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HARMONIZATION OF NATIONAL STANDARDS IN PRACTICE AND EDUCATION IN HYDRAULICS

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ABSTRACT
Water ecology has two major aspects - pollution prevention as a qualitative indicator and prevention of water overuse as a quantitative indicator.
The process of integration of the country to the EU and the problems arising from climate changes in the region demand precise measurement, adequate usage and pollution prevention of surface and underground water.
Standard methods and equipment for measuring and monitoring should be developed. The saved information must be editable, reliable and comparable. Good methods for processing and analysis mean good management and preservation of water.
The results of two international projects concerning the establishment of an information bank on basin principle about water resources are explored.

INTRODUCTION

No one can deny the importance of water in everyday life. Water is one of the most important natural resources. Today's easy access to fresh water and modern facilities makes it easy to forget the enormous efforts and complicated co-ordination, necessary to provide constant water flow for households, offices, factories and agricultural areas.

Water resources in Bulgaria are poor. Precise measurement, adequate use and preservation of surface and underground water resources are therefore of great importance.

Till 1989 water facilities were state-owned and governed through centralised planning. Since then, after the start of democratic development of the country, a need arises for development of standard methods and equipment for measuring and monitoring. The saved information must be editable, reliable and comparable. Furthermore, water cannot be viewed at a national level. It does not recognise borders and its availability depends on complex system of local and regional processes, interconnected with global climate, its changes and deviations.

The process of integration of the country to the EU and the problems arising from climate changes in the region demand the implementation of approved international standard methods. The harmonisation of our national law determines the importance of implementation of international standards in practice and education of hydraulics. Good management and preservation of water highly depend on the methods of processing and analysis of the regime information.

WATER AND WATER CONSUMPTION IN BULGARIA.

Rain is the major factor for formation of water resources. The average annual value of rain in Bulgaria is 673 mm, where the value for lowlands is 430 mm and for highlands – 1200 mm.

The total average annual rain is about 75 billions cubic meters; but 75% of it evaporates and only 25 % of it transforms into a surface outflow flowing into underground water resources and forming river outflow.

The irregularity of rain, small areas of river networks and climate specifics of outflow formation determine the regime of internal rivers, reaching correlation 1:2000.

Only 2 of 43 internal rivers, crossing national borders or flowing into the Black Sea and the Danube, have bigger network areas, over 10 000 sq. m. – Maritsa (21083 sq. m.) and Struma (10797 sq. m.). Half of the rest have a network area less than 1000 sq. m.

Typical for the river outflow is its territorial irregularity. Scarcest on water resources is the area of rivers directly flowing into the Black Sea.

Table 1.Hydraulic characteristics of some major rivers in Bulgaria

River	Watershed	Length of River	Density of the river network	Modulus of outflow	Mean Annual Discharge	Water Volumes 10^6 $м^3$
	km^2	km	km/km^2	$L/s/km^2$	m^3/s	Average annual
1	2	3	4	5	6	7
1. Ogosta	3157	144	0.73	6.0	25.21	795
2. Iskar	8648	368	1.08	6.5	56.9	1794
3. Vit	3225	188	0.50	5.87	17.05	538
1	2	3	4	5	6	7
4. Osum	2824	314	0.36	6.02	17	536
5. Yantra	2947	285	0.75	6.34	49.83	1571
Danube basin	**45831**					
7.Provadiiska	2132	119	0.48	1.05	2.23	70.3
8. Kamchia	5358	244	0.72	4.92	26.34	831
9. Veleka	995	147		12.24	12.18	384
Direct inflow into the Black Sea	**14500**					
10. Tundja	7884	349	0.52	4.51	35.56	1121
11. Maritsa	21083	341	0.74	6.09	128.5	4047
12. Arda	5201	241		14	83	2484
13. Mesta	2767	126		13.83	38.3	1206
14. Struma	10797	290		8.03	86.8	2733
Basin of the White Sea	**50300**					

Table 2 Dynamics of the annual water resources – water source (billions $м^3$) and year(1)

Year	1988	1995	1997
Surface water	13.066	10.092	12.037
Danube	n.a.	3.962	4.932
Dams	4.644	3.11	4.179
Inner rivers	n.a.	2.67	2.463
Lakes and marshes		0.45	0.463
Underground waters	1.458	0.906	0.841
Fresh water total	14.524	10.998	12.878
Turnover water	6.195	5.287	4.964

Table 3. Dynamics of annual (3) water usage (billions $м^3$)

Year	1988	1995	1997
1. Households	0.389	0.306	0.269
2. Trade and services	0.419	0.148	0.153
3. Water losses	0.33	0.61	0.989
4. Agriculture	0.309	0.21	0.236
5. Irrigation	2.725	0.179	0.209
6. Industry	2.043	1.454	1.426
7. Hydroelectric/ atomic ver stations	8.253	8.27	9.805
Total	14.524	10.998	12.878

INTERNATIONAL STANDARTS IN HYDROMETRY.

International standards in hydraulics and their publication is co-ordinated by the International Organisation for Standardisation (ISO) (Table 4), European Committee for Standardisation (CEN) and the World Meteorological Organisation (WMO). According to the Vienna Agreement these organisations are in close co-ordination and do not duplicate identical activities.

In Bulgaria there is an old practice for instructions creation. These instructions have often poor legislation adequacy and are often to be used only by particular authorities; the instructions easily and sometimes unreasonably are changed, expanded or revoked, e.g. in 1995 the requirement for a project for "Estimation of the impact of a facility on the environment" in the "Law for environmental preservation" was revoked, which later on was considered a mistake.

The harmonisation of the Bulgarian and EU legislation will improve:

- the overview of the accumulated experience;
- development and implementation in practice of new facilities and equipment;
- quality and reliability improvement of data and its usefulness for comparative analysis and international exchange;
- the implementation of national standards in university programmes will improve the future activity of specialists and will prepare them for work in various conditions in Bulgaria and abroad.

Table 4. ISO Standards in hydrometry

ISO 748:1997	Velocity area methods
ISO 772 :1996	Glossary of terms
ISO1070: 1992	Slope area methods
ISO1088:1985	Data for the determinations of errors
ISO 1100/1:1996	Establishment and operation of a gauging station
ISO 1100/2:1998	Stage discharge relation
ISO 1438:1980	Thin plate weirs
ISO 2425:1999	Tidal channels
ISO 2537:1988	Current meters
ISO 3454:1983	Sounding suspension equipment
ISO 3455:1976	Current meter calibration
ISO 3716:1977	Sediment load samplers
ISO 3846:1989	Rectangular broad crested weirs
ISO 3847:1997	End depth method
ISO 4360:1984	Triangular profile weirs
ISO 4362:1999	Trapezoidal broad crested weirs
ISO 4363:1993	Measurement of sediment transport
ISO 4364:1997	Bed material sampling
ISO 4365:1985	Determination of concentration particle size and relative density
ISO 4366:1979	Echo sounders
ISO 4369:1979	Moving boat method
ISO 4371:1984	End depth method(non rectangular channels)
ISO 4373:1995	Water level measuring devices
ISO 4374:1989	Round nose horizontal weirs
ISO 4375:1979	Cableway system
ISO 4377:1989	Flat V weirs
ISO 5168: 1978	Estimation of uncertainty of a flow rate measurement
ISO 5168:1998	Evaluation of uncertainties
ISO 6416 :1992	Ultrasonic method
ISO 6418:1985	Ultrasonic velocity method
ISO 6419/1:1984	Hydrometric data transmission system – general
ISO 6419/2:1992	Hydrometric data transmission system – requirements
ISO 6420:1984	Position fixing equipment
ISO 6421:2001	Method for the measurement of sediment in reservoirs
ISO 7066/1:1997	Uncertainty in linear calibration relations
ISO 7066/1:1989	Uncertainty in linear calibration relations
ISO 7066/2:1988	Uncertainty in non linear calibration
ISO 7178:1983	Errors in velocity area methods
ISO 8333:1985	V shaped broad crested weirs
ISO 8363:1997	Guide for the selection of methods
ISO 8368:1999	Guidelines for the selection of structures

HARMONISATION OF THE BULGARIAN WATER LEGISLATION AND E U STANDART.

Exploring the directives of EU for water preservation, it should be considered that they are related mainly to pollution prevention and not to prevention of water overuse. Consequently greater attention is paid to the qualitative not to the quantitative side of the problem.

The directives themselves divide into frame directives – determining the main requirements and legal means for water preservation, and subordinate directives – connected with the implementation of the requirements of the frame directives and giving more precise legal means in the respective direction, including limit values for certain hazard contaminate substances.

According to EU laws for water usage any legal subject consuming water carries the responsibility for water self-monitoring and is eligible to control. Management and control in most of the EU countries – France, Spain, Italy – is based on basin monitoring; for example, in France 6 basin committees are formed, with representatives of the central and local authorities, professionals and concerned specialists.

Water management through basin planning for major rivers in Bulgaria started in 1920 with the introduction of the "Law for water unions". In 1963 the "Law for preservation of air, water and soil" is introduced – an integrative approach towards preservation of environmental components – 11 years before the UK adopted such legal approach. Democratic changes during the past decade lead to decentralisation of water management.

The government's inability to maintain financial support for water management leads to neglection of hydraulic stations and facilities. This might lead the country to the situation of France, which in 1970 closed most of its hydraulic stations for "uselessness" after over a hundred years constant work. The period of continuous drought that followed brought up a severe necessity of information, resulting in restoration and further development of the monitoring network. The new "Law for water" introduced by the end of 1999 in Bulgaria includes integrated management of water resources, divided by river basins. Its goals are:

- preservation of water ecosystems,
- ecological and economically efficient water usage,
- achievement of reasonable prices of all activities related to water usage;

in other words, ceasing government subsidies on water economy.

DETERMINATION OF THE STREAM FLOW USING DATA OF WATER MONITORING AND WITH THE RECENT MODELS FOR STREAM FLOW SIMULATION

It is essential that students, studying in the field of hydrology, learn the most up to date methods and tools that are being used for the assessment of water resources.

It is well known that fresh water is a vital resource and will become even more significant in the near future as demand increases. Integrated management of water resources is essential to ensure the most effective functioning of the resources within the river basin; including water use, the environment, and economic investments. This is a complicated, inter-related system involving different spatial and temporal scales, as well as varied anthropogenic activities. Water resource management can not be effective without the incorporation of complete information pertaining to the present situation of the basin and also accounting for trends of the past useage of resources (Янчева и др. 1995).

The effectiveness of water resource management, taking into account the stochastic character of the flow, is directly dependent on the quality of the environmental information.

There are two types of apprаches for streamflow assessment:

- Using water monitoring data, and;
- Simulating streamflow using mathematical models.

Monitored stream flow data are based on the streamflow measurements from Bulgaria's national monitoring stations. It is very important that regulated stream flow, resulting from intensive anthropogenic activities in the river basin, is measured at the gaging stations. This makes using water balance methods for distribution of stream flow and for water resources management impractical because alterations to natural stream flow are not taken into account, such as reservoirs and irrigation channels. Also, gaging stations for stream flow observation are irregularly distributed in the river basin, which makes the assessment of stream flow in the upper part of the basin very difficult. This creates problems for governmental institutions when trying to determine the actual available resources that may be allotted to the users.

Simulation of stream flow using mathematical models is a field of hydrology which has developed with very quick progress over the past years. The main achievement obtained by using this manner of stream flow assessment, is that it gives the possibility to simulate undisturbed stream flow at every point of the river net.

The use of mathematical models for stream flow simulation requires:

- full, detailed information for daily precipitation and temperature, soils and land use, relief and other data for testing the models;
- complete monitoring data for the stream flow, necessary for calibration and validation of the mathematical models.

Hydrologic, and other data necessary for water management in Bulgaria, are dispersed throughout different governmental organizations. At the present time, it is too difficult for one department to undertake and maintain this entire database due to lack of funds. Another obstacle is the lack of digital computer systems for gathering, analyzing, and saving this vast information. These records need to be converted into long term time series in order to be entered into mathematical models used to simulate the functioning of water systems (Николова, 1979; Николова и др., 1996).

All these arguments motivated the creation of the structure for a GIS-based

GEOGRAPHICAL WATER RESOURCES INFORMATION SYSTEM

for the whole territory of Bulgaria (Hristov, Ioncheva, 2002).

The structure of the water resources information system was created in the Institute of Water Problems at the Bulgarian Academy of Sciences. All necessary data for the Yantra River Basin was entered into the system, called "*GeoWateRIAS-V.0*" (Hristov, Ioncheva, 2002), fig. 1.

Geographical water resources information systems are modern, powerful tools for gathering and organizing information. With this information, analysis and assessment of water resources, in relation to the development of the economy and agriculture in the river basin, can be used together to maintain ecological sustainability.

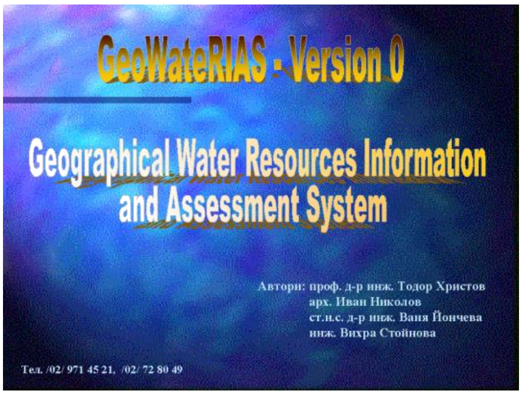

Figure 1.

The information system is able to include new information, which will expand the scope of the database, not only in detail but also in time, to include subsequent years. This is the necessary condition to have a water resource information and assessment system, as opposed to simply an information system.

The information system can be updated to include new information, which will expand the scope of the database; over successive years, the detail and time span may be increased to reflect changes in the basins. This is the necessary condition to formulate a water resource information and assessment system, as opposed to simply having an information system.

All available information in the water resources information system is situated in the topographic maps of the Yantra River Basin, as shown in figure 2.

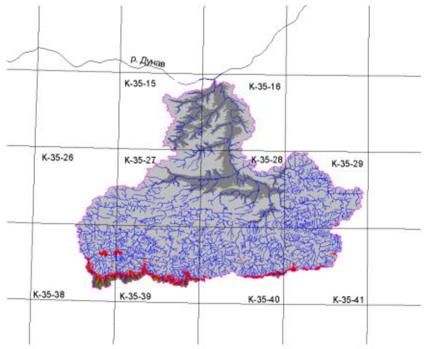

Figure 2. Network of Maps of the Yantra river Basin (Hristov, T., V. Ioncheva. 2002)

Hydrologic mathematical models are used to simulate the stream flow in 75 specific points of the Yantra River Basin (Ioncheva V.,T.Hristov. 2002). The simulated hydrograph for each gaging station is then compared with the observed hydrograph and detailed statistical assessment is made.

As a result of the investigation, the following conclusions can be made:

- Hydrologic mathematical models, used for stream flow simulation in Yantra River Basin during a ten year period, can be reccomended for incorporation into the decision support system;
- To ensure the optimal use of available funds, it is necessary to re-evaluate the location of the every gaging station to have the possibility to reduce the total number of stations. The remaining stations must be the most technologically advanced to produce the best quality of observed data.
- The net of the meteorological stations must undergo ongoing evaluation to more accurately represent and assess the precipitation for each river basin. Precipitation and temperature are the most sensitive meteroeological input parameters influencing on stream flow simulation for the hydrological model.
- It is necessary that every alteration of stream flow, in the territory of the river basin, is accounted for and then reflected in the information database. This will assist in the implementation of the mathematical simulation models for the assessment of the stream flow.

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