared for browsing with internet.*

Key words: information system, water, Eurowaternet, Eurowaternet-SI

1 Introduction

Information of water use, status and policy are searched for by experts, administrative workers, public, politicians, international institutions etc. Information should be reliable, timely, and suitable for the purpose of reporting about a state of environment (for national and international levels). At the same time, information are needed for water management planning on national and international level (Directive 2000/60/EC). Integral planning of water resources use and protections is based not only on information on hydrological, chemical, ecological characteristics of water, but also on impacts to water environment, water uses, future needs and possible conflicts. Therefore, data from different, not homogenised data sources, should be agregated and harmonised into higher level. To satisfy these needs, Ministry of Environment and Physical Planning in Slovenia supports development of the integral digital water information system in Slovenia (http://nfp-si.eionet.eu.int). In the paper, the development of such system (in the development project it has been named as 'Eurowaternet Slovenije'), started in the middle of the year 2000 (Globevnik and Vidmar, 2001; Vodnogospodarski inštitut, 2001].

2 Methods And Data Sources

The system incorporates the conceptual framework of the European Environmental Agency information system for waters (EEA, 1998):

1. Water environment is divided into four categories: rivers, lakes, ground water.
2. Monitoring locations on rivers, for which water quality and quantity data are incorporated are chosen from the national monitoring system. The catchment size of those locations should be distributed among small (< 50 km^2 , medium: 50 – 250 km^2, large: 250 – 1000 km^2, very large 100 – 2500 km^2 and the largest: > 2500 km^2).

3. The minimum number of monitoring stations on rivers, that data should be supplied for, depends on country size (one monitoring station goes for each 1000 km^2). For Slovenia we have chosen 25 locations)
4. For the chosen monitoring locations, data on population density and land use in a catchment should be added.
5. For the beginning, aggregated information on oxygen and nutrients from 1992 on are incorporated into the system.

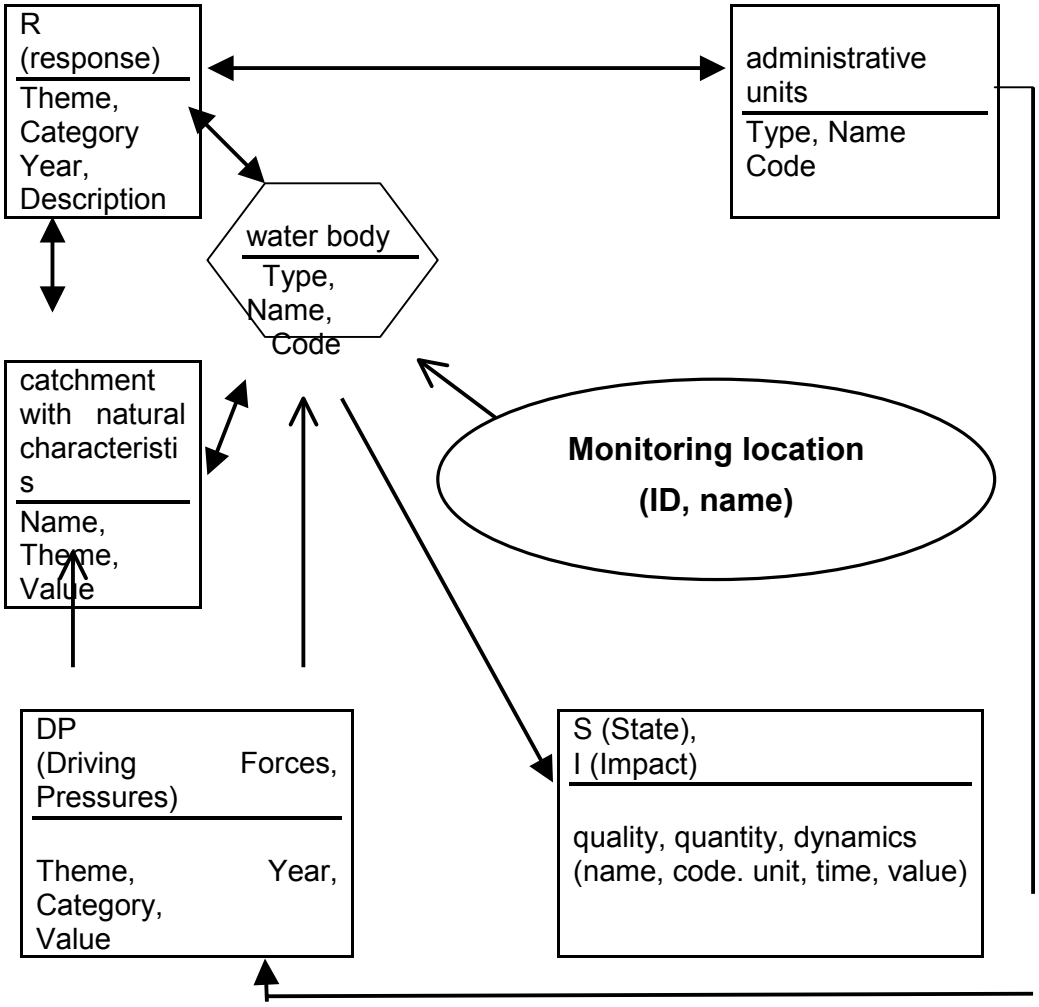
We extended the system on the bases of DPSIR information conceptual framework (Driving forces, Pressure, Status, Impact, Response), as has been already applied for marine environment (EEA, 1999) and is being developed for all environmental areas. Since the information have been gathered from the existing national data fond, we first prepared the list of possible information thematic areas:

- driving forces and pressures: settlements with population, area of industrial, agricultural activities, water energy production, tourist activities, recreation, fish production
- state and impact: water quantity, water quality, erosion, land use, eutrofication areas, dangerous substances existence, bio diversity..
- response: nature protected areas, drinking water protection regimes, action plans, programmes, water taxes...

We have included data, that have been shortly available (either in tabular, maped, textual or geographical formats), but with acceptable manipulation needs for integration, harmonisation, consolidation and verification. Chosen data have been grouped into information thematic layers. Each layer is in fact independable data base, but harmonised with the others and integrated into one, consolidated system. The basic geographical data base is Slovene hydrogeographical coding system (Brilly et. al, 1996, 1997).

The concept of data relations in the information system is given in the Picture 1.

Data sources are national information evidence and monitoring systems or data bases, prepared for special purposes. They are managed by national monitoring services, local public service organisations and other expert institutions. Data have statical or dynamical character. Statical do not change over the years, but can be occasionaly updated, if larger organisational or constructional changes occur. We have chosen data on administrative borders, hydrogeographical regions, water bodies, settlements and monitoring locations (Agencija RS za okolje; MOP-GURS, 2001). Data on areas with water supply and sewerage sytsem and data on waste water treatment plants have been taken from study Vahtar et al.(2000). Data on wetlands have been taken from the project, performed by Vodnogospodarski inštitut (2000). Dynamic data are water use data (Agencija RS za okolje, Inštitut za varovanje zdravja. 2001b; Statistični urad RS) and water quality and quantity on chosen locations (Agencija RS za okolje, 2000). Because the system does not yet directy communicate with raw water quality data base (Agencija RS za okolje), we have included already aggregated data, prepared for EEA needs (Feher et al., 2000). Data about locations of monitoring and water quality status have been taken from the report by Vodnogospodarski inštitut (1997).



Picture 1: The concept of the data structure and relationsins in the information system.

3 Results

Table 1 presents the final list of 31 thematic layers, with unique logical organisation of associated data. Informations are presented in a vectorised graphical, tabular or textual forms. For each thematic layer also a raster picture is added. Tabular data in XLS (MS Excel) format are prepared for 14 thematic layers, 2 have textual files (DOC format). Relational data bases in MDB (MS Access) format are developed for 12 thematic layers. For these data bases spatial relations exist. With the GIS program AutoCad MAP, we can perform spatial analysis.

Data and other information on water environment are organised into two levels. The first level is prepared for internet use, viewing and browsing. For this purpose HTTP modules are prepared and spatial data reduced (for faster network data exchange). To work in this level, a user only needs free of charge program, that can be copied from the internet (WHIP IT). This level is named 'INTRANET' level. In the second level a user has access to all data (135 MB). With two package programs, that

have GIS and relational data base routines (AutoCAD MAP 3 and ACCESS), the user can perform spatial analysis. We named the level 'INTRANET + GIS'. In this moment, the prototype system is installed on Eionet-SI server. Protocols for updating dynamic data are not incorporated into the system yet.

4 Discussion

The presented information system is built on unique conceptual bases. The data in the system are logically integrated into thematic maps (layers), that are compatible with each other. There is no redudance. Each theme is geographically presented in the Gauss Krüger coordinate system, that can be automatically transfered to WGS84 system (World Geographical System 84). Topological relations between tabular and spatial data are developed for those thematic layers that have a lot of attribute data. Some information layers have associated attributes only in one table or just in a text document file. The others have all informations incorporated in a geocoded form (DWG layers). It is very important, that the system gives possibility for modular extension of new thematic layers. Expansion depends on new data availability or new needs in the future.

There are a lot of data, that have not been included yet, because they are not harmonised and not geo-referenced or geo-coded. An example are three national data bases on water supply (Statistični urad RS, Agencija RS za okolje, Inštitut za varovanje zdravja), that refer to the same systems, but collects data with different methodological background. Not just for water supply systems, but also for sewerage systems in Slovenia, a unique geographical identificator is needed for each system. To that identificator, data about water use, sewage and waste water treatment could be geo-referenced and then integrated. The same is true for iririgation and drainage systems.

5 Conclusions

The integral digital information system on the waters of Slovenia, that has been developed in the framework of Eurowaternet, is an information base for the national reporting on water environment and for the reporting to international organisations. It is also a support tool for planning in water management. Furthermore, it is prepared for the public access to information by Internet. Each information thematic layer has meta data descriptions.

This is a system of aggregated, verified and logically integrated information on the state of waters in Slovenia, the pressures on the water environments and its protection: we can calculate population density and land use by catchments, water quantites and chemical status (oxygen and nutrient concentrations) of water and drinking water protection regimes shown for each administrative border. With the system development, information on drinking water quality, dispersed pollution and hazardous substances in waters will be added. The future prospect is, that complex performance indicators (as already shown in Radej et al, 1999) will be determined with the use of information in the system.

Table 1: Information thematic layers .

	Information thematic layer	**INTRANET+GIS**					
		INTERNET					
		type of file*					
		DWF	**JPG**	**XLS**	**DOC**	**MDB**	**DWG**
	GENERAL						
1	Rivers/Running waters	*	*			*	*
2	Hydrographic Areas and Watersheds	*	*	*		*	*
3	Catchment Areas	*	*				*
4	Standing Waters (lakes)	*	*				*
5	Groundwater	*	*				*
6	Wetlands	*	*	*		*	*
7	Hydrogeological Characteristics	*	*			*	*
8	Sea	*	*				*
9	Water springs	*	*			*	*
10	Local Community Districts	*	*	*		*	*
11	Administrative Units						
12	Water Management Areas	*	*				*
13	3D terrain		*				
	DRIVING FORCES						
14	Ameliorated Areas	*	*				*
15	Bathing on Natural Waters	*	*	*		*	*
16	Corine Land Cover 95	*	*	*		*	*
17	Settlements	*	*	*			*
	PRESSURES						
18	Ares with Sewerage Systems	*	*				*
19	Water Supply Areas	*	*				*
20	Municipal Waste Water Treatment Plants	*	*				*
	STATE						
21	Minimal Annual Specific Discharges	*	*				*
22	Flood Areas	*	*				*
23	Annual Percipitation		*				
24	EWN Monitoring Stations on Rivers	*	*	*			*
25	EWN Monitoring Stations on Groundwaters	*	*	*	*		*
26	EWNI Monitoring Stations on Lakes	*	*	*			*
	IMPACT						
27	Combined Estimate of River Quality	*	*	*			*
	RESPONSE						

28	Protected Water Resources	*	*	*		*	*
29	Nature protected areas	*	*	*		*	*
30	Drinking water protection zones	*	*	*		*	*
31	Surface water vulnerable areas	*	*		*		*

***DWF** - AutoDESK Drawing WEB Free Format: Data in 'light' vector forms (entities without handlers; layers can be turned on or off, editing is not possible)
JPG - JPEG-JFIF Compliant Raster Graphic Format
DOC - Microsoft Office97 Document Format
XLS - Microsoft Office97 Spreadsheet Format: Tables
MDB - Microsoft Office97 Database Format: Relatioanl data base in MS ACCESS 97 environment
DWG – AutoDESK Drawing Format-AUTOCAD MAP 3: Vectorised geographical data base in AUTOCAD 2000 (v MS Windows environment)

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