

**WATER RESOURCE EVALUATION ON HUNGARY NOWADAYS**  
SROP-4.2.1.B-11/2/CHR-2011-0003

**Neubauer Éva**

Analysis and Research Center of Climate Economics, Faculty of Economics and Social Sciences, Szent István University, Gödöllő  
E-mail: neubauer.eva@gtk.szie.hu

**—Abstract—**

In our work we tried to determine asset value of water from natural resources. After **reviewing existing methods** with formatting specific system, we tried to **model** the value added framework in which so-called *sustainability* values, values of *natural* conditions of water resource and values of *social* utilization appear with different weight.

In the model these factors can be upgraded as well, by adopting and taking into consideration economic, social and environmental changes. During the research it has crystallized that a **method** based on annuity capitalization can be the most effective, which is able to estimate water resource value as utilization of the final product in a nationally uniform system.

**Key Words:** natural resource valuation, water resource valuation, water in economics

**JEL Classification:** Q

*„All natural resources, especially agricultural land, forests and drinking water supplies, biodiversity – in particular native plant and animal species – and cultural assets shall form part of the nation’s common heritage, and the State and every person shall be obligated to protect, sustain and preserve them for future generations.”*

The Fundamental Law of Hungary

**1. INTRODUCTION**

Present appointed target is monetary evaluation of the link between human economic activity and water. Thought of valuation of water as natural resource

could raise numerous questions at theoretical level. We disregard moral, ethical or philosophical views, schools into one another in this study only the economic methodology and its needs discussed.

European Union is, undoubtedly one of the most influential on present state of our domestic economic history. There is no difference in water resource management either. EU orders to state members in framework directive that in what condition must be protected this natural resource.

The European Union with taking into consideration concerning contracts and Commission opinions, justifying the necessity of its establishment in 53 points has adopted the 2000/60/EC directive in 2000. October 23. on definition of frameworks of community action in water politics (EU VKI, 2000). Alignment to Water Framework Directive (WFD) at national level required many years of expert research work and consultation to take place qualitative and quantitative survey and classification of water resource of Hungary. Naturally, continuing of this work, monitoring and making necessary corrective decisions require durable future presence of the sector.

It can be accepted, that mentioned research results and their attachments of National River Basin Management Plan (NRBMP) are one of the main pillar of national water resource evaluation. At this approach, NRBMPs prepared with necessary regularity can serve as base of future water resource valuations.

At this present study we try to explore the economic concepts of water resource and determine the most acceptable for us. In addition, we strive for describe water resource valuation methods in a wide range.

*„The part systems of a complex organic whole exist in a state of such intimate interaction that it is hard to draw a line between their several functions, none of which in its normal form is conceivable without all the others.”*

Konrad Lorenz  
*Civilized man's eight deadly sins*

## 2. ECONOMIC APPROACH OF WATER RESOURCE

The economic definition of water resource can be accepted from RESS (1988, p. 9.), who means as the **elements and attributes of natural resource, which can be used for needs satisfaction of society at given or expected technological state of development**. This concept assumes two axioms:

- „objectively given physical, chemical, biological characteristics of water determine advantageous and disadvantageous attributes for society, of which carrier is the material of water. This is the value of water recourse potential.”
- „Satisfaction of human, economy and environment needs are related to valuable attributes
  - quality, quantity,
  - energy,
  - maintenance of living space of biological movements,
  - effort on risk minimum in economic, environmental approach.”

During the economic development relation to changing needs, economic value set of water is formed with different structure of elements. From this it follows, that development level of present productive forces in a given period and the environmental, economic and human water needs, water use needs determined by those appoint water resources as economic set. The historically changing structure of use of these is determined by three value factors: value of resource, utilization verticum and used external cost. From natural side, resource balances, capacity balances and need satisfaction balances (RESS, 1988).

So, according to MARJAINÉ (2005) economic approaches of natural resource evaluation are **estimations** of which aim is to monetary express **social value** of quantitative change, reduce advantages and disadvantages from many areas into one dimension.

### **2.1. Economic approach of characteristics of water resource**

Water is a natural treasure can be found all over the country. There are **spatial and temporal differentiation** in its quality and quantity thus needs also appear differently at these dimensions (RESS, 1988).

Water is renewable, namely **flow type** natural resource. That means that in spite of its use it can regenerate according to law of nature in a time perceived by human (BORA, 2001). But renewable resource can be used until exhaustion if the rate of usage [or pollution] is higher than the rate of reproduction [or purification]. In renewable resources this group is called **critical zone**. Typically, this is included by natural resources of which the recovery of supply processes is not take place even if usage of the resource has been completed (REES, 1985).

**1. table. Classification of natural resources (part)**

<b>Renewable (flow) resources</b>	
<b>Without of risk of critical zone</b>	<b>With the risk of critical zone</b>
solar energy	flora
geothermal energy	forest
atmospheric energy (wind)	fauna
water (hydropower)	aquatic ecosystems
tidal	part of water resources
waves	soil
marine currents	
biomass	

Source: BORA (2001, p. 16.)

*1. table* sends the message about water, that water movement activity due to natural law can't be exhausted with any over usage or over pollution according to our present knowledge. And that, one part of water resources and aquatic ecosystems are though able to regenerate, but they can reach their limit of capacity of regeneration with over usage or over pollution and if this is exceeded they become non-renewable ones. Well known examples for this are over-fishing, over-withdrawal of karst water, leaching of chemicals into shallow lakes or certain river sections which reduces assimilation and can causes algae, siltation or decease (BORA, 2001).

With a few exceptions water as natural resource is part of national wealth. Without completeness, following laws dispose over this:

– Act CXCVI. of 2011. on national wealth, **Chapter II. Property types belonging to the category of national property, 1. State property, 4. § (1) d) - e) paragraphs**, and: **Enclosure 1. to act CXCVI. of 2011., Exclusive property of the state, A) Rivers, streams, backwaters, tributaries and their river bed, and register of water establishments.**

– Act LVII. of 1995. on water management, **Chapter III. Provisions of property and operating of property, 6. § (4) a) - c) paragraphs**

### **3. WATER RESOURCE VALUATION**

#### **3.1. Clarify of subject of valuation**

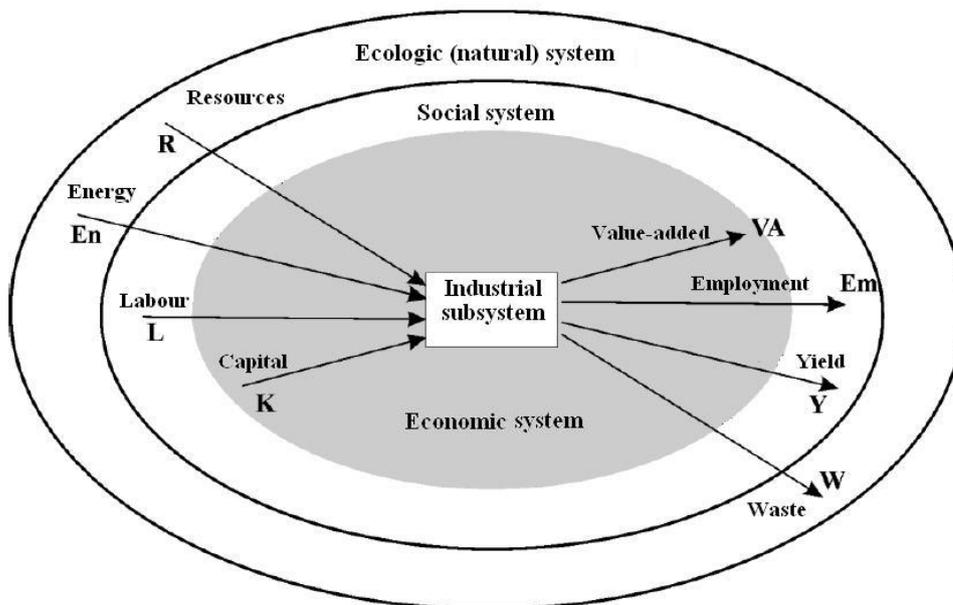
Considering to renewal rate of water resource in total can be interpreted as limited natural resource. This is an absolute limit which suits to Malthusian limits,

therefore quantity and renewal rate are constant. In our case, synthetically produced water is not considered. In addition, relative limit, which determines consumption, appears of which level is determined by place, time and purpose of usage. Relations among these determinants are represented by transport and storage costs. Finally, limits can be permanent static or variable dynamic ones (RESS, 1988).

During our research we try to calculate the value of water as natural resource. By this we mean that is part of the national water resource which is or can be used considering usage directions of multi-dimensional human activities. This study does not include those elements of life cycle which are connected to exploitation and subsequent levels of being like costs of construction and maintenance of infrastructure, storage, redistribution or managing pollution. These are typically market-based evaluated.

Considering the task, in system-based approach, following TYTECA (2001), economy can be supposed as it is implanted in social and natural systems, so that these systems are interrelated with each other.

**1. figure.** Implantation of economical, social and ecological systems.



Source: TYTECA (2001) cited by KEREKES-FOGARASSY (2007, p. 47.)

Water appears in all three systems; in the ecologic one water cycle is essential transfer medium and living space at macro and micro level. According to main water streams human society has been established, his culture and economy has been developed. This economy was built on water usage, because all the economic sectors basically use water both directly or indirectly.

In addition to the mutual relationship, existence of these systems is depending on each other typically from inside out according to *1. figure*. Thus, our social system is built on ecologic system, the former cannot exist without the latter one. Our economic system is built on our social system, but this in turn, cannot exist without the presentence of both social and ecologic systems. In our opinion, these conditions must be taken into consideration in the method.

*When the well is dry, we learn the true value of water.*

Benjamin Franklin

### **3.2. Methods to be used - Non-use values**

In case of **existence and intangible value**, following KERÉKES–SZLÁVIK (1996), value can be understood as the value of being itself. At this approach, water resource has value if society takes care of its long-term existence in this value. The natural value of elementary object must be assessed with careful objectivity. In addition to this valuation, citing MARJAINÉ (2001), “there are numerous explanations on the existence of heritage value which summarized by Freeman III [1994] as follows: 1. the intention is to leave certain resources by will for our descendants and for future generations; 2. feel responsibility for conservation of natural resources or their certain properties; 3. the desire to keep the opportunity of usage of natural resource in question by others.” In our opinion heritage value comes from the value of “being” and has to express that given water resource might be the reflection of thousands of years. This is the value of which benefits are respected, enjoyed by present society, but which is available after thousand years with the same technical conditions.

### **3.4. Methods to be used - Use values**

#### **Calculation of benefits based on imputation**

With mathematical economic methods can be shown, how effectively the unit elements of a supply proportion to be valued are utilized at direct or final consumers. In our case that is calculable, how much of the benefit generated during the production

process is included by a unit of the quantity of water resources. The bases of the calculations are modified Cobb-Douglas production functions, in which elasticity coefficient relate to water can constitute basis of evaluation of water resource. This method is mainly suitable at those water usage directions, where correlation relationship can be quantified and defined between benefit and used water as production factor.

#### **Benefit calculation set out from principle of substitution**

Replaceability of each supply unit at consumer can be revealed and by this way proportional numbers of substitution can be defined regard to the examined substitution alternatives. Evaluation can be accomplished by quantifying cost-savings or demonstratable surplus outcomes compared to outcomes or costs of substitution variables. This method is mainly suitable at those cases, where water utilization can be compared to other solution alternatives.

#### **Benefit calculation deducted from formation of differential allowance**

Proportion of real costs of one single unit of water production, obtaining can be received with defining real costs of water production, obtaining in case of all utilization directions and quarries. Any of the methods based on quantified benefits can be used depending on aim and feasibility of research and data availability (RESS, 1988).

Basis of property, resource valuation of components with positive effect are given by outcome proportion of usage of produced water resources at given development level. On the other hand, basis of property, resource valuation of negative, threatening components are given by value of damage of non-built protection capacities also at given development level. These are for example, *lost production values*, additional costs of *rescue and damage control* and *value of damaged components of national property*. Extents of these negative components are depending on type, presence and appearance of damage, extent of protection, economic and geographic structure of given area. Internal waters just like rainfall conditions are rather calculated at land evaluation (RESS, 1988).

### **3.5. Cost-based valuation methods**

According to MARJAINÉ (2005), starting assumption of these methods is value of natural resource, in our case water is equivalent to the extent of utility they

provide for human, which is equivalent to extent of costs of conservation or/and restoration.

She accepts two assumptions at national resources evaluation. According to one, people's income and changes in natural resources are replaceable with each other, so people accept decrease of environmental conditions, if they get compensations, and vice versa, with decreasing income they can live in better environmental conditions. The other one, the only thing is worth, for which people are willing to pay (MARJAINÉ, w.y.<sup>1</sup>)

Failure of cost-based evaluation methods is they cannot make real difference between alternatives, since extents of benefits of natural resource are considered to conservation costs. Real benefit by natural resource probably does not equivalent to costs of maintenance, therefore this group give significantly distorted result (MARJAINÉ, 2005).

This group includes the following methods: *productivity change method, defensive expenditure method, shadow project method, cost recovery method, method of substitute goods.*

These methods are very similar to each other. Their advantages are that they can be accomplished relatively easily, data are relatively easily available, and forming of the value of a change takes relatively short time (few months). Against these, they are suitable only for determining values related to usage, not recommended their usage in case of dominance of non-use values, resource values estimated by costs or benefit can be distorted (two times higher expense do not mean two times higher benefit), value of underlied natural resource is often only in indirect relation with the valuated good (MARJAINÉ, 2005).

Besides, the so-called methods estimate by demand curves can be used. **Stated preference methods** are large group of these. Feature of these that their inductions on demand of natural resource connected to product or service are related to changes in consumption, so these are rather ex post not hypothetical. Here the aim is to identify events at which behaviour of market participants and prices are affected by change of natural resource (MARJAINÉ, 2005).

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<sup>1</sup> w.y.: without year

Dr. Sándor Ress<sup>2</sup> revealed that extent of economic utilization of each water body can be analysed. The higher this value is the more preferable of using of given water body as natural resource is.

Its most commonly used methods are *travel cost method* and *hedonic price method*.

These two valuations are more suitable for determination of certain value parts, and not for the whole natural resource evaluation and research of results meets with fundamental difficulties of qualitative research, and therefore distortion must be expected at these cases (MARJAINÉ, 2005).

Third group of methods called **revealed preference methods** also belongs to methods estimate by demand curves. Their characteristic is that they outline hypothetic situations where respondents do not express their preferences by their behaviour at market. Methods of this group are *contingent valuation method*, *contingent choice method*, and *contingent ranking method*.

These methods can also be false due to their hypothetic way, they require professional skills and practise, and are often expensive and time-consuming. However, they suit for water resource evaluation, since value judgement of those who are not directly involved can turn out, and allow exploration of value of conversions (trade-off), thus monetary definition (MARJAINÉ, 2005).

In summary, these methods are typically used mixed by experts at certain cases to obtain more complete values closer to reality (MARJAINÉ, 2005). In our opinion, these methods should have been calculated with value of water as natural resource. This would exclude the condition that only that worth what people are willing to pay for.

#### 4. INTERPRETATION OF WATER ALLOWANCE

This method was worked out in SROP-4.2.1.B-11/2/CHR-2011-0003 research by Professor SZÚCS István at Szent István University, Hungary.

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<sup>2</sup> Dr. Sándor RESS is present chairman and CEO of Hungarian ÖKO Inc. After many years of research his publication on water resource evaluation was published in 1988, which is one of the bases of present study. The interview was in 27. August 2012.

*water allowance =  $V_{up}$  – access cost of better quarry than marginal one + average profit*

In other words, production costs of marginal quarries and their components, as well as average cost per water unit from one unfavourable quarry which are the bases of water allowance calculation can be understood as utilization final product.

Allowance according to utilization directions interprets and evaluates water resource in one system at national (even international) level. According to this, asset value of water as utilization final product ( $V_u$ ) is:

$$V_u = \frac{\text{water allowance} \pm \text{externalities} \pm \text{potential annuity}}{\text{capitalisation real interest rate}}$$

Total asset value of national water is:

$$V = \sum g_u \cdot V_u$$

where:  $g_u$  : relative weight rate of each water utilization directions

## 7. SUMMARY

In our work we tried to determine asset value of water from natural resources. After **reviewing existing methods** with formatting specific system, we tried to **model** on the value added framework in which so-called *sustainability* values, values of *natural* conditions of water resource and values of *social* utilization are appear with differ weight. In the model these factors by adapting economic, social and environmental changes and with taking them into consideration can be upgraded as well. At the development phase of the method we mainly relied on previous practice of Dr. RESS Sándor on water resource evaluation at national level. He lighted personally as well some elements of the analyses which must be taken into consideration according to our convince as determinants of water value. During the research it crystallized that a **method** based on annuity capitalization can be the most effective, which is able to estimate water resource value as utilization final product in a nationally uniform system.

Next tasks will include – beyond running in this method – to work out more precisely an environmental economic external index which is able to support environmental friendly systems (maybe with market incentives).

Separate task with requiring additional research is defining external influences of water allowance and factors of contingency allowance.

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