New directions in water economics, finance and statistics

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Abstract The IWA conference on water economics, statistics and finance involved multidiscipline participants from academia and industry and decision makers. A number of important issues were considered such as: how utilities are financed, the variety of water tariff structures, measurement of performance and benchmarking, national and regional water industry statistics, water facts, regulation, economic aspects, costs/benefits, feasibility analysis, as well as funding possibilities and practices. This is an overview paper that gives the state of the art on these issues, new directions, which were presented at the conference and the up-to-date literature.

Keywords Benchmarking; efficiency; full cost recovery; water demand; water policy; water valuation

Introduction and conference objectives

Over 1.0 billion people in the developing world, one person in five, lack access to safe water, while 2.4 billion people lack access to improved sanitation. In fact, in nine countries more than one person in four does not have access to safe water, and in 15 countries more than one person in four does not have access to adequate sanitation (UNDP, 2003). Access to a safe water supply and sanitation is fundamental for improved health, poverty alleviation and for development. Every year, 3.4 million people, mostly children, die from water-related diseases (WHO, 2002).

Access to water and sanitation, as well as sustainable management of water resources, are key issues in the world today and have for some time been the focus of the International Water Association (IWA) Statistics & Economics Specialist Group (IWA, 2005). With this in mind, an international conference was organised on "Water Economics, Statistics and Finance" with the co-operation of the Department of Economics of the University of Crete. The aim of this conference was to contribute to the transfer of knowledge on the entire water cycle from research to practice and to ultimately influence major policy decisions. Conference papers were presented in 12 different sessions as follows: residential water demand, benchmarking and performance measurement, irrigation water management, full cost recovery, valuation studies, risk assessment, food processing industries, cost analysis studies, analysis of hydrological data, financing water supply and sanitation, water utilities and partnerships, tariff structures and practices.

Water economics

Calculating costs and benefits

The full cost of a water project consists of the capital cost, operation and maintenance (O&M) cost, opportunity cost, economic externalities and environmental externalities, as shown in Figure 1. A more detailed analysis and case studies for the full cost components are illustrated by Rogers *et al.* (1998). Reliable cost calculations and estimations are essential in the water sector as in any other. However, the calculation of all the cost components in order to comply with the full cost recovery principle is always difficult. Usually, capital and operation and maintenance (O&M) costs (full supply cost) and

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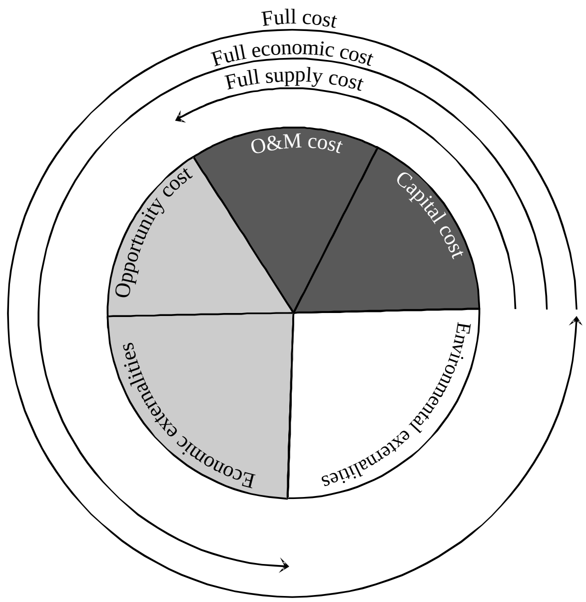


Figure 1 Full cost components, not to scale (after Rogers *et al.*, 1998)

opportunity cost are not very complicated, but other components have to be estimated based on well-structured economic valuation techniques.

The European Union Water Framework Directive has put forward the recovery of all the relevant costs for water services (EU, 2000). A guidance document has been produced focusing on the implementation of the economic elements of the Directive. It summarises the key economic elements, providing guidance on how to plan and organise an economic analysis and gives the methodology to be used, illustrated with some case studies (WATECO, 2003). Based on the above, a cost recovery assessment of water services in the Lower Rhine river basin was undertaken in order to investigate the extent to which the financial costs of the public water supply and municipal wastewater services were recovered (Grube and Meßmann, 2005).

Cost studies

The main conclusions of some cost studies presented at the conference are discussed as follows. Maurer *et al.* (2005) conducted a cost comparison for decentralised and conventional centralised wastewater treatment technologies. They stressed that for such a comparison to be made, data on local technical, financial and legal conditions is required. Chesnutt *et al.* (2005) applied the path-dependent method of full cost-causation, which combines hydraulic system data (pipe length, head loss, and flow control facility peak flows) with a statistically estimated linear pipe cost function to derive a basis for allocating transportation costs. Gratziou *et al.* (2005) provided a comparative cost evaluation of eight different activated sludge and natural wastewater treatment systems including construction cost, energy and chemicals costs, maintenance expenses and salaries. Stephenson (2005) studied the lifecycle costs of pipelines, concluding that by including all operating costs, the material selection is likely to change. Garcia *et al.* (2005) report that due to the French market concentration and the existence of transnational companies, the calculation of the operation costs is not easy to define and makes the local price estimation biased with respect to the cost of service.

Estimating water non-market benefits

If we want to apply cost benefit analysis (CBA) correctly, knowledge of water non-market benefits as well as costs is necessary. Until recently, the indirect impacts of any project were not fully taken into account in CBA. These impacts, which concern the environment (environmental externalities), have gained a lot of attention and numerous approaches have been applied for their calculation as there is not a real market value for this.

The calculation of environmental costs and benefits has also been recognised by governments and organisations that produce guidelines and reports on the successful use of methodologies (Government of South Australia, 1999; FAO, 2000; DEPA, 2002). Given the methodological problems involved in calculating environmental externalities, the inclusion of an environmental cost into the water price will typically have to be supported by political, rather than economic arguments (OECD, 1997). Economic benefits arising from water and sanitation projects for developing countries were analysed and calculated at a global level by Hutton and Haller (2004). Such benefits may include less expenditure on the treatment of diseases; time saving, and reduced impact on productivity, due to avoiding illnesses; switch away from other expensive individual water sources and sanitation practices; property value rise; leisure activities and non-use value.

The contingent valuation method (CVM) is a stated preference survey method in contrast to revealed preference methods such as travel cost or hedonic pricing, which estimate the value of a good, after the buying action of the consumer has been observed (revealed). Rather than being based on realized behaviour, stated preference is based on intended behaviour. The fact that CVM is used for measuring passive values and relies on what people say rather than what they do allows various forms of bias to develop for which the method has been criticized. However, this defect is outweighed by the benefit summarized by Carson *et al.* (2001) who claim that: 'without stated preference methods, economists have to admit that they are not measuring the passive use aspects of environment and other non-market goods, and that these are the aspects about which people care the most. A benefit-cost analysis that omits these considerations will at best be incomplete and at worst completely misleading'. Therefore, in the absence of better alternatives, we have to bear with this method but the criticism it receives has to be taken into account and dealt with. Discussion on stated preference techniques usually involves philosophical aspects revolving around whether the passive use values should be included in the economic analysis and about the technical criteria the method should fulfil in order to eliminate possible biases.

Most of the "Valuation studies" papers presented at the conference used the CVM. Genius *et al.* (2005) used CVM to estimate the Willingness to Pay (WTP) by people for the construction of a wastewater treatment plant. They derived a mean WTP, which turned out to be higher than the amount dictated by the financial analysis carried out by the municipality. Mallios and Latinopoulos (2005) used a CVM to value irrigation water in a Greek agricultural area. Menegaki and Hanley (2005) have performed two CVM surveys to derive mean WTP and the factors that affect them, one survey for farmers and one for consumers. Farmers were questioned on using recycled water for irrigation and consumers were questioned for eating food products which have been irrigated with recycled water. Genius and Tsagarakis (2005) analysed the extent to which households in an urban area are willing to pay to ensure a fully reliable water supply when the latter induces changes in drinking water quality. In a similar study Hatzaki *et al.* (2005) elicit residents, WTP as an extra percent over their water bill in order to contribute to the completion of works that will eliminate water supply shortages during peak water demand periods. Karkanakis *et al.* (2005) have estimated the WTP for visitors to Cournas lake, for the facilities and services which would be provided for them at the lake.

Considering hedonic pricing and travel cost, Hanley and Spash (1993) in their seminal book on cost-benefit analysis and the environment give the definitions and the paraphernalia of these two methods: 'Hedonic pricing seeks to find a relationship between the levels of environmental services (such as noise levels or total suspended particulate levels), and the prices of marketed goods (houses)'. As far as travel cost is concerned, this method is predominantly used in outdoor recreation modelling which includes fishing, hunting, boating and forest visits. It works by using the cost of consuming these services as a proxy for their price. Nauges and Strand (2005) used hedonic pricing as a means to find the value of water connections in Central American cities. They show that 'the value of housing property is significantly affected by whether or not the house is connected to the water system, by whether the tap connection has a meter and whether or not water is rationed'.

Other stated preference methods are conjoint analysis or choice modelling. They deal more with the valuation of characteristics and attributes of a good rather than with its total value, and they have been used in marketing and transport research fields. Boxall *et al.* (1996) state that 'choice experiments offer considerable enhancements through the incorporation of substitute choices and the possibility of examining a broader range of potential environmental quality changes'. Birol *et al.* (2005) conducted a choice modelling experiment for the estimation of non-use values of wetlands in Greece and suggested that if they are combined with direct and indirect use values of a wetland, then a comprehensive cost-benefit analysis will have been carried out.

Bateman *et al.* (2002), in another landmark book on stated preference techniques, refer to additional methods of benefit and cost estimation in the environmental context. One of these is multi-criteria analysis. In this method 'various criteria (risks) are compared to see if any sets of criteria dominate others. Dominated sets are then eliminated and remaining sets can then be compared with some form of weighting. If weights are WTP prices, this method reduces to CBA. Often multicriteria analysis does not involve reference to individuals' choices, rather it tends to involve expert opinion'. Psychoudakis *et al.* (2005) used multicriteria analysis and cost-benefit analysis to evaluate three wetland management scenarios.

Tariff structures and prices

A water tariff is a powerful management tool. Revenue efficiency, economic efficiency, equity, fairness, income redistribution and resource conservation are some of the objectives that can be pursued through prices (Boland and Whittington, 2000). Setting a water tariff requires striking a balance between the aforesaid objectives (Dinar and Subramanian, 1997; Whittington, 2003). Pricing should also aim to promote the sustainability of water resources and the full cost recovery of water services (Avis *et al.*, 2000) and it can be used by governments to transfer income between sectors through cross-subsidization (Dinar and Subramanian, 1998).

The main types of tariff structures are described in Figure 2. Combinations of the cases described are very often used. Two part, rising block tariffs are widespread (EEA, 2001). A two part tariff comprises a fixed part and a volumetric part. The former is a charge independent of consumption and is intended to cover overhead costs and possibly capital expenditure and fixed O&M costs, while the latter is related to actual consumption over the billing period. There is a tendency for tariff structures to move away from decreasing block and flat rate pricing structures towards volumetric and increasing block tariffs (Seppälä and Katko, 2003). Lately, some utilities also include a time component, with a peak or seasonal additional charge for consumption. Therefore, a price may

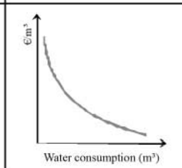
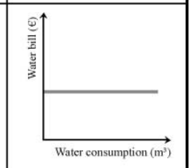
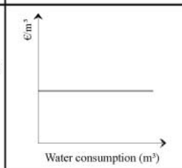
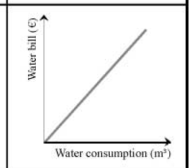
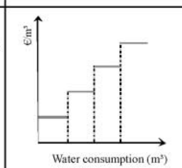
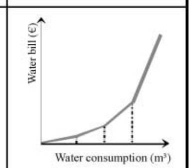
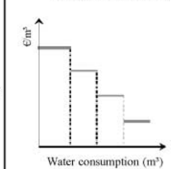
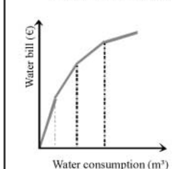
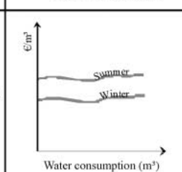
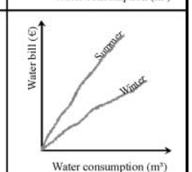
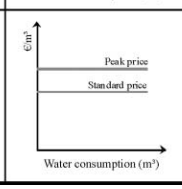
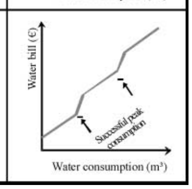
Tariff structure	Definition	Description	Cost per m³ consumed	Typical scheme
Fixed, blanket, one charge, uniform rate	A fixed charge is applied irrespective of the quantity consumed.	Does not require a meter, administratively simple, low economic efficiency, low equity.		
Flat, single block rate	Single price per unit charged.	Administratively simple, encourages conservation, gives the sign of water scarcity.		
Increasing, ascending block	Each consecutive block is sold at higher price per unit.	Encourages conservation, gives the signal of water scarcity, promotes equity.		
Declining, decreasing, descending block	Each consequent block is sold at a lower price per unit.	Does not encourage conservation, it applies to areas where there is plenty of water to sell.		
Seasonal pricing	A different higher price applies during the summer season. It may apply to any of the above-mentioned structures.	Encourages water conservation where seasonal demands are the target conservation efforts.		
Peak load pricing	Price may be based on: days of the month, daytime vs. night or peak time of the day. It may apply to any of the above-mentioned structures.	Advanced metering systems are required. Encourages conservation when water demand is high.		

Figure 2 Different tariff policies applied to residential water (see also Cameon, 1995; Pezzey and Mill, 1998; EEA, 2001; New East Consulting Services Ltd., 2001; MacDonald *et al.*, 2001; Montginoul, 2005)

contain one or more of the components indicated by Eq. 1.

$$\begin{aligned} Water\ price = & f\,(Fixed\ component + Volumetric\ component \\ & + Time\,(peak)\ component + Other\ charges) \end{aligned} \tag{1}$$

Apart from the fixed and volumetric components, residential water bills may also include: a wastewater portion (normally related to water consumption), taxes, cost related to supply pipe size and connection charge. The billing period varies; it can be one, two, three, four, six or twelve months long. Longer billing periods have the advantage of incurring less expenses in bill printing and collecting, but they delay cash flows by the authority. However, proper tariffs enforcement, effective billing and revenue collection are important for the economic performance of water utilities (Seppälä and Katko, 2003).

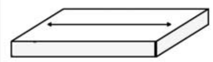
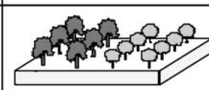
Pricing structure	Definition	Description	Typical scheme
Fixed	The fixed part in agriculture may be based on the irrigated land size (per area unit, e.g. ha) or per user, for a billing period.	If it is a single part tariff farmers are not encouraged to increase irrigation efficiency.	
Area based	Water price is dependent on the area served. This may be determined by a government policy or many water authorities follow their own pricing policies.	Administratively simple. Equity depends upon farmers.	
Cultivation or crop based	Price is adjusted to the crop. Prices are set on the basis of the crop water requirements.	Complicated in cases of more than one crop. Encourages efficiency.	
Time based	Time based is a variable part if the water provided is charged according to the time during which the water is pumped. In these cases water volume supplied per hour is known.	Administratively simple.	

Figure 3 Different tariff policies applied to irrigation water (see also Dinar and Subramanian, 1998; Abu-Zeid M., 2001; Johansson *et al.*, 2002)

Users have become accustomed to subsidised charges for water (Avis *et al.*, 2000). Seppälä and Katko (2003) report that if full cost recovery is considered for water pricing in EU countries, the percentage family income spent on water services would rise from 0.3–1.2% to 1–3%.

Affordability issues are of major importance and practices so far have been in two directions: income support, and tariff adjustment and innovation (OECD, 2002). Vulnerable consumers and low income families may not be able to afford the standard rates. This is especially true for families with many children, which need more water, and the family income per head is low. In such cases, special tariffs should apply. In Greece, it is a common policy for many water utilities to apply low charges for families with four or more children (Genius *et al.*, 2005). Mara (2005) recommends different charges per household based on a portion of their wage. In some cases the first block is not priced at all or is provided at a very low price or the fixed part includes a standard consumption.

Some tariffs like fixed or flat rate, which are applied to residential water use, may also apply to irrigation purposes. Indeed, a two-part tariff with a fixed and a volumetric part is commonly met. Figure 3 shows some of the most common components of the agricultural water price which have not been described in Figure 2. Irrigation water is under priced in many countries (Redaud, 1998; Avis *et al.*, 2000) and there are even areas where it is free for farmers (Molle, 2002).

Water demand

Water demand in relation to price has been widely studied, particularly with regard to the price elasticity (percentage change in consumption caused by a 1% increase in price). Studies of elasticity have recorded wide ranges of values, usually from -0.1 (i.e. 0.1% fall in consumption) to -1.0 (i.e. 1% fall in consumption) (EEA, 2001). An extensive review of water demand price elasticity for more than 60 studies has been published by Arbués *et al.* (2003); most of these studies show that demand is inelastic. McNeill and Tate (1991) used various studies to provide a frequency distribution of price elasticity for residential water demand coming from various studies in the range of -0.1 to -1.3. Beecher *et al.* (1994) reviewed over 100 studies of the price elasticity of demand and concluded that the most likely range for elasticity of residential water demand ranges from -0.20 to -0.40, while for industrial demand it ranges from -0.50 to -0.80.

Metaxas and Charalambous (2005) estimated the water price demand elasticity for eight different cases in six regions and found that they lie within the price inelastic range. They concluded that water utilities cannot necessarily through an increase in prices effectively influence residential customers to use less water, to change or substitute their source of supply or to accept water conservation strategies without first understanding the way people relate to water. Reynaud *et al.* (2005) report that the pricing structure plays a significant role in influencing price responsiveness. Gaudin (2005) found that 'the inclusion of price information in consumers bills increases responsiveness to price, indicating that individuals may not take the time to enquire about marginal prices or perform calculations from their bill, but do react more strongly when prices are transparent'. She concluded that 'a utility that gives marginal price information on the water bill can attain the same level of conservation with a 30% lower price increase'. According to Latinopoulos (2005), irrigation water is inelastic for low prices (<0.06 €/m^3) while for higher prices (>0.08 €/m^3) there are significant water demand reductions and an improvement of water economic efficiency.

Financing

The European Union has developed a guide to cost-benefit analysis of investment projects (EU, 2002), with analysis of projects by category, including water projects. This guide applies the financial gap method and the financial rate of return on equity to estimate the gap between the cost of a project and the affordability levels of the beneficiaries, which have to be covered by grants. According to Almagro (2005) 'the practical application of these methods bears the implicit risk of having part of the Community assistance benefiting economic agents other than the targeted ones. This risk can be easily mitigated with some basic checks and balances'.

Financing for the poor

In September 2000 the world's leaders adopted the UN Millennium Declaration (UN, 2000), and among other things have decided 'To halve, by the year 2015, the proportion of the world's people whose income is less than one dollar a day and the proportion of people who suffer from hunger and, by the same date, to halve the proportion of people who are unable to reach or to afford safe drinking water'. There is an international debate on water charges for poor people in developing countries and in poor regions in developed countries. Chowdhury (2005) supports that the poor pay higher premiums for water services and that the poorest developing countries are unlikely to have the funds for an even development of the sector, even through international aid. Data analysis from four countries reports a cost of 295 US$ to acquire a functioning piped water connection which is regarded as unaffordable by the poorest (Franceys, 2005). It is suggested that water utilities need to adjust their new connection policies, reducing any official charges with costs amortised over several years or over the entire customer base. Similarly, Mara (2005) suggests that water utilities 'should not charge connection fees but recoup connection costs through the increasing tariff structure. In this way, non-poor households subsidize poor and very poor households'.

Microfinance is a term used lately for the systematic and effective support of poor people in developing countries allowing them to have access to financial services. It consists of innovative financing mechanisms based on local conditions. There are microfinance mechanisms which can provide an approach for increasing and sustaining water supply and sanitation coverage to the poorest populations (Kouassi-Komlan *et al.,* 2004). Microfinance institutions are facilitating poor communities to access improved shelter and services though the provision of small credit, including credit to pay for water connections (UNDP and World Bank, 1999). Fonseca *et al.* (2005) presented successful examples of financing mechanisms at regional levels which aim to increase and maintain coverage for the poorest. 'These examples have demonstrated that sustainability of services requires that financial allocations need to be linked with empowerment and people's involvement'. Microfinance options and constraints for financing water supply and sanitation services in Sub-Saharan Africa are also explored by Mehta and Virjee (2003).

Water utilities and partnerships

About 5% of the population on earth (~300 million) receive water from private companies (UNDP, 2003). International schemes, practices and applications on PSP are analysed by OECD (2002). The main categories of Public Sector Participation (PSP) have been presented by Lamothe (2003) who also summarises the outcome of a project that provides a comparative study of national strategies for PSP in Europe.

Private capital will bring effective cost recovery through clear managerial practices, and will facilitate carrying out large investments through the availability of resources (Brikké and Rojas, 2001). However, this is based on the assumption that customers pay for their services and private companies are unlikely to be interested in providing water services in rural areas in low income countries (UNDP, 2003). In such cases strong regulation is needed. Gains in extension of water services are recognised through PSP, but impacts on poor households are also reported (Loftus and McDonald, 2001). Furthermore, users are unlikely to participate in decision-making and they would have to pay higher tariffs to repay any investments and provide a profit (Brikké and Rojas, 2001).

Some recent applications of PSP in water services were presented in the conference as follows. Renard (2005) discussed applications of public private partnerships implemented in China, stressing the need for community involvement and the key role of local officials and government authorities. According to Suleiman *et al.* (2005) 'Privatisation of water services of Amman does not release the public sector from its responsibility for transparency, fairness of pricing and accountability for coherent policy'. Phumpiu and Gustafsson (2005) discussed the water governance reform in Honduras, which comprises institutional and organizational changes of the existing centralized decision making in the water and sanitation sector. They concluded that water and sanitation projects need a strong impulse in education to generate awareness of their importance. Participation of all stakeholders is also stressed by Meade (2005) who analysed the outcome of the first regional water utility establishment in Armenia. Chowdhury (2005) supports that 'the Asian poor (i.e. indigenous communities, farmers, women and the urban poor) face the negative impact of water privatisation'.

Statistics and benchmarking

Water statistics are prepared by national services or international organizations. The need for reliable water statistics is apparent because they are the basic input for forming water policies. Major categories include statistics on: water resources, water supply for all uses, wastewater generation collection and treatment, pollutant discharges to water bodies, water quality and pricing.

The IWA Specialist Group on Statistics and Economics has published International Statistics for Water Services (IWA, 2004). Water charges, water consumption, water abstraction and other basic indices are regularly updated. The prices compared in the reports are presented from the point of view of the domestic customer, whose main interest is the amount of the water bill. A recently compiled source of data and benchmarking know-how is the free web-accessible database called IBNET (International Benchmarking Network) (Milnes, 2005).

Further work from IWA (Task Forces on Performance Indicators and water losses) has been undertaken with a report on water losses management and techniques. This is an 'International best practice standard for defining and calculating components of water balance, and selecting the most appropriate performance indicators for different components of non-revenue water and water losses' (Lambert, 2002). The need to apply appropriate and common methodology worldwide is specifically stressed in this publication. Other relevant works include 'A Review of Performance Indicators for Real Losses from Water Supply Systems' from Lambert *et al.* (1999) and 'Performance Indicators for Water Supply Services' by Alegre *et al.* (2000). A project based on the latter publication was carried out in Bavaria (Germany) and Austria in order to make cross-border comparisons. This project highlights another benefit of benchmarking: not only orientation for single enterprises, but also assessment of regional and national performance levels (Theuretzbacher-Fritz *et al.*, 2005). However, there are still some wellplanned and performed benchmarking systems, such that of the Danish Water and Wastewater Association (Bastrup, 2005).

Currently, the IWA Task Force on water losses is working on providing a simple method for assessing economic intervention frequency for an active leakage control policy based on a regular survey. Calculations are based on three key parameters: average rate in the rise of unreported leakage, marginal cost of water and cost of intervention (Lambert and Fantozzi, 2005).

Statistical analysis techniques

Advanced statistical techniques are employed in the analysis of water resource data; some such applications were presented to the conference. Atsalakis and Ucenic (2005) used a neuro-fuzzy approach to forecast water consumption. They developed the ANFIS model (Adaptive Neuro-fuzzy Inferences System technique) for one-step ahead prediction of daily water consumption. Wu *et al.* (2005) use multivariate statistical analysis to characterise groundwater quality. Kao *et al.* (2005) used the Water Quality Simulation Programme (WASP) as a planning tool to perform the water quality evaluation for the Love river in Taiwan. Wang *et al.* (2005a) studied the stemflow process of major rivers at seven stations in Western Europe for trend analysis (using Mann-Kendall test and seasonal Kendall test) and non-stationarity (using Augmented Dickey-Fuller (ADF) and KPSS tests). Furthermore Wang *et al.* (2005b) studied the long memory phenomena in streamflow processes of the Yellow river at different timescales with autocorrelation function analysis, classical R/S analysis and aggregated variance plot (heuristic methods), and Lo's modified R/S test and GPH Test (statistical test methods).

Benchmarking and efficiency

A major field that water experts are concerned with is the effective use of available resources. This applies to water transportation, application, water extraction metering and management of water services. Technology advances and educational actions are factors that may affect water consumption. Chesnutt (2005) has demonstrated water savings achieved by the landscape intervention of evapotranspiration irrigation controllers and by customers being given irrigation education. Metering is an essential element of water demand management (EEA, 2001). Galanakis and Chamilothoris (2005) tackled the issue of under-registration of water consumption, reporting that it can reach 20–30% of water consumption. The minimization of losses in water distribution networks is among the prime targets for all water utilities. Analysing flow and pressure data from boundary district meter areas, in comparison to billing information, contributed to the leakage management of the Water Supply Company JP Vodovod-Kanalizacija d.o.o. (Horvat, 2005).

Benchmarking between water utilities provides the tool for systematic and detailed performance comparisons identifying real performance improvements. Dinar and Saleth (2005) have developed a composite indicator, the Water Institutions Health Index, with data from over 43 countries using 16 institutional variables. Marques and Monteiro (2005) applied a benchmarking methodology, the Data Envelopment Analysis (DEA), to the Portuguese water sector. In addition to this, a bootstrap technique was also used to enable the efficiency measures robustness obtained by the DEA assessment in relation to the sample change and the non-observable variables. Hernández-Sancho and Sala-Garrido (2005) also used the DEA to calculate efficiency for the Spanish wastewater treatment plants.

Policy conclusions and future perspectives

Sustainable water use and water availability are key issues for the world today. Addressing these issues requires appropriate asset management for water conservation. Reliable water statistics are also needed as an input for water policies. This IWA conference gave insight into problems faced by both rich and poor countries, problems which require much work in the future before they can be effectively addressed.

Key issues today the water companies face are the water and wastewater asset management including effective metering, water leakage; long term planning. Moreover, appropriate financing and pricing are required to ensure economic efficiency, equity, resources conservation and affordability. Therefore, benchmarking in water and sanitation for water transportation, application to the field and management of water services should be properly defined and practised. Finally, water companies in many countries still need to work towards the estimation of the full cost recovery principle with emphasis on environmental externalities.

Considering financing water supply and sanitation, microfinance schemes for the poor can be created, while the private sector participation in the provision of water supply and sanitation services should be carefully monitored in order to alleviate any impact on the poor.

Policy makers need reliable water statistics (on water resources, water supply for all uses, wastewater generation collection and treatment, pollutant discharges to water bodies, water quality, and water pricing) to be used as an input for the formation of water policies. Policy makers should also forecast demand and supply of water for residents, agriculture and industry, and the optimal transfer of water between uses. Access to water and sanitation will still be considered a major issue in the near future as we are too far away from making it available for all.

Furthermore, the efficient participation of consumers-users and local authorities in the formation and applications of any water policy is stressed by many authors worldwide.

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