ISSUES ON THE ROLE OF EFFICIENT WATER PRICING FOR SUSTAINABLE WATER MANAGEMENT

Author:

Simona FRONE*

Abstract. *This paper aims to highlight some of the main issues raised by developing and implementing the most appropriate approach to water pricing, and to induce a sustainable water management.*

Therefore, we define the concept and utility of water demand management as one objective of efficient water pricing. Next we analyse the basic economics and some important theoretical insights of water pricing.

We further with state the main four inter-correlated principles of sustainable water pricing (full-cost recovery, economic efficiency, equity and administrative feasability) and the trends and challenges of their actual implementing in the water pricing policy of Romania and other EU countries.

We end with a review of opinions, personal conclusions and recommendations on the actual opportunity, effectiveness and role of efficient water pricing in fulfilling the goals of sustainabilty.

Key words: *sustainable water management, demand management, efficient water pricing, sustainable cost recovery, equity*

JEL Classification*: L95, Q25*

Water, the most fundamental constituent of life, is one of the vital environmental elements for sustainable development of a nation. Water is essential for

* Simona Frone, Ph.D., Senior Researcher, Institute of National Economy – Romanian Academy, e-mail: frone.simona@gmail.com.

achieving sustainable development, since the proper management of water resources is an essential component of growth, social and economic development, poverty reduction and equity, and sustainable environmental services – all important for achieving the Millennium Development Goals.

Sustainable development depends on managing the costs of service provision using the existing infrastructure along with additional investments in new water infrastructure and rehabilitation, both physical and institutional. Therefore, specialists and managers in water supply and sanitation, hydropower, irrigation and flood control have long been aware that water is essential to sustainable development, but they do not make decisions on large economic development objectives and the allocation of human and financial resources needed to meet these broader objectives. These are made or influenced by leaders in government, the private sector and civil society, who must learn to recognize the water role in attaining their objectives and act according to some principles of sustainable water management.

While most of the old challenges of water supply, sanitation and environmental sustainability remain, new challenges such as water scarcity and increasing water demand due to global popullation growth, environment-intensive production and consumption behaviour, adaptation to climate change, rising food and energy prices, rising R&D costs of water systems and ageing infrastructure are nowadays increasing the complexity and financial burden of water management.

Therefore, economists should try to find the best theoretical and practical approaches to deal with these challenges, expressing awareness of the fact that water is no longer a free public good, but a rare and valuable economic good.

The scarcity of the water resource has become a concern only in more recent studies, reflecting the shift from the engineering perspective of increasing supply to satisfy demand to the economic perspective of also managing demand through price to efficiently allocate the existing quantity of water supply.

1. Requirements for sustainable management of water resources and uses

At the International Conference on Water and the Environment (Dublin, Ireland, in 1992), four main principles of water emerged and became the cornerstones of a subsequent water sector reform for a sustainable development.

Principle 1: *Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment*.

According to this principle, three main socio-economic characteristics of water are highlighted:

- Water is critical to sustaining life.
- Freshwater is however a finite resource because the hydrological cycle yields on average a fixed quantity of water per period, and the quantity of water resources cannot be adjusted significantly by human actions.
- As a resource, water is essential to development and paradoxically vulnerable to development.

Principle 2: *Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels*.

The principle of participation emphasizes other important features:

- The involvement and subsidiarity in water projects decision making at the most feasible level with full public consultation and input from users in the planning and implementation of water projects, which leads to more successful projects in terms of scale design and operation and maintenance.
- Participation also helps to ensure that environmental resources are protected and that cultural values and human rights are respected.
- Participation can help coordinate interests, increase transparency and accountability in decision making and can also improve cost recovery, which is a key to revenue generation and financing sustainable water management.

Principle 3: *Women play a central part in the provision, management and safeguarding of water*.

In developing countries, as well as all over the world, there is strong evidence that water managers must consider the urgent need to mainstream gender in integrated water resources management to achieve the goal of sustainable water use.

Principle 4*: Water has an economic value in all its competing uses and should be recognised as an economic good as well as a social good.*

Water has a value as an economic good as well as a social good. Treating water as an economic good is imperative for logical decision making on water allocation between different, competing water sectors, especially in an

environment of water resource scarcity. In a sustainable integrated WRM, the economic value of alternative water uses helps guiding decision makers in the prioritisation of investment.

Although water is an economic good, it is also a social good. In view of a sustainable development, it is particularly important to view water allocation as a means of meeting social goals of equity, poverty alleviation and safeguarding health.

The Brundtland Report did not address the water issue particularly; however, we may agree with a definition of sustainable water consumption stating that ”water consumption should meet basic needs for water servicing without jeopardizing the ability of future generations to meet their water needs and while protecting the water need of the environment”(OECD,1998).

Water is a limited and scarce natural resource (freshwater resources form less than 1% of the total water in the globe) essential to life, which behaves rather differently from other elements of the biosphere, since for water there is no choice between resources. Therefore, although water resources are renewable, water systems can be so degraded that they are potentially lost, and the ecosystem can be dependent on a minimum quantity and quality of water to a threshold below which they are damaged. The only choice to be made in sustainable water management is how to allocate water and find the most efficient way of using it.

Sustainable Water Management is an Integrated Water Resources Management (IWRM) (as it was defined by the Technical Committee of the Global Water Partnership) namely "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."

According to some experts, (D. Seckler, Water Resource Institute, 1996) the number of people living in countries facing water scarcity will represent 13-20% of the global population by the year 2050, so water might become a major determinant of the structure, trade and growth prospects of national economies.

Since water becomes a rare good, the need to control the deterioration of water quality is translated into water legislation, enabling countries to state the purposes and objectives of their water policies. As a result of this pressure put by sustainable water quantity and quality management problems, a new area of water policy has emerged in Europe, through the adoption and implemention of plans for the Water Framework Directive (60/2000/EC). The prime objective in

the new policy era is defined as a sustainable use and management of water resources (Kaika, 2003) and the implemention of WFD aims at promoting effective policies to prevent the degradation of water resources, on the one hand, and the intensified water scarcity, on the other hand.

In 2007, the European Commission adopted a Communication on Water Scarcity & Drought (WS&D) which identified several policy areas that had to be addressed if Europe was to move towards a water-efficient economy. In order to address and mitigate the challenge posed by water scarcity and droughts, it is essential to improve water demand management.

Demand management is defined as the development and implementation of strategies aimed at influencing demand, so as to achieve efficient and sustainable use of a scarce resource, namely water. Besides efficiency, it should promote equity and environmental integrity.

Demand management strategies mainly consist of non-structural measures such as economic and legal incentives to change the behavior of water users and the creation of the institutional and political environment that enables this approach (H. Savenije and P. van der Zang, 2002).

An improved water demand management may lead to an increase in the efficiency of water use and/or reduction in water consumption, with several very important economic and environmental benefits in the medium and long run, such as:

- reduced costs of water treatment and distribution system capacity (including the capacity of infrastructure to collect and treat wastewater);
- savings in capital expenditures because of deferred or downsized new water supply projects;
- energy savings for heating water as well as for pumping and treatment;
- environmental benefits of reduced removal of water from streams and aquifers, which leaves more water to preserve the ecological resources of streams, wetlands and estuaries.

All these issues stress the fact that sustainable and efficient water use represents one of the biggest challenges of the present and the coming decades. Although in some cases, the target of sustainability may be in conflict or in competition against the efficiency target, we support the statements of Baumann et al., (1998) and try to further argue that, in the case of rare water resources, efficient use and pricing can indeed promote sustainable water use.

Especially the last decade has produced marked improvements in the available "know-how" for planning and evaluating demand management alternatives. Taking into account the previous experience and stakeholder consultations, an integrated approach based on a combination of options is considered now in the EU as the most appropriate approach to address WS&D (water scarcity and droughts), compared to alternatives based on water supply or economic instruments only. However, the first policy area to be addressed in the member countries is putting the right price tag on water (COM (2007) 414 final).

Implementing a sensible system of water pricing is one of the major means of efficient water use and the first requirement for the promotion of such use is full-cost prices.This way, suppliers and regulators using charges for use, metering and educating by increasing the awareness of the user about water conservation must reduce water demand toward a more sustainable level (EEA, 2000).

One area of water policy that has become increasingly subject to pricing principles is that of public water supply and wastewater services. Efficient and effective water pricing systems provide incentives for efficient water use and for water quality protection. They also generate funds for the necessary infrastructure development and expansion, and provide a good basis for ensuring that water services can be provided to all citizens at an affordable price.

Due to its particular duality as an economic and social good, water must be considered to be not only a commodity but also a natural resource and a perceived human right. Here we should mention the main characteristics of water as environmental quasi-public good (Frone D.F., Frone Simona, 2011a), which tend to complicate the issue of water marketing and pricing:

a) Water is to a large extent a non-excludable good, since water falls from heaven, flows and evaporates with no boundary.

b) Water is, nevertheless, rival so it is not a pure public good but rather a common pool resource, with a finite amount that must be shared in common for a variety of uses and geographic areas.

c) The renewal of water is both seasonal and stochastic, involving uncertainty in supply. Given the constant need for water, this feature calls for investments in infrastructure that enable us to store and regulate the supply of water.

d) Water cannot be considered as a homogeneous good, since the quality of water may vary substantially, both in space and time. Again, ensuring the quality standards for various uses of water needs water infrastructure investments.

e) The public aesthetic and recreational uses of water are considered "pure" public goods, featuring both non-exclusion and non-rivalry. We can include in this category public and aesthetic uses and benefits coming from non-use as well (for generating ecological services, for instance).

f) Other important water benefits, such as waste assimilation benefits, show partial public-good features, because the capacity of any water stream to serve for waste assimilation is a rapidly congestible good (beyond some point, it is not possible that water gives that benefit without restricting the same benefit to other potential users).

g) Some other water services having fewer public-good features (closer to being private goods) are the services of drinking water and sanitation, which generally have high degrees of exclusion and rivalry.

h) There are water services that are also excludable but show less rivalry in use, like fishing, hydroelectric and transportation activities, which do not necessarily require extracting water (at least in significant ways) from other potential uses.

2. The basic economics of water pricing

The oldest debate in the literature on water pricing is whether to price water by its average cost (based on financial reasons of cost recovery) or by its marginal cost (based on the economic reasoning of promoting an efficient use of the resource).

Essentially, a resource is considered to be used efficiently if the benefit for society from consuming the last or marginal unit of the resource is the same as the cost of obtaining it (including the opportunity cost of foregoing other alternative uses).

If the price of the resource is equal to its marginal cost, then a consumer can adequately compare the benefits obtained with the costs occurring with the consumption decision. If the unit price differs from marginal cost, consumption levels will be either too high (for prices below marginal costs) or too low (for prices above marginal costs) in relation to the socially optimum level of consumption.

As we try to point out below, although marginal cost pricing is consensually recognized as the most efficient way to price water, its implementation depends on the characteristics of water supply and demand.

Sustainable water management calls for a growing awareness of these issues and for an integrated approach to the supply and demand of water. Therefore, modern water industry and infrastructure deals both with:

- the supply side, consisting in the collection, treatment, transport, storage and distribution of fresh water;
- the demand side, by collecting, transporting and treating the used (waste) water.

Concerning the water demand, an important feature is the great variability of water use by regions, family types, housing characteristics, industrial composition and income. Thus, the current trends in water use vary among countries and among sectors, within the countries. Some of the most important issues are:

- agriculture accounts for about 69% of the total freshwater abstraction globally;
- most of the additional food needed to feed the growing world population is expected to come from irrigated land, therefore increasing the demand for water in the agriculture;
- for most OECD countries, irrigation water represents over 80% of the total agricultural water use, lately encouraged by irrigation water subsidies;
- only about 8% of the global water abstraction is used by households;
- growing use of freshwater for cooling in electricity production is an important emerging trend in many OECD countries[1].

Water is an economic good not only used as an input, but also directly consumed. The consumer behavior is highly influenced by preferences (the way they internally value the good), the price of the good, and budget constraints. All of these factors will shape what is known as the willingness to pay for a good, which is the basis for a downward-sloping demand function, relating price to quantities demanded.

Thus the demand function relates the quantity of commodity (water) that a consumer is willing to purchase to price, income and other variables. Demand may be typically expressed as a function of different variables, with a general form:

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[1] OECD, Pricing Water Resources and Water and Sanitation Services, 2010.

$$q = f(x_1, x_2, \ldots x_k) + \varepsilon$$

where: f is the function of variables x_1, x_2, xk, ε is a random variable describing the joint effect on q of all the factors not explicitly considered by the variables. The most important factor determining demand is price: the lower the price, the greater the quantity demanded.

The price elasticity of demand for water measures the willingness of consumers to give up water use when facing rising prices, or conversely, the tendency to use more as price falls (Mays, 2009).

Normally, in a competitive markets, supply and demand for a good will interact to form an equilibrium price, which leads to optimal allocation of resources. Competitive firms will seek to recover their production costs (otherwise they are out of the market); and in each period, the same good or service will be offered to consumers for expected market prices.

However, given its many public good features mentioned above, this classical competitive market is seldom feasible for the operation of water services. Or, when markets can be organized (i.e. for potable water), they show a monopolistic behaviour, which characterizes water provision when there is a large water infrastructure in place.

Thus, potable water is often supplied directly or regulated by the State, and the price formation will not be an automatic result of supply-demand market interactions. Notwithstanding the lack of markets, the production of water services still requires the use of scarce resources, and costs will be incurred. If the price paid for the use of water does not cover the costs (which should reflect an efficient provision of water services; costs related to non-efficiency and rent seeking in water provision must not be considered as part of a full cost recovery approach to water services), we would have troubles assuring the provision of water in the near future.

Consequently, full cost recovery is one of the most important principles of Sustainable Water Management, as we consider water an important economic resource.

But what costs are to be included in the full cost equation? To begin with, all direct production costs must be considered. These are related to the use of all inputs and capital goods in the process of generating the water service. But often, the use of water services generates the so-called environmental externalities (for instance, pollution when used for waste assimilation services),

and the costs of generating these externalities need to be considered in a full cost recovery approach to water issues.

From an economic viewpoint, supply of water is mainly driven by (Frone D.F., Frone Simona, 2011b):

- the costs of constructing and operating the infrastructure;
- the opportunity costs of these resources for alternative uses;
- the costs of the externalities.

Full cost recovery may include the opportunity cost of water as a cost, that is, foregone benefits of using water in its best next alternative needs to be considered as well. The opportunity cost of water is determined mainly by three factors:

i) *Actual characteristics of the supply system* (location and hydraulic connections). Opportunity cost is very low if water can be used only for the proposed project, and it is high when transfers of water from one use to another are easy to implement;

ii) *The regime of water property rights enforced*. Here, opportunity costs are close to zero where transfers of water are prohibited by the law, but they become relevant where private markets are free to operate;

iii) *The specific use of water.* High-valued uses impose a lower opportunity cost on low-valued uses of water.

The inclusion of opportunity cost in the full cost recovery approach, however, has proven to be impractical for charging users water tariffs accordingly. In general, users will find it very unfair to be charged a "cost" which is not directly related to the provision of the service they are receiving. However, opportunity cost calculations can be fruitfully used as a guide for authorities in using economic instruments, in looking for better water allocations, and also in prioritizing future water investments, given scarce resources.

Therefore, to get a better awareness, the total social costs faced for supplying water may be represented[1] as in Figure 1:

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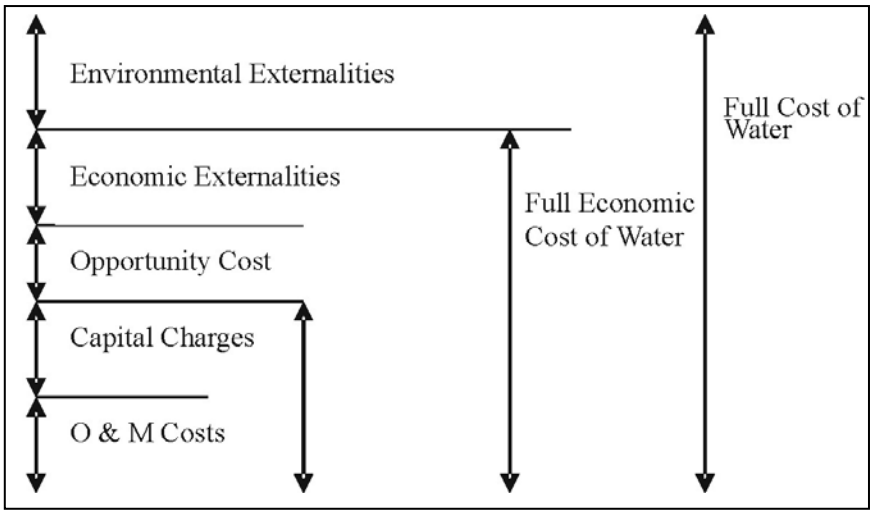
[1] Rogers, P. at al., "Water is an economic good: How to use prices to promote equity, efficiency, and sustainability", *Water Policy* 4 (2002).

Figure 1 - The components of water use costs



In the economic analysis of water, the supply costs are one of the main topics; they are usually referred to as "use costs". These water use costs may be distinguished as follows:

- headwork costs, as incurred in the abstraction, storage and treatment of water;
- network costs, incurred for the distribution of water, and for the collection and disposal of wastewater.

The total water cost function may be expressed as a quantitative relationship aiming to describe the cost of supplying output at each scale, from zero up to the system's theoretical capacity, in any period of time. Thus, it is a function of the quantity of water supplied to the economy.

For the economic analysis, a total water cost function can be approximated by a quadratic function of the form:

$$TC(Q) = aQ^2 + bQ + c \quad (1)$$

where: *TC* are total costs, *Q* is the quantity of water and *a, b, c* are parameters of the relationship, estimated through the regression analysis.

The **average costs of water,** *AC* = *TC/Q*, are equal to the total costs divided by the unit of water produced. Nevertheless, more important for economics may be the marginal costs, since they express the incremental costs of getting one more

unit of water and determine the right incentives to proper, sustainable management of water.

The **marginal costs of water supply,** $MC(Q) = \Delta TC/\Delta Q$, are strictly positive and tend to be increasing in the short run, due to scarcity and capacity constraints.

Another very relevant issues for the water supply are the specific economies of scale, measured by the **output elasticity of total costs.** The water output elasticity of total costs $E_{TC,Q}$ is defined as the percentage change in total costs per unit percent change in quantity supplied.

$$E_{TC,Q} = \frac{\partial TC / TC}{\partial Q / Q} = \frac{\partial TC / \partial Q}{TC / Q} = \frac{MC}{AC} \tag{2}$$

Depending on whether there are economies or, diseconomies of scale respectively, the output elasticity of total costs $E_{TC,\,Q}$ can be lower or higher than unit; it may also be equal to unit, if the costs are constant all along the relevant values.

The total cost of water supply function can exhibit several slopes, depending on the relative strength of two opposite effects:

- for raw water extraction, the marginal costs are greater than the average costs, (since usually the closest, cheapest sources of water are used first) and here the costs of abstraction curve has a positive slope;
- for further water operation utilities (infrastructure network and treatment), marginal costs are usually less than the average costs, with quite important economies of scale.

It is an empirical matter to determine the actual size and degree of the economies of scale and, consequently, the slope of the water supply costs curve.

Another key economic aspect in the management of water is also the distinction between short- and long-run costs:

- in the short run, the daily output may be increased through some operational changes and organizational innovations;
- in the long run, new additional capital will be required for new projects or for the expansion of the existing plants and infrastructure.

These issues are most important in the economic analysis approach, whereas, to assess the social cost of providing water, a long-run perspective and marginal cost calculation is required to be compared to water demand.

Higher water supply elasticity may appear in the long run, due to the "indivisible" character of water provision (since in order to have even modest levels of output, major water infrastructure works are necessary).

3. Principles and goals of efficient and sustainable water pricing

In the pricing of water for sustainable management, it is important to be aware that value and charges are two distinct concepts; the value of water in its alternative uses is important for the reasonable allocation of water as a scarce resource, whether by regulatory or economic means.

Conversely, charging for water is an economic instrument meant to achieve multiple targets such as:

- Influence behaviour towards conservation and efficient water usage.
- Support to disadvantaged groups.
- Incentives for demand management.
- Cost recovery and signalling of consumer willingness to pay for additional investments in water services.

When developing a sustainable water pricing structure, four important issues should be taken into account. These principles or goals of sustainable water pricing are very inter-correlated and only work for sustainability together, when and while they are all met.

I. Full cost recovery

As already mentioned, the full cost recovery is one of the most important principles of Sustainable Water Management. To develop sustainable water supply and sanitation utilities, the water industry should be able to earn a profit, or at least to cover:

- Capital costs for installations (to extract, treat and transport the water);
- Variable costs of water extraction, treatment and transportation.

Here we consider important to mention that, because water systems are monopolistic in character, they should not be encouraged to base their water pricing strategy on full monopolistic high cost recovery.

A sustainable efficient water pricing should be an incentive for optimality, reflecting the least-cost means of investing in capital facilities, operating the water infrastructure and complying with environmental standards. Optimizing water utilities is usually an issue of economies of scale, so that a process of aggregation and regionalization may be a key for full-cost recovery or at least sustainable cost-recovery (Frone Simona, 2008).

II. Equity

Since water is actually vital for human life and welfare, every person should be able to acquire sufficient water to survive, at least. A sustainable water management issue is therefore a water bill to be quite affordable (but raising the price with demand).

An affordable water tariff should not necessarly undermine the efficiency goal of water pricing. Therefore, a sustainable water pricing should be high enough:

- to meet the revenue requirements of the utility;
- to send efficient signals to customers.

At the same time, this principle of equity must work in relation to the demand of different generations: the price of water should be sufficiently high to avoid over-extraction and excessive pollution of water, ensuring that future generations too will hold a share in the scarce amount of water available.

Still, the sustainable water price should be low enough for customers to afford their support of the water service and infrastructure over time.

Table 1. Economic efficiency and impact of water pricing

Water pricing	Impact on water customers	Impact on water systems
Too low (underpricing)	o water bills more affordable o inefficient, too high levels of consumption (demand)	o reduced revenues, lower financial capacity o postponement of necessary investment expenditures o increased supply need o high poltical involvement
Too high (overpricing)	o water bills less affordable o constrained water use	o excess profits o enhanced financial capacity on short term

Water pricing	Impact on water customers	Impact on water systems
	and reduced quality of life	o unsustained financial capacity on long term by decreasing demand and inducing fraud or bypass
Efficient (sustainable)	o water bills may or may not be considered affordable o sending the appropriate price signal o inducing water use based on prices that reflect the cost of service	o ensured financial capacity o ensured maintenance of the system over time o sound investment decision about future capacity needs o reduced need for subsidies

Source*: Own comments and synthesis, mainly based on references.*

III. Economic efficiency

This is a most important sustainable management issue, since economic efficiency in the water sector means that the price of water should be equal to the long-run social marginal cost (Dalhuisen & all, 1999). This has two main important analytical features:

- the social marginal cost of water supply must include external environmental costs;
- the long-run cost includes the capital and operation costs for water infrastructure facilities.

An efficient (sustainable) pricing of water (see Table 1) would provide the right incentives to use water efficiently and, at the same time, to further develop the water sector and eco-efficient technologies.

Again, we must point out that economic efficiency is a fundamental principle, but not the only goal of water pricing, and efficiency is a necessary but not a sufficient element of sustainable development.

IV. Administrative feasibility and viability

Unfortunately, there are often some administrative feasibility constraints to sustainable water management, mainly linked to:

- high costs of water metering and monitoring;
- poor knowledge and assessment (in monetary terms) of external costs;
- potential lack of transparency and awareness.

4. Current trends and challenges of efficient water pricing policies, in Romania and some EU countries

As we try to point out, sustainable development of the water sector faces some new important challenges:

- due to limited water resource availability, the deteriorating quality, the impacts of climate change and poor management, there is now an increasing competition for the use of water resources for human consumption, productive purposes, and the support of ecosystems;
- the urge to ensure access to adequate, sustainable and affordable water and sanitation services for all (as a Human Right stated by UNO in 2010) is constrained either by water scarcity as one limiting factor, or by management factors including ill-conceived investment, under-development or deterioration of infrastructure due to insufficient cash flows (which in turn limit access to external funding), inappropriate regulatory frameworks, limited managerial and regulatory capabilities.

Therefore, our national and European water policies need a mechanism to allocate water where it is most needed, and a financing mechanism to generate revenues and leverage additional sources of finance.

Another threat to sustainable water management and development is climate change, also expected to affect the capacity of water systems to meet human and other needs while preserving resource quality and availability. The main water-related impacts of climate change are expected to be in terms of shifting and more variable hydrological regimes, i.e. changes in water distribution around the world, changes in its seasonal and annual variability, and an increase in the frequency and/or intensity of extreme events (EEA, 2007).

From the viewpoint of ecological sustainability, an efficient pricing of water supply and sanitation services can contribute to ecological efficiency if used:

- to manage demand (to encourage a more reasonable and efficient use of the resource);

- to recover the costs of the damages borne by the environment (i.e. negative impacts on ecosystems, including pollution).

In Europe and worldwide, a variety of pricing levels and tariff structures are curretly used, in order to contribute to ecological sustainability. Another important issue is the economic efficiency and the financial sustainability of water utilities, based on the cost recovery for water supply and sanitation services.

Public water supply and wastewater services constitute one particular area of water policy that has increasingly been subject to pricing principles. Here too, efficient and effective water pricing systems should provide incentives for efficient water use and for water quality protection. They also should generate funds for necessary infrastructure development and expansion, and ensure a good basis for ensuring that water services can be provided to all citizens at an affordable price.

According to a previous detailed study concerning water management in Romania (Platon V., Dulcu G., 2004), the economic instruments for water management and protection have developed and included fixed service charges, various water charges, taxes, penalties and allowances. Their major aim is to have a rational and economical management of waters to ensure that users respect the quality limits for water discharges, to prevent the depletion of water resources, to prevent quality damage and favor resource conservation.

The water legislation in Romania was several times improved and amended in order to comply with the EU Acquis and to apply the principles of sustainable water management. According to Water Law no. 107/1996 as further amended and completed, in Art. 80 (1) on the Water Economic Mechanism, it is stated that: „Water represents a natural resource having

an economic value, in all its forms of use. The conservation, re-use and saving of water shall be encouraged through economic incentives, especially to those which demonstrate a permanent concern for protecting the quantity and quality of water, as well as through implementing penalties to those who waste and pollute the water resources.

In order to achieve this, the Water Law shall apply the cost recovery of water services, including the environmental costs and resources involved, based on economic analysis and on the polluter pays principle. By 2010 it aimes to promote a policy of cost recovery in water uses and stimulation of efficient use of water resources. This policy will determine, based on the economic analysis provided, an appropriate contribution of various major uses, especially industry,

agriculture and water supply for the population, to the cost recovery of water services. The contribution thus established will take account of environmental effects, economic, social, geographical conditions and climatic conditions".

Although the legal framework for a sustainable water management is in force and comprehensive, there are still some challenges in implementing a sustainable water pricing and water management in Romania, as we shall try to point out below.

The same study cited before (Platon V., Dulcu G., 2004) identified some of the main policy issues for the water sector development in Romania, at that time:

- The demand for drinking water for household purposes was still at a high level, due to:
  - water losses in the obsolete distribution networks, and
  - very largely due to water waste by the consumers caused by the bad state of household plumbing, the cuts in water supply in some areas.
- The new investments, especially in municipal water supply and waste-water treatment plants, should take into account the likely drop in water consumption which should be brought about by an improvement of the water supply network, water metering and pricing system.

We shall see that the important improvement in the water metering penetration and the doubling of the water supply and sanitation price have indeed produced a drop in the water consumption in Romania.

As we mentioned in section 2, the economic literature on water pricing generally recognises long-term marginal cost (MC) pricing as the first-best pricing option, hence in reality it is seldom used. IWA (2008) indicated that globally only Australia reported the use of MC pricing as one of the principles for setting water tariffs, while in Europe only Italy mentioned MC pricing as a guide to set tariffs, for industrial users.This may derive from the fact that MC water pricing may conflict with some policy objectives (the financial sustainability of operators) and may be costly to operate (in part due to metering).

Still, the metering of water consumption is a prerequisite for the application of efficient water pricing policies. Metering is very important for water demand management and it can save long-run costs in terms of reduced impacts on the resource.

But, from the viewpoint of the administrative feasibility and viability principle, metering generates short-term costs (for manufacturing, installation, maintenance,

and replacement) and may also reduce revenues for the water company, causing net cash flow problems. Benefits from metering will therefore depend in part on the price elasticity of demand (Dalhuisen, J., *et al.,* 2003).

At present, metering penetration is currently high enough in many EU countries, as reported by a recent survey (OECD, 2010): 95% in Sweden, and about 100% in Belgium, France, Portugal and Hungary, 96% in the Czech Republic and Poland and Portugal (usually at the level of buildings).

Also in Romania, the water metering penetration has increased from 90% of the water sold in 2006, to 95% of the sold water in 2010 (IBNET, Country Report Romania). At the same time, due to the metering and taking into account the important rise in the price of water supply and sanitation services meanwhile (over 100%), the total water consumption (l/person/day) has decreased dramatically (by more than 25%) in Romania (from 206 l/person/day in 2006 to only 153 l/person/day in 2010); for comparision, in the same period, total water consumption has decreased by only 5% in Poland, and by 10.3% in the Czech Republic (but water consumtion in these countries was less than 200 l/person/day in 2006, so the margin of water saving was lower than in Romania).

This trend clearly states the importance and effectiveness of water pricing as an economic instrument for water demand management and water conservation in Romania. On the other hand, although this effect is welcome if kept within sustainable margins, we consider that lately it was too aggravated by the economic crisis, leading to severely restricted water consumption (from the normal sustainable level of about 170 l/person/day).

Our computations based on water demand modelling in Romania for a longer time period (1998-2009) have resulted in an estimated parameter of -0.385 for the price elasticity[1], i.e. an increase in water price of one percent, resulting in a decrease in water consumption (demand) of 0.385 percent.

Our conclusion is that water demand is fairly elastic of the pricing in Romania, but the parameter fits well within the results of other sophisticated research studies, such as the meta-analysis by Dalhuisen & all (2003), who found an average price elasticity of -0.41, and a median of -0.35 for a standard deviation of 0.86. On the other hand, in the richer and more developed EU states, the price elasticity of residential water demand is sensibly lower, with an estimated level of

[1] Frone S., Frone D.F., Sustainable Water Pricing and Demand Management Issues in Romania (forthcoming).

-0.22 in Germany and between -0.12 and -0.17 in Spain (Schleich, J., Hillenbrand, T.,2007).

Indeed, prices for water services, sewerage and sanitation in Romania increased by almost 104% between December 2005-December 2010, according to the National Statistics Institute (INS, Romanian Statistical Yearbook 2011). These services became more expensive every year, by 21.41% in 2006, 12% in 2007, 12.55% in 2008, 15% in 2009 and 16% in 2010. Thus, the growth in tariffs for water and sewer was three times higher than the general price index, an inflation accumulated over the last five years being 34.33%.

This leads to the question whether these tariffs increases were justified by the necessary investment needs and financial viability of the water operators, or they represent, at least in part, an effect of their natural monopolistic position?

The financial sustainability of operators (whatever their status) is, of course, another requirement for the sustainable operation of water services. The key issues of sustainability is the level of revenues and their stability or predictability.

Data from IBNET and other surve show that, for domestic services, providers in most countries cover on average at least the operation and maintenance (O&M) costs, sometimes within large margins as in Denmark, England and Wales, and the Netherlands (see Table 2).

Table 2. Cost - coverage ratio for domestic water supply and sanitation services in selected EU countries, various sources, 2008

EU Country	Ratio*	Comments
Czech Republic	1.17	IB-Net
Denmark	2.78	Estimates based on the unit cost for water
Germany	1.0	IB-Net
Hungary	1.09	IB-Net
Italy	1.19	National Report (Blue Book, 2008)
Netherlands	2.03	Data refer to water supply services only
Poland	1.35	IB-Net
Romania	1.08	IB-Net
Slovak Republic	1.42	IB-Net
United Kingdom	2.62	OFWat, Financial Performance and Expenditures of the Water Companies, 2007-08 report

**For IB-Net data, ratio of total WSS (billed) revenues on total operating expenditure.*

Source*: miscellanous public sources, mainly IB-Net.*

Because other financing instruments (taxes and transfers) are more volatile and beyond the reach of the water community, cost recovery through tariffs is considered a significant driver of the financial sustainability of water operators. Different tariff structures respond more or less effectively to the financial needs of utilities. In terms of the structure of prices for public water services, there is a clear trend in the developed European countries away from fixed charges and towards volumetric charging; in other words, the more you use, the more you pay. Even where fixed charges still exist, the policy of allowing large free allowances is declining. Hungary, Poland and the Czech Republic, for example, already use pricing systems based solely on volumetric pricing, with no fixed charge element at all.

In the case of Romania, large investments in consolidating and expanding water and sewer services in Romania were and are still required, as was the increase in efficiency of the water operators, (including utility service concessions to private companies, as happened, for example, in Bucharest).

But these investments and the loans contracted, directed from above, have created in many cities vicious circles. Local and regional operators passed the costs of these investments in higher rates (fixed charges), which led, in terms of impact on water customers, to an increase in non-paying and the number of debtors, increasing their total debt and the disconnection. According to the predictions of our theoretical economic analysis in Table 1, in terms of impact on water systems, this translates financial blockage, whereas in this way, operators accumulated arrears in paying suppliers and overdue loans.

On the other hand, the lack of competition and the fact that prices of services and their increase are dictated solely by administrative measures (not by the fair relationship between market supply and demand) have contributed greatly to doubling water and sewerage prices. Romanian National Institute of Statistics data (INSE, 2011) show that the rise water and sewerage services in the last five years far exceeded the increase in production costs for water operators. Thus, while the water consumer price became more expensive (by over 100%), producer prices in this sector increased between 2005 and 2010, by only 55%.

Therefore, as concerns the water supply and sanitation pricing policy in Romania, apparently the principle of economic efficiency contradicts the principle of equity, since in the last years, marked by the global economic and financial recession, the burden of increase in the price of water (required by the cost recovery policy stipulated by the EU Water Framework Directive and the

ammended Romanian Water Law) was mainly supported by the impoverished Romanian people (the 56% lucky enough to have access to public water supply, in 2010).

Furthermore, the development prospects of the water sector imply that prices for water in Romania will continue to grow in 2011-2015, especially for the sewage and wastewater treatment (A. Boer, 2011). According to this expert opinion, there are currently in preparation and implementation investments of about 4 billion euros, financed mainly from Cohesion Funds. The projects will also improve the quality and accessibility of services, so the degree of connectivity in cities will reach 100%. Their co-financing will be provided by borrowing, which will be reimbursed from charges.

This means that the problem of equity and affordability of water supply and sanitation services is quite problem in Romania, where the prices of water supply and sanitation services should be adequately designed and adjusted, both in terms of levels and structures, to contribute to different policy objectives.

This requires a careful assessment of the possible consequences of prices on ecological, social, economic and financial dimensions; local conditions prevail and should be reflected in the data used for such assessment.

5. General conclusions and recommendations for sustainable water pricing

Economic theory may be an important base to guide water pricing strategies, since sustainable water pricing is based on marginal-cost pricing theory, which stresses economic efficiency as a fundamental goal.

However, efficiency is a necessary but not a sufficient element of sustainability. Sustainable water pricing may require an evolution from a quite rigid doctrine since marginal-cost pricing does not always and entirely reflect the real needs of the water systems and the served communities.

From the perspective of sustainable water resources management, there are also other major concerns (Dziegielewski, 2011):

(1) a purely economic market approach may not adequately protect natural ecosystems because environmental values (also referred to as ecological services) are rarely quantified or transacted in the market;

(2) true markets for water cannot be established within the existing complex system of water laws and water rights;

(3) water marketing can cause economic dislocations in economies that depend on water but which cannot compete with the highest bidders (for instance rural economies may lose access to water that would be transferred to higher value uses in urban areas).

Therefore, a thorough neo-classical interpretation of "water as economic good" stating that water should be priced at its economic value, so that the market ensure that the water is allocated to its best uses, has led to a considerable misunderstanding over the 4th Dublin water principle (H. Savenije and P. van der Zang, 2002). This purely economic pricing of water would damage the interests of the poor and make, for instance, irrigated agriculture and complete access to water supply and sanitation virtually unfeasible. As a result, a number of disclaimers were added to the fourth Dublin principle, stating that water is also a "social" good and that water should be affordable to the poor.

In an alternative school of thought there is no such confusion, being in agreement with the other Dublin principles and the concept of IWRM. Here, in the papers of Green (2000) water economics is understood to "deal with how to meet best all human wants" making the right choices about the allocation and use of water resources on the basis of an integrated analysis of all the advantages and disadvantages (costs and benefits in a broad sense) of alternative options.

So, some economists (Savenije H.and van der Zang P., 2002) state that considering water as an economic good is mainly about making integrated choices, and not about determining the right price of water. They even consider water pricing as the pitfall of the concept "water as an economic good." There are other authors sharing the quite similar opinion that basic economic principles provide necessary but not always sufficient input to the process of designing water rates (Beecher Janice, A., Shanaghan, P.E., 1999).

A recent study (Bithas, 2008) also states that full-cost pricing should be a reference point for setting water prices if the objective of sustainability is adopted. Social equity should be brought about by its inclusion in all other appropriate instruments and not by the underpricing of water use. However, the author agrees that additional policies – beyond efficiency – and relevant

instruments should be developed and applied in order to ensure sustainable water use.

As for the case of Romania, one of our main conclusions, based on empirical evidence and economic analysis, is that, lately, water pricing has become and will continue to be a strong economic instrument for residential water demand management.

On the other hand, as we argued above, since water is a vital and quasi-public good, and currently in Romania only about 50% of the population has access to public water supply, sewerage and sanitation (due to the underdevelopment of water infrastructure), the pricing of water should not prevent Romanian people and businesses from being connected to public water systems and consuming the right amount of water needed for a modern and civilized lifestyle and/or technological purposes.

Therefore, we believe that implementing sustainable water pricing in Romania, able to provide an efficient and effective economic instrument for a sustainable water demand and supply management still is quite a challenge, though there may be two circumstances that would ease the burden of higher prices for water consumption in Romania:

- Whether there will be a sustained economic growth, able to increase consumer purchasing power.
- Whether the expected unification of the charge for water services, implemented at the newly created regional water operators, would allow for regional cross-subsidization of the tariffs (Frone, Simona, 2008).

The efficient and sustainable water pricing should reduce and prevent the waste, pollution or loss of publicly supplied water, by ensuring, at the same time, the continuity, further development and maintenance of water and wastewater services and utilities.

How efficient, important and comprehensive must be water pricing to provide for a sustainable water management and development? Ideally, a sustainable water pricing should:

a. reflect true costs and therefore induce efficient water production and consumption;

b. promote the achievement of least-cost solutions for the provision of water service (optimization of water infrastructure and operation);

c. be equitable in terms of incorporating cost-sharing practices as needed to enhance affordability of the water service;

d. ensure the long-term viability of the water utility.

A cost - benefit analysis recently carried out by the Romanian Water Association in relation to water pricing affordability in Romania revealed, as stated by the RWA President (Ciomos, V., 2011), that there is little chance for implementing the much-vaunted full-cost recovery principle, at least in the short run.

Therefore, we may conclude that, due to the difficulties involved by the practical implementation of water pricing with full-cost recovery, a sustainable water pricing should allow for sustainable cost recovery (SCR), a concept with at least three main features:

- an appropriate mix of tariffs, taxes and transfers to finance recurrent and capital costs, and to leverage other forms of financing;
- predictability of public subsidies to facilitate investment (planning);
- tariff policies that are affordable to all, including the poorest, while ensuring the financial sustainability of service providers.

A sustainable cost recovery strategy for the water sector aims to sustainably cover costs through a combination of three sources of revenues: tariffs (or other charges linked with water use), taxes (in the form of subsidies from national or local governments) and transfers (from international donors or local charities) – the “3Ts” (OECD, 2010).

Evidence shows that final users and local or international taxpayers are those who actually pay for water. External sources of funding that must be repaid (loans, bonds, etc.) or compensated for (equity) can only bridge the gap between funding needs and available resources, particularly for investment costs that could not be covered up through revenues alone.

The most important issues in sustainable water pricing and other policies for sustainable water management is to never forget, disconsider or neglect any of the four dimensions of sustainability, as shown in Table 3.

Although the environmental, economic, financial and social objectives can support each other, sometimes they can also give rise to potential conflicts and necessary trade-offs. However, sustainability can achieve a balance among

these goals, representing a whole that is larger than the sum of the parts considered separately.

Table 3. Main issues and policy objectives for sustainable water management

Objective: **Environmental sustainability** Policy: **Discourage depletion of critical natural capital** • Guarantee the preservation of ecological functions of water natural capital • Minimise the use of "supply side" solutions to water scarcity • Use efficiency - Encourage water saving - Discourage wasteful water use • Minimise the alteration of natural flow patterns	Objective: **Financial sustainability** Policy: **Guarantee long-term reproduction of physical assets** • Compensate for the resources that are used as inputs in water-related activities • Cash flow should guarantee the conservation of the value of physical assets • Cost efficiency: minimise lifecycle costs of services, *i.e.* the creation of physical capital and operation and maintenance costs • Cost recovery should be for optimized costs only
Objective: **Economic efficiency** Policy: **Water is allocated to the most beneficial uses and economic resources are not wasted** • Allocation efficiency: - Allocate water with priority to uses of highest value to society as a whole - Compare costs of water management and water-related services with their value, *i.e.* do not misallocate economic resources • Regulation should ensure optimal risk allocation among stakeholders (including users and taxpayers)	Objective: **Social equity** Policy: **Access to affordable water in fair and equitable conditions** • Identify "water needs" and allocate water in a way that is not skewed by concentration of power • Structure tariffs so that lower-income users can have access to and afford to use WSS services • Achieve an equitable way to share the cost of managing water resources

Source*: Own interpretation based on table 1.1., p.25, pricing water resources and water and sanitation services © oecd 2010.*

Still, the implementing of a really sustainable water pricing system by the water management authorities and companies, with all the involved principles and features, may be a difficult task. Some practical strategic steps for this may require:

- the long-term planning of financial management, investment, development, and pricing at water companies;
- economic optimizing of the activity taking advantage of economies of scale (for instance through aggregation and regionalization) of water utilities, since achieving least-cost operations provides a basis for long-term efficiency;
- proper economic assessment of the costs of water and WSS provision;
- acknowledgement of the cost-price-demand correlation (function);
- sending accurate price signals that reflect marginal costs;
- addressing equity concerns of policy choices which have distributional consequences;
- continuous monitoring of the costs and revenues;
- making the neccessary price adjustments, when needed.

Further theoretical and empirical research will be dedicated to the analysis and comparision of the effectiveness and sustainabilty of different policies and models of water pricing, for achieving the Water Framework Directive aims in Romania and other European Union member countries.

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References

1. Baumann, D.D., Bolond, J.J., Hanemann, W.M., (1998). *Urban Water Demand Management and Planning*, Mc Graw-Hill, New York.
2. Beecher Janice A., Shanaghan P.E. (1999), *Sustainable Water Pricing, Water International*, IWRA.
3. Bithas, K. (2008), *The sustainable residential water use: Sustainability, efficiency and social equity. The European experience*, ecologicale conomics *68 (2008) 221– 229.*
4. Ciomo V. (2011),*"Romania Steps Up to the Water Framework Directive*, in Blue Planet- Water World November 2011 www.waterworld.com.
5. Dalhuisen et al. (2003), *Price and Income Elasticity of Residential Water Demand: A Meta-Analysis*, Land Economics 79(2).

6. Dalhuisen, Jasper M, De Groot, Henri L.F., Nijkamp P. (1999), "The Economics of Water. A survey of issues" *Econpapers*, 1999.
7. Dziegielewski B.,(2011), "Management of water demand:unresolved issues, *Water International*, IWRA.
8. European Commission (2007) "Addressing the challenge of water scarcity and droughts in the European Union". Communication from the Commission to the Council and the European Parliament, COM(2007)414.
9. European Environment Agency (2000), "Sustainable Use of Europe's Water? State, Prospects and Issues", in *Environmental Assessment Series*, 7, Copenhagen.
10. European Environment Agency (2007), "Climate Change and Adaptation Issues", *Technical Report* No. 2/2007, EEA, Copenhagen.
11. Frone D.F. & Frone Simona (2011a), Principles of Sustainable Water Management, in Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development", ISSN 18445640
12. Frone D.F. & Frone Simona (2011b), "Special Characteristics of Water Supply and Demand", in *Scientific Papers Series, Management, Economic Engineering in Agriculture and Rural Development"*, ISSN 18445640.
13. Frone Simona (2008), "Factors and Challenges of Regionalization in the Water and Wastewater Sector", *RJE nr.2(36)/2008.*
14. Green, C. (2000). "If Only Life Were That Simple; Optimism and Pessimism in Economics." *Physics and Chemistry of the Earth* 25, No. 3: 205–212.
15. INS, *Romanian Statistical Yearbook* , 2011.
16. INSE, "Activities regarding public utility of local interest", 2011.
17. IWA (International Water Association) (2008), "International Statistics for Water Services", IWA Statistics and Economics Specialist Group, presented at the IWA Water Congress, Vienna, available at www.iwahq.org.
18. Kaika M. (2003), "European Environment, 2003", Wiley Online Library.
19. Mays, L.W. (2009), *Water Resources Engineering*, John Wiley &Sons.
20. OECD (1998), "Water Consumption and Sustainable Water Resources Management", Proceedings, Paris.
21. OECD (2010), "Pricing water resources and water and sanitation services"© OECD 2010.
22. Platon V., Dulcu G. (2004),"Country-Specific Issues and Proposed Tariff and Charge Reforms: Romania", in *Assessment and Development of Municipal Water and Wastewater Tariffs and Effluent Charges in the Danube River Basin*, UNDP/GEF DANUBE REGIONAL PROJECT.
23. Rogers, P. at al. (2002), "Water is an economic good: How to use prices to promote equity, efficiency, and sustainability", Water Policy
24. Savenije H. and P. van der Zang (2002), "Water as an Economic Good and Demand Management Paradigms with Pitfalls", IWRA, *Water International*, Volume 27, Number 1, March 2002.
25. Schleich J., Hillenbrand T., "Determinants of Residential Water Demand in Germany", Working Paper Sustainability and Innovation, No. S 3/2007.
26. epp.eurostat.ec.europa.eu/portal.
27. www.ib-net.org.