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METHODOLOGY FOR ECONOMIC EVALUATION OF WATER MANAGEMENT

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RESUME

Economic analysis is the key requirement of EU Water Framework Directive. On a level of river basin area, economic analysis includes three dimensions: 1. economic characterization of water use: current and future projected economic importance of capacities and potentials of water resources; 2. program of measures for achieving good water status: cost-benefit analyses, cost efficiency analyses, cost scale and influence: and 3. water services price policies: evaluation of institutional alternatives for recovery of water services costs, including analysis of cost distribution. The analysis includes leveling of current and projected water resources data with costs and benefits of water services on the level of river basin area within local communities and integrated on sub-region level.

Key words: *EU Water Framework Directive (WFD), economic characterization, economic evaluation, methodology*

INTRODUCTION

In the base of the Water Framework Directive [1] is consisted of principles of integrated river basin management. This includes harmonization of water protection goals from social-economic characteristics in river basin. Different methods of using water pressure and endanger water status through negative influence, but at the same time they significantly influence conditions and level of economic activity and contribute to economic development and social wealth. Introducing economy into preparation of river basin management plans creates conditions for harmonization of opposing interests of stakeholders on sustainable development interests.

Economic analysis is a central part of the planning process, and its purpose is to get information that is necessary for making management decisions and for stakeholder and public informing. It is information on water use, its economic importance and its influence on water status, on costs that it makes and who should cover those costs.

Economic elements of WFD are the most controversial and the most challenging part of WFD implementation process. To achieve sustainability of water resources, WFD proclaims and integrates economic principles like:

- full cost recovery based on the principle "polluter pays",
- using economic methods and tools of "cost-efficiency analysis" as important part of decision making process,
- economic instrument implementation in water policies and water management

Economic guidelines, within the Common Implementation Strategy – CIS on an EU level, give conceptual framework for introducing economic analysis in the process of creating river basin management plans, define some basic economic terms and give practical guidelines for approaching certain economic issues. In accordance with CIS implementation of WFD will become operational in three steps, table 1.

Economic tasks in WFD implementation are:

1st step – economic characterization (description) of river basin;
2nd step – comprehensive economic river basin analysis;
3rd step – definition of the most economical programs of measures for achieving required goals.

Table 1 Economic tasks and steps in WFD implementation

S T E P		
1st	**2st**	**3st**
CHARACTERIZATION	RISK EVALUATION	PROGRAM OF MEASURE
River basin description: Water characteristics Pressures and influences on water Water services and water use	Predict river basin status Required status of river basin River basin at risk	Potential individual measures Economic individual measures Achievable program of measures Deviations River basin management plan

Economic analysis is a mean that is used here to enable decision makers to make realistic and efficient decision. Economic analysis, by it self, is not the one making decisions, it just helps – similar to other fields and expertise – in making better decisions by interpreting their economic dimension and influence.

RIVER BASIN ECONOMIC CHARACTERIZATION

Economic characterization refers to gathering data and definition of indicators of statuses and trends in water use, that are important base for making decisions in the late phase of planning. It includes:

1. evaluation of economic importance of water use, that will help to do identification of potential conflicts between economic development and water protection and open the way for recognizing the main water management issues, but also arguments for possible deviations from the goals of environment protection determined by WFD;

2. definition of basic scenario (long-term dynamics of river basin development), as starting points for evaluation of expected pressures and water status, water bodies "at risk", where planned status doesn't match the status required by WFD;

3. assessment of achieved rate of cost recovery of water services by considering financial costs and resource and environmental protection costs. Including external influences [2], external costs that appear in case when activity of one subject causes the damage or loss to other subject and when this loss is not compensated [3], tends to identify full economic cost of water services, and through implementation of cost recovery principles avoid their transfer to future generations.

The purpose of this step is to use existing and available data to get introductory review of water resources use in river basin. This includes economic analysis of water use, trends in water supply and demand and current level of water services cost recovery.

The main goal of economic analysis of water use includes evaluation of water importance for economy and social-economic development of river basin. It will give economic profile of river basin in terms of general parameters, e.g. economic turnover, gross income, employment and the number of significant water users.

The goals of this step are analysis of water use status in terms of researching human activities influences (industry, agriculture, reactions on water, commercial fishing), water services in terms of water supply, limits of cost recovery of those services as well as institutional framework for cost recovery.

WATER USE ECONOMIC IMPORTANCE EVALUATION

Economic characterization begins with identification of significant water uses and water services in river basin area. In accordance with WFD, the term "water use" refers to water services and any other human activity that, according to analysis of pressures and influences, has significant influence on water status. That means that including a certain activity in the category of water use or water services depends on a water state in river basin.

Preliminary analysis of certain economic activities, that refer to water use and pollution contribution or some other form of water status degradation (morphological, biological), have shown that the industry and the agriculture are significant users of water in river basin. In other economic fields there is several economic elements identified as significant pressure sources. For economic characterization purposes, economic activities are divided into three basic economic sectors, shown in the Table 2. In a later period, depending on a result, decision can be made on possible, more detailed economic analysis. Comprehensive analysis can be conducted on a certain area of river basin at which there is identified risk of not achieving wanted water status.

Table 2 Overview of basic economic sectors for characterization of water use

ECONOMIC SECTOR	ECONOMIC FIELDS THAT ARE INCLUDED IN THE SECTOR
Agriculture	Agriculture, hunting, fishing, forestry
Industry	Mining and quarries, basic production, civil engineering, electric energy and water supply
Services	Other services

To understand basin economy and to give social-economic overview of basin, economic development indicators are used: gross domestic product, number of legal entities sorted by professions, investment overview, unemployment rates, compensations and salaries.

Economic significance of every form of water use must be examined for the point of its significance as water user, as well as from the point of its absolute and relative contribution to physical and chemical quality of water in river basin. It is not necessary to report about all activities in river basin, but only about the ones that have significant pressure or influence. The forms of water use can be divided into use of water or release into water.

The choice of indicators that connect social-economic information with information on pressures on a level of certain sector must be carefully planned. Data on physical flow of water, amounts of used water and water pollution are used as pressure indicators. These analytic indicators will enable comparison and ranging of sectors in comparison to efficiency of water use and present a valid base for decision making in water management.

The term "water services" includes all activities of accumulations, draining, preserving, processing and distribution of surface or ground water, or services of gathering, cleaning and releasing waste water that are provided for households, public institutions and economic subjects. The conductors of these activities are not, per se, water users, but also mediators between water resources in nature and actual users: households, legal entities, institutions.

DEFINITION OF BASIC SCENARIO

Basic scenario presents the projection of chosen group of water services indicators in accordance with the current policies, e.g. independently of requirements from WFD. The point is in predicting future needs for water and investments in water services and using water until 2015 which is the year planned for achieving goals of WFD.

The main activities of this approach model are:

- assessment of existing economic trends
- predicting of future economic trends
- implications and plans for future investments in water sector

EVALUATION OF ACHIEVED COST RECOVERY RATE FROM WATER SERVICES

Evaluation of cost recovery rate from water services is done to determine on which level is the current recovery rate, as well as what influence certain policies of water prices on efficient water use.
A simple formula can be used for calculating cost recovery:

Cost recovery rate (%) = (total income – subventions) / total costs x 100

It is important to count the total economic costs (financial cost, environmental protection cost and water resources cost) into the total amount of costs, in the way that they are defined in CIS guidelines on economy.

Financial costs consist of:

- operational costs and maintenance costs – running costs (personal costs, material costs, energy costs and other costs that referring to providing daily services) and maintenance costs to keep regular funds in good operational state until the end of their life circle;
- administrative costs – costs of regulating water services activities (e.g. compensation for concession, water resource management costs);
- capital costs – costs that refer to investments in infrastructure (costs of paying principal and interests that refer to new investments, amortization).

Costs of environmental protection and resources refer to damage dealt to water resource, environment and other users of water due to compromised water quality or depleted supply or inefficient use of water resources. In the Republic of Serbia there isn't usable experience of calculating cost recovery with including these costs, so one can only use the experience from the EU countries.

Cost recovery analysis had to be limited on municipal water services level: public water supply and drainage of urban waste waters, because data and information for analysis of cost recovery are available on that level. To make the analysis complete, it is necessary to include other social-economic sectors, which mostly depends on availability of data from those sectors. Methodology that will be implemented depends from institutional management of municipal water services in the republic of Serbia.

Municipal water services are under the authority of local governments, which have an obligation to, independently or in cooperation with other, secure their actions in their area. For conducting these activities they can establish municipal enterprise, public institutions or they can do it through other legal entity or individuals based on contracts on concession or contracts on trusting activities of water system.

Service provider is responsible for management and work of water infrastructure. Incomes from conducting activities are achieved through price of services paid by users. Infrastructure of water system is mostly owned by municipalities or cities that are responsible adopting and implementation of investments programs into work of water system and equipment. Considering that that infrastructure is of interest to state, a big part of financial means for co-financing of building is secured on state level.

Components that make price of water are: the price water supply services, price of waste water drainage services, purification (water cleaning and processing), compensation for financing and maintenance of infrastructure, compensation for protection of water sources, compensation for water protection, compensation for water use, VAT on prices of municipal services and in the future probably compensation for concession for water exploitation.

Current water price structure contains several instruments for recovery of these costs:

- compensation for infrastructure financing – incomes from local budget for building water system that are optionally issued by local government;
- water compensations (compensation for water protection, compensation for water use);
- obligatory compensation regulated on the state level, intended to cover costs of managing of quality and quantity of water resources and reinvestments in water system infrastructure that is of state's interest.

ECONOMIC ANALYSIS OF WATER USE

For the Pek river basin analysis of water use is implementation through four steps:

1. evaluation of economic significance of water use,
2. trend analysis
3. cost recovery analysis
4. information for support of the most profitable measures analysis

Evaluation of economic significance of water use

Economic significance of all water uses must be evaluated in comparison to their importance as water users, as well as on its absolute and relative contribution to physical and chemical quality of water in river basin. It is not necessary to report on all activities in river basin, but only on the ones that present major pressures and influences. Using water can be characterized as water consumption and as drainage into water.

Consumption is done for a number of purposes, including drinking water in households and using water in production processes. Water that is consumed by water system is provided for households and legal entities including industrial and commercial use, as well as water consumption in schools, hospitals etc. Some industries can have, which is common in the Pek river basin, their own sources of water and that kind of consumption must be researched also. Agriculture, if it is developed, consumes large amount of water. Water in agriculture has many uses: growing of agricultural cultures, gardening, horticulture, and livestock farming. Fish farming uses small amounts of water. On the other hand, that water is flowing back to watercourse, and this kind of use does not have consumption character.

The main forms of water use could be:

- water consumption by water system (water supply of households, industries, etc.)
- personal households supplying
- personal industry supplying
- water consumption for irrigation
- water consumption for fish farming
- water use for tourism and recreation.

The first step of economic analysis of water use in the river basin is clear identification of these water uses, their locating and explanation in terms of significance of their pressure on water bodies. After uses and users are identified, there will be organized data collecting, so there are description and information on every use. It is necessary to examine whether there is any previous research or data base. Data analysis should give answers to following questions:

- Which activities have important effect on water resources?
- How much water is used per user?
- The number of companies (enterprises) that do water supplying
- The percentage of population connected to public water system
- The percentage of population with their own water supply?
- How much water is used by water system?
- Water consumption per capita?
- Is there water loss and what's the percentage of that loss?
- How much water is used by industries if they supply themselves?
- The purpose of water use in production process?
- The percentage of arable land and land with crops?
- The percentage of land that is covered with irrigation systems?
- Which crop species is usually grown in the river basin?
- The number of fish farms?
- The species of fish being breed?
- Annual production of fish?
- The influence of tourism on water use?
- The number of tourist staying overnight per year?

Releasing into water present water use, because watercourses are used as recipients for wastewaters. Water users like households, industry and agriculture are both consumers and polluters of water. The number of releasing into water bodies has important effect on water status. Major threats to water quality are releasing of municipal and industrial waters directly into closest rivers and watercourses, as well as washing down from agricultural fields on which there is use of fertilizers and pesticides. Different industries bring different pollutions to river, depending on whether it is food industry, metal industry, textile or some other industry. Agricultural sector has the potential to influence the water quality in many ways like point and diffuse source pollution (mostly pollution by nitrates, phosphates and pesticide).

Economic analysis used in the Pek river basin should provide information on how is current ecologic status influence by water use and especially releases. Because of this, it is very important to clearly identify every subject that influences water status, and then to locate it and describe it. Issues that should be researched are:

- Which sectors bring pollution to rivers sorted by the significance of their influence?
- What amounts of wastewaters is collected and released by water system with sewage?
- Amount of released wastewaters per household, economic sector (industries) and non-economic activities

- The percentage of population connected to sewage system
- The percentage of population connected to wastewater treatment facility
- The percentage of treated wastewaters
- Industries with wastewater treatment
- Influence of pollution on water life
- Forms of pollution (nutrients, heavy metals, new/emerging pollutants

There is much information that requre research and data gathering, so one complete and comprehensive evaluation of water use in the Pek river basin could be conducted. Integrated data base can contain two types of data on water uses. On one hand, it can contain descriptive or empiric information as well as certain analytic information that link together technical, ecological and economic data – to evaluate economic significance of water use, and contribution to economic development should be described in a way which explains the part of water use in transport, employment, income, number of those who will have benefits from using it etc.

The analysis of water use can result in a number of identified and defined forms of use in different sectors of economy. Usually, most often and easiest is identification of water use in households, industry and agriculture, and it is considered that those uses are the clearest. But they are not the only ones. There are other forms of uses like: tourism on or by the water, recreational and sport uses and esthetic values. Of course, importance of these forms of uses depends on their development at river basin.

Households are important users of water considering that it is the most basic and unavoidable form of using water. Households are supplied by water and use water through releasing wastewater. Because of that, they can be users and polluters of water. Water supplier for households in the Pek river basin is the municipal water system. But households sometimes have their own water source and in that case the water use cannot be officially controlled. Households are well known as very important water users. Wastewater collection should be done by municipal water system. However, in the Pek river basin households are very often not connected to sewage system, so they use an alternative like septic tanks or direct releasing into watercourse. Even when households are connected to sewage system that water is also released into watercourse without any previous treatment. Households in the Pek river basin are not only big consumers, but also significant water polluters. Economic analysis of the Pek river basin analyzes all relevant and available data and facts connected to influence of households on water status.

Industry and agriculture con be more or less developed in a river basin. Importance of their influence on water status in terms of water consumption and pollution can vary from river basin to river basin. One of the steps in identification of water use in the Pek river basin is research of how developed are industry and agriculture in the river basin. Some river basins can have poorly developed industrial production, in comparison to others where industry is developed and where water pollution is significant. Industrial water use can be closely examined by dividing them in types: food processing, textile and leather production, paper industry, metal industry. Ways of water use in industry can be numerous, like processing, cleaning, transportation, diluting and cooling down in production facilities. Industries often reuse the same water many times for different purposes. In terms of agricultural development, some areas are used for mass agriculture, while others can be completely unsuitable for agricultural production. Agriculture use can be divided on using for irrigation (farms, vineyards, pastures, horticultures, parks, etc.), livestock farming, fish farming and forestry. Accordingly, it is necessary to examine economic value of these uses also considering their ecologic consequences.

Exploitation of the sand from riverbeds is a form of water use. It is one of characteristic activities for the Pek river basin. In this case that sand is used, and not water, but exploitation of sand changes ecologic and esthetic values of river. For example, natural river banks can become modified due to unavailability to create deposits of new sand. This activity can jeopardize habitats of plant and animal life.

Tourism on water and by the water is one of the economic sectors that can be identified as water use. If tourist offer of an area is based on activities connected to water, then tourism is also a form of water use. This means that potential tourists are being attracted on a certain location by natural beauties, as well as possibilities of using water bodies for recreation. Tourists can be water users, but also water polluters. They can be water users without consuming that same water and without its pollution by using water bodies for swimming, rafting or recreational fishing.

There are also other forms of recreational water use like: camping by the river, rafting, kayaking, economic and ecologic values of these forms of use and their influence on water status should be examined and determined. Recreational activities can influence water resources directly and indirectly. Direct influences appear when recreational activities, like swimming of boat riding, are done directly on water. Indirect influences appear when land activities, like camping or hiking, are done near river banks.

Trend analysis

This step of economic analysis of water use should secure rough prediction on who will use water in the next 10 years. Annex III of WFD states that economic analysis should consider long-term predictions of supply and demand of water in river basin and where needed to: asses the amount, prices and costs of water services and asses relevant investments, including prediction of those investments. Doing long-term predictions is also called scenario "business-as-usual".

The focus of trend analysis would be the evaluation of pressures and key social-economic initiators that can influence on those pressures: demography, climate, sector policies, e.g. common agricultural policy, and technological development and in that way water resources. Increased demand for water by households depends on trends of yearly population increase and in that way the predictions could be made. Any plans that were done in the region on issues of industrial, agricultural or tourism development will surely have important influence on water demand. Certain projections of these development trends should be made. The existing legislation on water that deals with issues like protection and preservation of water also can have an effect on water demand as a consequence. Three sources of information that can be used for starting the approach of trend analysis are:

- population projections,
- municipality development plans
- industrial/commercial/business plans

One should be aware that 1990's present big political, social and economic crossroad for Serbia (breakup of big federation of Yugoslavia, war in the region, Kosovo independence, change of political system, transformation and privatization of economy, involvement in integration and globalization processes) which is also confirmed by social-economic indicators of the time. Data on GDP as a synthetic indicator of production of certain economy show a big decrease in economic activities in the years of sanctions and war in the region, period of political unstableness which lasted many years, economic recovery after 2000. Due to this fact, often it is not possible to identify proper historic trends which could be a base for predictions of future status.

Considering future demand for water and pressures on water, assessment is done based on expected development of certain macroeconomic and sector variables from existing plans and strategies. There are many documents that analyze development goals and needs of certain sectors and systematized programs and measures for achieving those goals, very often on state level. Based on those documents it is possible to make a scenario of water use in future or evaluate the level of pressures and influences on water that come from them. Projections of basic demographic and macroeconomic indicators are shown in physical planning documents and in the Strategy of macroeconomic development.

Cost recovery analysis

The first fact that is necessary to examine is the current level of cost recovery. Water services cost recovery analysis [5] is based on financial data that are public, on local and state level. Annual

financial reports are being collected for all municipal enterprises that provide services of water supply and wastewater drainage for users in the Pek river basin.

During the calculation of cost recovery rate we should include enterprises which prime function is providing water services. Evaluation of cost recovery rate includes assessment of work costs, maintenance and water system management. In the Pek river basin, it is necessary to monitor some of the basic parameters, i.e. categories: the number of employees, total incomes, subventions, donations, total costs. Cost recovery rate can be calculated based on this principle. It is necessary to collect data on prices of water for water enterprises in the Pek river basin, but also on cost recovery benefits of the key-big water users. After defining services and their costs, the analysis should give the answers on following questions:

- What are the fees for water and wastewater in water system companies in the Pek river basin?
- Does existing prices cover the costs of services?
- What is the percentage of covered costs?
- Do these prices give encouragement for rational water use?
- What is the rate of paying the bills for water?
- What are legal and institutional instruments for regulating prices and costs recovery?
- Is there an application of the principle "polluter pays"?
- What's the amount of subventions in the sector?
- Where do external subventions come from and in which way are they financed?

Information for support of analysis of the most cost-effective measures

Methodology for choosing the most cost-effective measures is in fact identification of possible risks for water body, identification of pressures and pressure creators. The point is in necessary analysis of costs and benefits from potential measures and instruments, and the next step is the choice of optimal, best combination of potential measures.

PROGRAM OF MEASURES

Program of measures (WFD, article 11) is the key of planning of river basin management and it determines the action which will be conducted during the period of planning to secure the goals of the Directive and include following circumstances:

- basic measures needed for implementation of legislation for water protection in river basin in accordance with other relevant directives;
- assisting measures, concerning prices and other economic instruments with intention to encourage sustainable and efficient water use;
- additional measures, if abovementioned is not enough for achieving requirements of the Directive (e.g. for international river basins).

IMPLEMENTATION OF THE PROGRAM OF MEASURES FROM THE DIRECTIVE FOR MUNICIPAL WASTEWATER TREATMENT

Framework directive on water requires identification of "significant pressures" as the central part in river basin characterization, written in the Article 5 and Annex II from WFD. Article 10 of WFD emphasizes the need for using combined approach for point and defuse pollution source that equally refer to:

- goal of water quality or standard of water quality and
- best available techniques (BAT), shown through limit values of emissions.

While WFD addresses environment quality, UWWTD [4] addresses emissions. The Directive for municipal wastewaters treatment (Urban Waste Water Treatment Directive – UWWTD) is BAT directive and it states the limit values of emissions.

UWWTD Directive requires that all agglomerations with over 2000 population equivalent (P.E) have to have collectors for municipal wastewater. So, we can tell that every agglomeration with population over 2000 PE presents significant pressure, and recipient can be considered as potential "water body at risk".

CONCLUSION

This work, derived from the research from program Exchange 3, "Common efforts for protection and management of the Pek river" required – in accordance with the EU Framework Directive on Waters – to describe river basins in economic sense. Economic analysis is the central part of the planning process, and its purpose is to acquire information that is necessary for making management decisions and for informing stakeholders and public.

Methodology for economic evaluation of water management and economic analysis contain enough detailed information with a goal to develop appropriate projections of costs, with principles of improving water services cost recovery, long-term prediction of supply and demand for water in river basin and where it is necessary: evaluations of limits, prices and costs considering water services, which also includes evaluation of investment, including relevant predictions of those investments. Considering this, methodology and economic analysis can serve as a "matrix" for some future-similar characterizations of river basins.

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LITERATURE

[1] Directive 2000/60/ec of the European parliament and of the council establishing a framework for Community action in the field of water policy, of 23 October 2000
[2] Tietenberg, T., L. Lewis, L.: Environmental & Natural Resource Economics , Ninth Edition, Pearson Education, Inc., New Jersey 2012., pp. 16-27.
[3] qLife, No.2, Cotrugli Bs, Quantum 21.net, Rijeka, 2009. (John R. Ehrenfeld „ Dostizanje održivosti: Jednostavna rješenja ne postoje", str. 21-36.)
[4] Direktiva Veća 91/271/EEC
[5] Zakon o vodama („Službeni glasnik RS",broj 20/10).