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Water Resources Management Precautions and Regulation Exercises in the European Union

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Abstract: Water scarcity is an increasingly alarming issue in European continent. The European Union (EU) is not fall apart from this worldwide problem since both water scarcity and droughts have now emerged as a major challenge and global warming is to make matters worse [1]. The potential problems and mitigation options differ between locations and technologies – meaning that mitigation measures have to be designed to deal with local conditions. The case studies throughout the European geography do not provide a single set of best available mitigation options. Nevertheless, such studies and statistics provide check-lists of potential problems and a catalogue of potential mitigation options, with enlightening of succes stories.

Key words: Water scarcity • Draught • Abstraction and availability • Water use • Europe

INTRODUCTION

Water Scarcity and Droughts in Europe: "Water scarcity" means that water demand exceeds the water resources exploitable under sustainable conditions, whereas "drought" means a temporary decrease in water availability for some reasons. In last decades, droughts have dramatically increased in number and intensity in Europe. The number of areas and people affected by droughts went up by almost 20% between 1976 and 2006. One of the most widespread droughts occurred in 2003 when over 100 million people and a third of the EU territory were affected. The cost of the damage to the European economy was enormous. The total cost of droughts over the past thirty years amounts to _100 billion.

European citizens and economic sectors which use and depend on water directly, hit by water scarcity and droughts, such as agriculture, tourism, industry, energy and transport sectors. The detrimental impacts of scarcity and droughts on natural resources at large through negative side-effects on biodiversity, water quality, increased risks of forest fires and soil impoverishment as well. It has become an EU priority to devise effective drought risk management strategies.

Needing for a more sustainable and integrated approach to managing water resources in Europe is already reflected in water-related policy and the acquis communitaire. The most important legislation, the Water Framework Directive (WFD), requires the 'promotion of sustainable water use based on a longterm protection of available water resources'. To this end, the 'registration and control of abstraction of both surface and groundwater' is identified as a key measure. The European Commission has also recognised the challenge posed by water scarcity and droughts in a 2007 communication[1] which outlines the severity of the issue and presents a set of policy options to address water scarcity and drought throughout Europe.

Ensuring effectiveness, policy action on water scarcity and droughts has to be based on high-quality knowledge and information on the extent of the challenge and projected trends. Filling knowledge gaps and ensuring data comparability across Europe or any other region is certainly a precondition. In this context, the Middle Eastern and Northern African states may clone nice patterns from this exercises.

Precise information on the extent and impacts of water crisis (scarcity and droughts) is indispensable for decision-making at all levels. Shared definitions are vital to ensure data consistency at any regional level. Besides that, the challenge of water scarcity and droughts needs to be addressed both as an essential environmental issue and also as a precondition for sustainable economic

[1] This paper widely benefited and extracted from the report titled: Water Resources Across Europe – Confronting Water Scarcity and Drought, by European Environment Agency, EEA Report No 2/2009

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growth in Europe. As the EU seeks to revitalise and reinvigorate its economy and to continue to lead on tackling climate change, the devising of an effective strategy towards water efficiency may make a substantial contribution.

As seen in many parts of the world, reduced river flows, lowered lake and groundwater levels and the drying up of wetlands becoming increasingly commonplace in many places in Europe. Overexploitation poses a threat and demand well exceeds availability of available water. The impacts of water scarcity are likely to be exacerbated, with predicted increases in the frequency and severity of droughts, driven by climate change in future. The major challenge provided by water scarcity and droughts has been recognised in a communication from the European Commission which estimated that "at least 11% of Europe's population and 17% of its territory have been affected by water scarcity to date and put the cost of droughts in Europe over the past thirty years at _ 100 billion."[2].

Excessive abstraction rates exacerbate imbalance between abstraction and water availability. In 2007, as part of the European Commission's assessment of water scarcity and drought, thirteen Member States submitted information on river basin water exploitation index (WEI) which is calculated annually as the ratio of total freshwater abstraction to the total renewable resource [3]. The WEI above 20% implies that a water resource is under stress and values above 40% indicate severe water stress and clearly unsustainable use of the water resource [4].

Although calculating the WEI at a river basin scale provides additional detail, such analysis still struggles to reflect fully the level of stress upon local water resources since the WEI is based on annual data and cannot account for seasonal variations in water availability and abstraction. In southern Europe, agricultural and tourist water demands peak at summer when the natural water resource reaches a minimum. The annual average approach of the WEI is unable to capture this and cannot precisely reflect the potential threats.

Another shortcoming of the WEI is that it can overestimate water stress since it does not account for the consumptive use. Abstracted water is returned to the source where abstraction is dominated by power generation. Despite its failures, the WEI still provides a useful indication of water scarcity and there is a broad geographical correlation between those river basins with the highest WEI and reports, from a range of sources, of diminished water resources and associated detrimental impacts.

Socio-Cultural Influence, Wealth and Individual Behaviour: Tourism can markedly increase 'public water' use, particularly during the peak summer holiday months and especially in southern European coastal regions already subject to considerable water stress. Not only do tourists use water for food, drink and personal hygiene purposes, leisure facilities such as swimming pools, water parks and golf courses can significantly increase water use. Tourists use more water than locals per capita. The Organisation for Economic Co-operation and Development (OECD) reports that per capita water use by tourists in deluxe hotels in Greece averages 450 litres/day - several times higher than average use by local Greek residents [5]. Non-tourist water use in the home generally ranges between 100 and 200 litres/per person/day across Europe.

As GDP increases, the proportion of households connected to public supplies increases. Higher household income is also linked to greater water use and ownership and increased capacity of water appliances (e.g. showers, toilets, water heaters, dishwashers, washing machines, sprinklers and swimming pools).

A sigmoid (S-shaped) curve has been used to describe the relationship between per capita domestic water use and national income, [6] whereby at low income levels water use initially accelerates sharply with the development of economies and lifestyles. Upon reaching a threshold where the average household is fully provided with dishwashers, washing machines and other appliances, water use then stabilises or decreases with any further increase in GDP.

The positive relationship between public water use and GDP/income/wealth at lower earnings levels indicates that future increases in household usage are likely in certain areas of Europe. When Europeans become wealthier they buy more water use appliances. In 1970, for example, 65% of UK households had washing machines but by 2002 this figure had increased to more than 90%. Similar trends have been observed in other western European countries. This growth may not impact significantly upon household water use, since modern dishwashers are equally or even more water efficient than the washing of dishes by hand.

Recent innovations that have improved the efficiency of water appliances have been important drivers for reducing water use, promoting water savings without requiring a change in consumer behaviour or, necessarily, an awareness of water issues. Of particular note have been the technological improvements to large domestic appliances such as washing machines and dishwashers, which have led to large reductions in water usage. In 1970 washing a 5 kg cotton load typically required 200 litres of water, by 2004 this figure had fallen to 49 litres [7].

Another problematic issue is leakage. Good amount of 'loss' of water can occur in public distribution and supply networks prior to it reaching domestic premises. There has been an awareness recently upon reducing such loss and declines in leakage are apparent in some European countries. In Denmark, for example, loss in recent years has reduced to 6–7% from more than 10% in 1996 [8]. In other parts of Europe, however, water loss remains considerable. In Croatia, for example, loss rates increased markedly in the late 1990s but have since stabilised at close to 40% of the total water supply [9].

Changes in lifestyle, such as longer and more frequent baths and showers, more frequent use of washing machines and the desire for a green lawn during summer may be specific to particular age groups. Older generations, for example, generally make only minor changes to the less intensive water use behaviour they grew up with, whereas younger generations are typically used to a more water-intensive lifestyle.

One behavioural change with adverse environmental impacts has been the marked rise in the consumption of bottled mineral water in Europe over recent years. Current annual consumption is in excess of 80 litres per capita, having typically increased by at least 15 % in most countries in the period 2002–2007 alone [10]. The manufacturing process also uses water and releases carbon dioxide. The Earth Policy Institute estimates that 2.7 million tons of plastic are used to bottle water globally each year, with an estimated 25% of all bottled water being exported across national boundaries. Bottled water requires considerable energy to transport, thereby releasing further greenhouse gases in the process. In contrast, the transport of water from a treatment works to household taps is relatively environmentally benign [11].

Water supply abstraction is varying in Europe. Combined total supply across the eastern countries of Bulgaria, Czech Republic, Hungary, Poland, Romania, the Slovak Republic and Slovenia declined by approximately 37% between 1990 and the period 2002–2005. This decline is attributed to the introduction of metering and higher water prices in the 1990s, although recent economic growth in eastern Europe is predicted to reverse the overall downward trend in the future. A similar but less marked reduction in supply is apparent for western Europe over recent years, driven by the implementation of water saving measures including leakage reduction and metering.

National average per capita public water supply varies widely between European countries, ranging between 50 and 150 m^3 per capita annually. Household use typically accounts for 60–80% of the public water supply across Europe with personal hygiene and toilet flushing accounting for about 60% of this proportion.

An absolute distinction is possible to exist between components that are sensitive to climate change (showering, gardening, lawn sprinkling, golf course, swimming pools and aqua parks) from those that are non-sensitive such as dish and clothes washing. [12]

Household water use during spells of unusually hot weather also provides some indication of the effect of climate change. For example, peak water use increased as much as four-fold over the norm during the summer of 2003 in some Swiss kantons [13]. Such strong short-term changes in water use do not, however, give a clear indication of the longer-term response [14].

While future changes in household water use due to climate change may not be marked, increases are most likely during the summer months when the general water resource is at a minimum and the adverse environmental impacts of abstraction are at their peak.

Sustainable Use of the Public Water Supply: There are a number of measures available in order to reduce the use of publicly supplied water. They are namely, water saving devices; greywater re-use; rainwater harvesting and the efficient use of water in gardens and parks; leakage reduction; behavioural change through raising awareness; water pricing; and metering.

Toilet flushing accounts for about 25–30% of total domestic water use and as such, considerable overall water savings can be achieved by reducing flush volumes. The amount of water used for a single toilet flush has dropped considerably in some countries in recent decades, particularly as dual flush and low flush (less than 6 litres per flush) toilets have come onto European markets. Regulation in building standards may help driving a change. The maximum cistern volume allowed has fallen from over 12 litres in the 1950s to just over 4 litres today in UK.

Cistern replacement devices are also simple and cheap means of reducing flush volumes, typically by about 1 litres per flush. They are particularly used in older toilets with large cistern volumes. Water can also be conserved with a delayed action inlet valve, which prevents the cistern refilling during the flush. Without such a valve, the water released is greater than the cistern's capacity by 17% according to one study cited in a UK Environment Agency report [15].

Relatively recent technologies introduced both waterless and vacuum toilets. Vacuum toilets use a powerful vacuum to pull waste through the toilet, together with about 1L of water to rinse the bowl.

Currently, many older urinal installations wasting significant volumes of water in public and commercial buildings. Water use by showers can be reduced considerably by aerating the water flow, which helps to simulate the feel of a power shower but without requiring high volumes of water. Such aeration can also be applied to water flowing through taps. Taps with infra-red sensors saving 70%.

Greywater refers to all household wastewater other than that from toilets, i.e. wastewater from baths, showers, washbasins and the kitchen. In the most simple re-use systems greywater is stored and subsequently used, untreated, for flushing toilets and watering gardens.

Greywater from baths, showers and washbasins is generally preferred to that from kitchen sinks and dishwashers since it is less contaminated. The microbial quality of greywater raises public health concerns, particularly when it has been stored for some time [16].

Rainwater flowing from a roof or driveway can be transferred via guttering or piping to a receiving container and subsequently used for activities such as gardening and car washing. Such rainwater harvesting not only reduces household use of treated public water supplies but can also make a small contribution to lessening the severity of storm discharges. The practice, typically, has little or no detrimental environmental impact. Provided that it is correctly collected and stored, rainwater can be used for toilets, washing machines and gardens without further treatment.

As well as harvesting rainwater, other measures can limit the amount of water used in gardens, parks and green spaces. Adding compost, manure or bark helps soil retain moisture, while watering early in the morning or evening will reduce water loss through evapotranspiration, particularly in summer. Choosing plants that are tolerant of water scarcity, including drought resistant species, reduces the amount of watering required.

In recent years there has been a marked increase in the awareness-raising campaigns which encompass a number of different approaches, including websites, education programmes in schools, local authority leaflets, advertising stands at live events and the use of general media outlets (i.e. television, radio and newspapers).

Eco-labelling is playing an increasingly important role in helping consumers make informed choices about the water (and energy) efficiency of the appliances they plan to buy. The EU's eco-label establishes criteria based on each stage of a product's life cycle. For example, for washing machines to achieve an eco-label, their water use must not exceed 15 litres per kg of clothes washed in a 60 °C cycle.

In addition, clear instructions must be provided regarding water and energy conservation. In addition to eco-labelling, the concept of eco-certification has been growing steadily within the tourism industry, particularly in Europe, where most of the schemes worldwide are located [17]. The Malta Tourism Authority has established an eco-certification scheme to promote water conservation in hotels based on a detailed audit system [18]. To qualify for the label, hotels have to install rainwater harvesting systems, fit showers and taps with water saving devices and monitor swimming pool water use. The reuse of treated wastewater effluent is also recommended.

As set out in the Water Framework Directive, water pricing can be a key mechanism to achieving sustainable public use of water. While most European countries are progressing towards water pricing for public supply, quantifying the effect of pricing upon use is complex due to significant variation between countries, a general lack of reliable and comparable data, cross subsidies and a masking by other water demand measures.

The success of water pricing is depend on its link to the volume of water consumed, since this underpins the incentive for efficient use of water [19]. With respect to the public water supply, meters are used in homes and business premises to quantify the volume used. Metering leads to reduced water use; in England and Wales, for example, people living in metered properties use, on average, 13% less water than those in unmetered homes [20]. The use of meters is growing steadily throughout Europe, particularly in single-family houses, although uptake in apartments is currently low due, in part, to technical challenges.

Agriculture is a significant user of water in Europe, accounting for around 24% of total water use. This share varies markedly, however and can reach up to 80% in parts of southern Europe, where irrigation of crops accounts for virtually all agricultural water use.

By combining information describing area equipped for irrigation with a soil water and cropgrowth model, the European Commission's Joint Research Centre (JRC) has predicted irrigation water demand for the EU and Switzerland [21]. The findings reflect the importance of irrigation to agriculture in much of southern Europe and illustrate the approximate volume of irrigation water demand within a defined spatial unit (a 10 km x 10 km cell).

CONCLUSION

Increasing problems of water scarcity and drought clearly indicate the need for a more sustainable approach to water resource management across Europe. As other parts of the world. A marked shift towards demand-side management, implying a key role for measures that control or improve the efficiency of water use is a must. Any expansion of traditional infrastructure-based water supply would occur only when all other options have been exhausted.

A more equitable approach to abstraction is necessary, the need to achieve and maintain healthy freshwater ecosystems is obvious. Implementing such a management approach successfully would not only help adapt to climate change but also contribute to lower energy consumption.

It can be suggested therefore that, more has to be done to introduce certain measures swiftly at regional level which may fit for all. In this sense, it is important to consider the role of the state of the art research results which are vital for policy making.

REFERENCES

1. Communication from the Commission to the European Parliament and the Council on addressing the challenge of water scarcity and droughts in the European Union. COM(2007) 414 final.
2. Ibid.
3. Water scarcity and droughts. Second interim report-June 2007 http://ec.europa.eu/environment/water/quantity/pdf/comm_droughts/2nd_int_report.pdf
4. Raskin, P., P.H. Gleick, P. Kirshen, R.G. Pontius, Jr and K. Strzepek, 1997. Comprehensive assessment of the freshwater resources of the world. Stockholm Environmental Institute, Sweden. Document prepared for the fifth session of the United Nations Commission on Sustainable Development, 1997.
5. OECD, 2000. Environmental Performance Reviews-Greece. OECD Publishing, Paris
6. Flörke, M. and J. Alcamo, 2004. *European Outlook on Water Use*. Center for Environmental Systems Research — University of Kassel, Final Report, EEA/RNC/03/007
7. Stamminger, R., A. Barth and S. Dörr, 2005. Old Washing Machines Wash Less Efficiently and Consume More Resources. HuW 3/2005. Available at: http://www.landtechnik.uni-bonn.de/ifl_research/ht_7/huw3_2005124_131_oldwm.pdf
8. Consumption of drinking water by region and use. Available at: http://www.statistikbanken.dk/statbank5a/ default.asp?w=1024
9. Croatian Statistical Yearbook 2008. Available at: http://www.dzs.hr/default_e.htm
10. Beverage Marketing Corporation, 2008. Available at: http://www.bottledwater.org/public/Stats_2007.doc
11. EPI, 2007. Bottled Water Boycotts-Back to the tap movement gains momentum. Earth Policy Institute, 7 December 2007. Available at: http://www.earthpolicy.org/Updates/2007/Update68.htm
12. EEA, 2008. Impacts of Europe's changing climate - 2008 indicator-based assessment. EEA Report No 4/2008. European Environment Agency, Copenhagen.
13. Auswirkungen des Hitzesommers 2003 auf die Gewässer. Schriftenreihe Umwelt Nr. 369. Bern-Ittigen: Bundesamt für Umwelt, Wald und Landschaft, 174 S. Available at: http://www.bafu.admin.ch/publikationen/publikation/00533/index.html?lang=de
14. Feenstra, J.F., I. Burton, J.B. Smith and R.S.J. Tol, 1998. Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies. United Nations Environment Programme and the Institute for Environmental Studies. Available at: http://dare.ubvu.vu.nl/bitstream/1871/10440/1/f1.pdf
15. Environment Agency, 2007, *Conserving water in buildings. A practical guide*. Environment Agency,
16. Dixon, A., D. Butler, A. Fewkes and M. Robinson, 2000. 'Measurement and modelling of quality changes in stored untreated grey water'. Urban Water, 1(4): 293-306.
17. Hamele, H., 2002. Eco-labels for Tourism in Europe: Moving the Market towards more Sustainable Practices. In Honey, M. (ed.), 2002. *Ecotourism & Certification: setting standards in practice*, Island Press, 2002. Available at: http://gtz.de/de/dokumente/en-tourism-materials2004-labels.pdf
18. Maltese Tourism Authority, 2008. Eco-certification. Available at: http://www.visitmalta.com/eco_certification
19. Communication from the Commission to the Council, the European Parliament and the Economic and Social Committee: Pricing policies for enhancing the sustainability of water resources. COM(2000)477 final.
20. Environment Agency, 2008. Water resources in England and Wales-current state and future pressures. Environment Agency, Bristol.
21. Wriedt, G., M. Van der Velde, A. Aloe and F. Bouraoui, 2008. Water requirements for irrigation in the European Union. JRC Scientific and technical report 46748; EUR 23453 EN. ISBN 978-92-79-09149-0. WWF/Adena, 2001. Alcobendas, city of water for the 21st Century. http://assets.panda.org/downloads/Alcobendas.pdf