REDUCTION OF WATER CONSUMPTION FOR SUSTAINABLE WATER MANAGEMENT

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ABSTRACT

As a result of climate change extreme weather and river flow events are projected to become more frequent, experts say. The regional, time and quantitative distribution of precipitation is expected to change, which through the flow of rivers affect groundwater supplies, being one of our major sources of water supply. Therefore water management should be given a priority role among activities aiming at the preparation for climate change. A means of it is the re-evaluation of our current water use patterns and the reduction of water consumption of all concerned in their own context.

1. INTRODUCTION

The three most important but only partially renewable resources on the Earth are water, energy and food. Water supply directly affects all three areas, so caution must be taken when water management principles and practical steps are considered and implemented. In order to make essential healthy drinking water available for the generations after us in quantities to cover at least their basic needs, we must avoid the overexploitation of water resources and in many cases we need to reassess current water use patterns. Thus sustainability should be interpreted as the coordination of ecological and economic considerations (where the economic standpoint cannot necessarily aim to maintain or raise the pace of today's economic growth). The protection of the quantity and quality of drinking water is not only justified by the finite quantity of water resources, but also by the energy intensity of water supply: if you consume less water, in conjunction with it the energy consumption is also reduced. In addition, examining the full range of water supply –including drainage, too– applying some modern technologies, energy can be gained from the process, which can be either used to reduce the energy demand of water supply or to be utilized for other purposes.

2. FACTORS DETERMINING WATER MANAGEMENT IN HUNGARY

Hungary is a country rich in both surface and underground water resources. This is due to its geographical location: in the middle of the Carpathian Basin, on the base level of its rivers around, largely circumscribed by the Alps and the Carpathians, with the rivers flowing here. These surface water flows provide favourable conditions further strengthened by excellent soils for agricultural cultivation. This feature may get even more advantageous over time due to weather extremes and general drying caused by presumptive climate fluctuation, scientists say. To better utilize this advantage also implies the modification of water management concepts, with more close-to-nature solutions to water management and with stilled

permeation of streams, as well as with the reconsideration whether dams are the only solution to flood prevention (Glatz 2002).
Hungary's already mentioned "water luring" position is accompanied by the risky consequence that the quantity and quality of water coming from other countries are heavily dependant on the state and conditions of the surrounding countries, their economic and nature shaping activities, etc. Water management, therefore, is determined by a regional nature – above average in Hungary.
Most of Hungary's surface waters do not show their original, natural state but are significantly regulated. This situation started off on a large scale with the regulation of the River Tisza, which was the time when the largely technology-driven drainage system evolved. In today's water management besides its technological nature the ecological approach is also picking up strength (Varga, M. 2009), in the pursuit of long-term protection of water quantity and quality. I intend to briefly expand on a few possibilities hereinafter.

3. SUSTAINABILITY OF WATER SUPPLY

Total costs of both the investment and operation of today's water supply networks (purified pipe-line drinking water provided for consumers and subsequently closed-channel sewage and rainwater drainage, sewage treatment, disposal into natural recipients) rank the highest among all urban infrastructure networks. Economic sustainability of these networks is enhanced by any technical solution that allows for reduced costs. The pursuit of ecological sustainability aims at the protection of the quantity or quality of water used. Such a modern approach can be applied by both water service companies and water users.

3.1. Sustainable water supply on the water suppliers' side

When making use of natural resources, we should pursue the combination and coordination of both the engineering and the ecological aspects of sustainability. Perhaps the greatest difficulty with these two approaches is the two different space and time scale thereof (Somlyódy 2000). The ecologist sees long-term consequences of development decisions, but society calculates with short-term benefits and expects that developments as well as engineering work are conform to them. The way an engineer can reconcile the two is to incorporate feedbacks into the systems set up, on the basis of which operation of the systems can be corrected.
A problem of water supply both in our natural and built environments is that the spatial and temporal distribution of water resources vastly differ from needs. Due to climate fluctuation extreme water flows are expected to grow, both in respect of quantity and frequency. A sustainable solution should be found to this in water supply. By reducing water consumption we by all means move towards sustainability. To do this, in some cases, the normal water supply infrastructure is to be reconsidered. Analysing the utilisation of waste water, we can conclude that about half of the pipeline drinking water could be replaced by water meeting less stringent requirements but produced more cheaply. This could be rain or the so called "grey water" (once used but low-contaminated waste water). This would require a differing

development of sewerage systems from the present ones. However, a number of energy-saving solutions could also be implemented alongside the existing water supply system.
These are usually based on the decrease of pumping electricity demand during extraction of water, its transportation and storage (because of the time difference of stock and needs arising), by using advanced, tailor-made pumps with adjustable power and pumping consumption capabilities. The electricity-saving potential is best characterized by the fact that in 2001 20% of the world's energy intake was assigned to the propulsion of pumps (Eördöghné 2008). To lessen the aversion to economical solutions we find it essential to make users realize that this and the majority of the solutions further discussed do not bring about any reduction in the current feeling of comfort.
Water consumption could be further reduced by the diminished volume of water loss is the pipeline system (this amounts to about 25% in Hungary, rating us in Europe's mid-range). Due to leaks in the water supply networks the entire planet loses 45 million m^3 water on a daily basis - approximately the water demand of roughly 200 million people (World Bank 2006 data - in Grundfos). A major source of this loss is due to pipeline failures, leaks, and the long time that elapses until these problems are located. The cause of pipeline failure in many cases is the pressure surge in the network itself, in the form of mechanical stress on the material of the pipeline (see Figure 1). To tackle this problem a novel idea is under trial/development, which targets to keep the pressure of the pipeline system low outside peak periods thus trying to reduce the harmful effects of surge, or in case of existing leaks to reduce the "driving force" of runoffs. Keeping water pressure low is also beneficial on the consumption side of the network as it can facilitate lower water consumption.

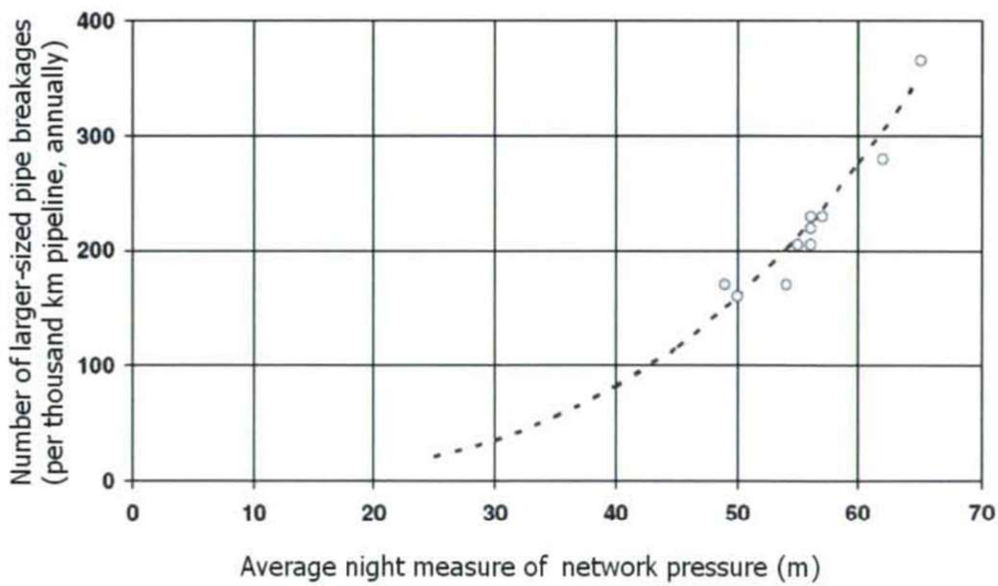

Figure 1. Impact of water pipe pressures on the frequency of pipe breakage (source: Grundfos)

In the second phase of water supply, in sewage disposal, most of the energy demand is represented by the electric propulsion of the aeration equipment used in wastewater treatment plants to speed up the degradation process. This can also be reduced by less water consumption (which, as a consequence, further reduces the volume of waste water to be treated) as well as by managing rainwater separately, ideally utilising it in situ.
We could also gain energy from sewage disposal, thinking of the utilisation of the caloric content of waste water by heat pumps (as several operating devices demonstrate it in Germany, Switzerland, see Figure 2.), or the use of gases during waste water treatment e.g. in gas engines.

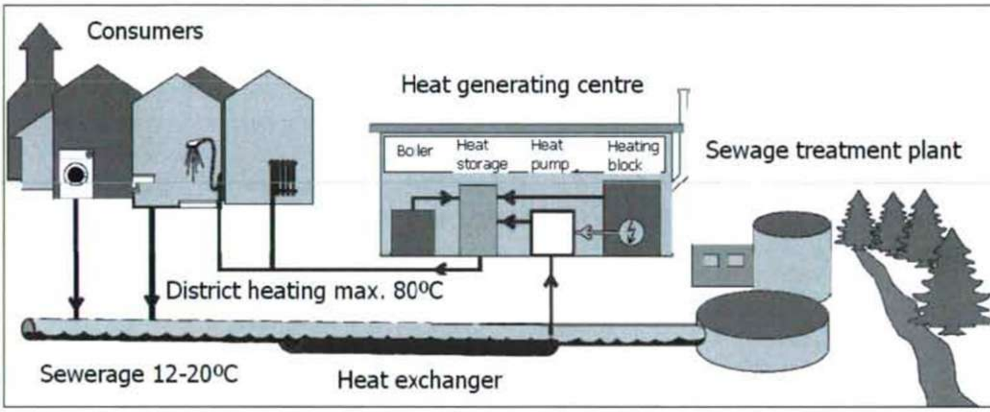

Figure 2. Utilisation of the caloric content of waste water by heat pumps (source: POP 2009)

Among water saving opportunities on the water suppliers' side we should not forget to mention thermal water recovery –both as water and as energy– in Hungary. Here it is worth examining the exploitation of thermal water whenever designing the energy resources for heating and providing running hot water for certain establishments or when choosing appropriate energy resources for other technological purposes.
A great number of investments attest the energy efficiency of thermal water recovery, but there is a lot of headway to be made and a lot of R&D activities are still required in this topic.

3.2. Potentials of water users in their sustainability efforts

If we seek the most efficient incentive to encourage water saving, we will eventually get to ethical issues. Apart from the price level of water, the most reasonable explanations, the availability of water saving instruments, it is also the ethical attitude towards the assessment of the needs of other customers (including those of future generations). Unfortunately, this area still offers a lot to do. Simultaneously with forming attitudes and environmental awareness of consumers, we should familiarize them with such technical solutions that can contribute to the sustainability of water supply. At today's level of environmental awareness we may say that perhaps the most effective means of encouraging reductions in water consumption is the price of water (see Figure 3).

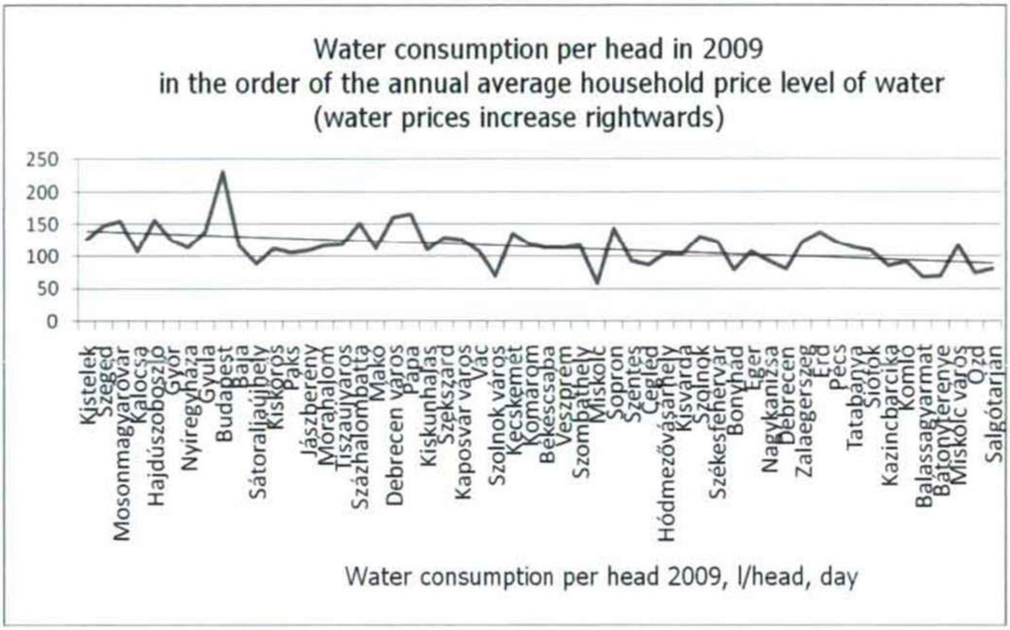

Figure 3. Impact of price level of water on the volume of water consumption (own construction)

In case of households water-saving solutions can be classified into four categories:

- changing patterns of water consumption
- application of technical water-saving devices
- use of alternative water sources
- use of alternatively designed sanitation systems

These options can be the most effective when complementing each other. Spreading general awareness of them requires a lot of dissemination efforts in the fields of education, social and individual attitudes.

The first practical step towards the reduction of water consumption is to identify those areas where currently we waste most our of drinking water (in an unjustified way) (e.g. toilet flushing, cleaning, garden watering, and a range of water demand, where no drinking water quality would be required). The majority of these could be covered by the more environmentally conscious solution – use of rain or grey water (e.g. washing machine's water for washing used for flushing toilets), since it would actually decrease the amount of water extracted from the environment (whereas using one's own wells would only reduce the amount of the water bill). The modernity of water consumption fixtures also significantly influences the amount of water used (e.g. water faucets with air stirred in make an impression of taking more water, etc.). In public institutions where cost sensitivity is lower towards the price of water it is appropriate to use self-closing or timed faucets. Even more attention should be paid for the quantity of hot water consumption due to its higher production costs, e.g. by installing thermostatic mixer taps or circular network design.

Today's system of water use – indoor plumbing and closed-channel drainage followed by sewage treatment – results in very high specific water consumption. As a response to it environmentally conscious solutions have been developed such as dry, otherwise known as composting toilets, the separated drain-off (separator) toilets or anhydrous urinals.

The applications of these systems apart from protecting water resources also carries the advantage that by treating waste water of physiological origin separately, nutrient management may become more favourable: utilising the N, P content of waste water may decrease the synthetically produced N, P quantity.

Dry toilets operate without water flushing and are placed inside the building. The faecal accumulates in a ventilated composting chamber together with wood chips added after use of the toilet. Organic household waste can also be deposited in this container. Composting is performed by soil bacteria to be found at the bottom the chamber, resident in the thin layer of topsoil. Such bacteria need oxygen and cellulose for their vital functions, the former is provided by ventilation, the latter by the wood chips. Composting takes place at temperatures around 60-70 °C, which kills pathogens. The decay lasts 1.5-2 years; the end-product is odourless, sterile humus.

The use of dry toilets will reduce water consumption and sewage load approx. by 35%, and also, about 40% less household waste is produced.

The bowl of the separating toilet (Figure 4.) is divided into two parts, with separate flushing systems. The faecal gets down the drains, the urine (with minimum water flushing) gets into a plastic container. Storing the urine in this plastic container for at least 6-9 months we get a soil nutritive substance suitable for substituting potassium, phosphorus- and nitrogen-containing fertilizers, thus decreasing their production and use (GayerJ. – F. Ligetvári 2007). The technology developed ensures odourless operation with a one-time emptying of the container in a year. The amount of water used for flushing is decreased by nearly 80%.

Figure 4. The bowl of the separate drain-off (separating) toilet (Novaquatis)

The special surface of non-flush pissoirs is made of polyester fibreglass, which is water repellent, so no flushing is required. The siphons contain biodegradable sealant liquid, the density of which is lower than that of water, so the fluid flows through it smoothly. Apart from the saving in flush water it is an additional positive feature that there is no acid cleaning of the toilet that would also damage the environment.

To convert water use patterns into sustainable ones is mainly at the disposal of consumers that live in areas with no sewer. In such cases, the locally applied, natural wastewater treatment solutions can be offered. Different wastewater treatment plants (wetlands, lakes, etc.) use natural processes to treat sewage-water. Bacteria break down the organic matter of the sewage, using oxygen for their functioning. This oxygen is provided by the intermediary plant. A significant portion of the purified water evaporates; the rest gets back into ground water or running waters.

4. CONCLUSION

Among the strategic measures to be taken regarding climate-change, an enhanced role should be attributed to water management. Ecologically sustainable water supply means to protect drinking water both quantitatively and qualitatively.
This analysis presents some possibilities thereof, drawing attention to the fact that a common feature of all sustainability efforts lies in cooperation: "cooperation" between man and nature, and cooperation between experts in different professional fields.

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