Water and the City

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ABSTRACT

The growth and development of urban spaces in all parts of the world is an outstanding feature of modern history. Apart from being notable growth generators of economies, cities have also been localities where the poorest of the poor congregate seeking the opportunity to make a living. Another outstanding feature of cities has been the growth and development of their comprehensive water infrastructure.

The theme included eleven sessions with 37 presented papers and one Round Table Panel with five presentations that were regrouped for synthesis under the following categories: water and urban landscape, ancient urban water, managing urban water systems (technological breakthroughs, integration and regionalisation, flood control, policy and politics, challenges in developing and transition economies, sanitary and environmental education) and water privatisation. By 2007 more than a half of the world's population were living in urban areas; urban growth is fastest in the third world. Thus, the theme will only grow in importance in the future.

Several presentations showed that decisions on water resources and services are to a large extent public by nature. The paradigm shift under way towards more efficient water use is limiting the growth of water use. The use of traditional technologies should also be considered when striving towards sustainability. Finally, understanding their pasts is a basic requirement for any sound strategic and visionary planning of preferable futures for cities.

KEYWORDS

Water supply, sewerage, city, urban infrastructure, management, services, strategic decisions

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1. INTRODUCTION

Water has become an increasingly pressing issue in cities all over the world. It has been a field of comprehensive scholarship in recent years. Researchers in a variety of fields have conducted research on water-related problems in cities, especially over the past two decades. However, some of the groundbreaking work in the field can be traced back to the late 1960s, when environmental consciousness in North America and Western Europe made societies increasingly aware of urban environmental crises.

Since the 1970s environmental historians, such as Joel Tarr and Martin Melosi, have studied city service and infrastructure development – the underlying problems, motives and solutions.[1] More recently, water has become one of the key issues in environmental history. Although the research tradition is not very old, there is evidence of robust research activity. The city and its environment are part and parcel of water history. However, it has to be borne in mind that water history, especially in the urban environment, relies extensively on the history of technology for part of its content. Understandably, water history in the urban environment is noted for its diversity. Water-related issues in the city vary widely, and researchers in numerous disciplines have been working in complex inter-, multi- and transdisciplinary research relationships trying to find answers to issues of water supply, health and sanitation. Their efforts are timely. Since 2007 more than half of the world's population has moved to urban environments according to the UN-HABITAT 2006 Annual Report.[2] We are now officially living in the 'Urban Millennium'. And the development is not about to stop. The 2003 World Water Development Report predicted that by 2030 more than 60 per cent (nearly 5 billion people) of the world's population will be living in urban areas. But the rural and urban-rural mixture areas must not be forgotten either.

Especially water historians have taken a keen interest in the field of urban water. This was evident from the popularity of the theme 'Water and the City', one of the four major themes at the 5th biennial conference of the International Water History Association (IWHA) held in Tampere in June 2007. This theme featured prominently in eleven sessions, all linked to the development of water and its use in cities. A total of 37 papers were presented on the theme at the conference. Over and above this, there was an Open Round Table Panel on 'Water and Sanitation Services Governance: Pasts and Futures' with five presentations. As a gesture of support for the discussions at the conference the water utility of Tampere commissioned a book on the history of the city's water supply since the mid-1800s.[3] The city's water infrastructure is a notable example of the fact that ancient technologies have not been forgotten. For example, Archimedes screw pumps are currently used at the city's modern wastewater treatment plant to pump untreated sewage and returning sludge (Fig. 1). That proves that even

ancient technologies can be used in the modern world, reminding us again of the linkages between past, present and even future.

FIGURE 1. Archimedes screw pump –- one of the oldest water technologies still in use at many wastewater treatment plants. The pictured pump has commemorated the 100th anniversary of Tampere Water since 1998 (Photo: T. Katko).

The grouping of the presentations on the Water and the City theme is based partly on the sessions, though some regrouping and synthesising was done for this theme article. Some of the presentations are also linked to other major themes of the conference. Our theme paper starts with water and urban landscape, followed by ancient urban water, approaches in urban water history, modern urban water systems, water privatisation, and related evolution of education. This structure may be considered too fragmented but, on the other hand, it brings out the diversity of issues related to water and the city. Our intention was to reflect widely the views presented on the themes instead of selecting only a few key issues. Yet, in the discussion attention is also given to some of the salient issues described in presentations at the conference, with their implications for the current debate on urban water management. We suggest that there is evidence of an evolving historiography in water history that is aware of the environment, technology and the nature of humankind in cities all over the globe.

2. WATER AND THE URBAN LANDSCAPE

Some interesting and original views on water and the city, particularly from an environmental perspective, were expressed at the conference. They were put forward during presentations dealing with the urban landscape and water, water-based food and the transformation of urban waterways, as well as through the visual representation of urban environments stored in photographic archives.

Water towers, as one of the few visible parts of urban water systems, are a familiar feature of the urban landscape. Spoon presented a European view on American water towers, their siting and design, with special focus on Prince George's County in Maryland. One of the water towers, Pointer Ridge, built in the early 1970s, overpowered nearby single-family homes, which led to a huge uproar and political outrage as well as well-drafted guidelines for new water towers in the community. However, no new water towers were built for 25 years, and the guidelines were left to gather dust on shelves. The results of regional and national searches, targeting the planning, urban design and water industry professions, showed little signs of proactive design of water towers in the US. They are considered industrial products, and currently most water utilities have to choose between just two steel tank designs that are manufactured in the country. Community input, if any, is limited to the paint schemes of these tall structures. No urban design, planning or architecture professionals are involved in the siting and design of these skyline-defining landmarks. The recommendations made included searching for multi-use and partnership opportunities; comparison of sites before adjoining development takes place; requiring an architectural review; design of antennae; and requiring extensive public and multi-disciplinary participation in the siting and design process.[4] As Asola[5] points out, water towers are important landmarks and a prominent feature of any urbanscape.

The 11 km^2 watershed of the Mätäpuro Brook in central Helsinki, Finland, which underwent rapid development in the twentieth century, provides a good example of Finnish small watershed management. Urbanisation took a heavy toll on the seven-kilometre stream in the form of flash flooding, erosion and low water quality. Sections of the stream were piped for storm water management and stream crossing purposes. Water quality monitoring began in the mid-twentieth century and gave first indications of the deplorable water quality. Despite continuous urban development, the stream water quality has started showing signs of improvement during the past two decades. One reason was the national ban on phosphates in detergents. The author observed a sizable trout in the stream several years ago, and his son caught one in 2003. Media reports and public interest led to increased awareness of the stream. A proposed road expansion was consequently rerouted to protect the stream, permanent stream buffers have been established, and the brook has been included in the Helsinki Small Watershed Program.[6]

The first outdoor Daguerreotype picture was taken of the River Seine in the heart of Paris, France in 1836, signalling the beginning of urban landscape photography. A series of historically significant 'firsts' were displayed in the form of photographs that included depictions of water. It was emphasised that photographic images not only reflect how we see water but also shape our perception of it. Examples of such perceptions related to water included photographs of the newly opened American West, and the Dust Bowl drought years. Examples of the use of water in advertisements were also elaborated. From its beginning, photography has helped in documenting and creating artistic images of water. With the current explosion of electronic photography, and audiovisual and virtual advertising, the cultural phenomenon of water in the lives of people, and depictions thereof, deserve further investigation.[7] Related to this theme, a selection of photographs from a book by Luumi[8] were displayed next to the conference auditorium. The selection showed the dynamics and variety of water in nature during the four seasons of the conference host country.

Cities must also have food supplies to keep going. City dwellers have, for at least 500 years, relied on fisheries to feed them. According to Kraikovskiy,[9] the key problem with the fisheries of St. Petersburg, Russia between the fifteenth and the eighteenth century was the system of management. A comparison between Russia where the fishing grounds were state property and England where they were primarily private property showed where the problem lay. In Russia, the Emperor as the supreme owner granted the right of use to a person or organisation, while the common people had no say in the matter. In England, again, fishing grounds were private property. Consequently conflicts between owners were the subject of public discussion. Much can be said about the principle of freedom of speech. Malinova[10] approached the issue of water pollution in St. Petersburg from the perspective of hygiene and urbanisation, on the one hand, and expansion of areas of summer-time dwellings for city people, on the other. The strategies of the well-to-do residents of St. Petersburg and London were also compared. The presentation made it evident that people's reactions to pollution and health threats depended largely on the local environment as well as the manner in which people adjusted to new knowledge circulating in society.

The history of Tampere, the Finnish host city of the conference, has been characterised by the rapids as an energy source – for old industry like sawmills, corn mills, paper mills, textile and metal factories and glassworks – as well as the rapids being used for fishing for centuries. The town of Tampere was founded in 1779 and grew rapidly into an important industrial city. In the 1960s and 1970s industries relocated outside the city centre leaving vacant industrial space behind. The value of the industrial cityscape was understood by the 1990s, when protection, re-use and integration of new buildings became catchwords. Today, the former industrial buildings house offices, theatres, art centres, workshops, retail space and museums, thus preserving the industrial heritage of the city.[11]

Geographically, the city of Tampere is located between two lakes connected by the Tammerkoski rapids flowing north to south. The upper and northern lake Näsijärvi has been regulated since the 1800s. The first regulation permit was granted in 1923 and has been modified several times since. The lower and southern lake Pyhäjärvi has been regulated since 1962. The original purpose of the regulation was to promote hydropower production and flood protection, but it has also had an impact on lake ecology (e.g. fisheries) and recreational use. These have to be taken into account when planning the future regional centralised wastewater system.[12] Yet, Tammerkoski rapids have also great recreational value. Parks adorn the banks of the rapids on both sides, and with the decline in industrial activity the recreational value of the rapids has grown significantly. The designation of the rapids as a Finnish national landscape has brought more appreciation and interest both to the city's industrial heritage and park culture (Hautamäki). The preserved factories along the river banks, their surroundings and their successful re-use are a good example of the appreciation of cultural and industrial heritage. In fact, Tampere City Board has suggested that the Tammerkoski rapids with its banks be added to the Unesco Heritage List.[13]

In a wider regional context Tampere and its surroundings can be seen as elements of a 'fast' metropolitan network, a 'medium-fast' small town network and a 'slow' landscape network. The water-infrastructure may have some potential for use in the battle against uneven regional development. As Hynynen[14] pointed out, such a structural model can create a common mental geography that unites the region into a single structure with its otherwise seemingly passive water areas.

3. ANCIENT URBAN WATER SUPPLY

The papers presented at the conference provided a perspective and created an awareness of the long history of human preoccupation with water management. According to Bandaranayake,[15] Sri Lanka has a long history of irrigation water management based on a reservoir storage system. The system, dating back to the sixth century B.C., operated for over 17 centuries producing a flourishing hydraulic civilisation. The water storing, regulating, controlling and management systems were based on an interconnected reservoir system designated as cascades. A sophisticated water management system was developed linking the small cascade tank systems with the large storage reservoirs. The system consisted of (i) a technical-physical set up, and (ii) a social-cultural arrangement where people used water for irrigation, drinking, sanitation and other domestic needs.

As for groundwater, Iran has traditionally used qanats (infiltration galleries, Fig. 2) which first came into existence about 2,700 years ago and have since played a vital role in the survival of the country. In their presentation Semsar Yazdi and Labbaf Khaneiki[16] postulated the hypothesis that the technological changes in the exploitation of groundwater not only disrupted the environment,

but also corrupted society's traditional attitude toward the natural resource. It is impossible to keep new technology away from the people, but it is possible to awaken the environmental consciousness of society to realise that over-pumping of groundwater leads to a serious crisis sooner or later. Thus, tradition can still teach us how to live in harmony with nature. People and nature can live side by side as long as we look at nature through the eyes of our ancestors, even though we are equipped with the newest means to extract natural resources.

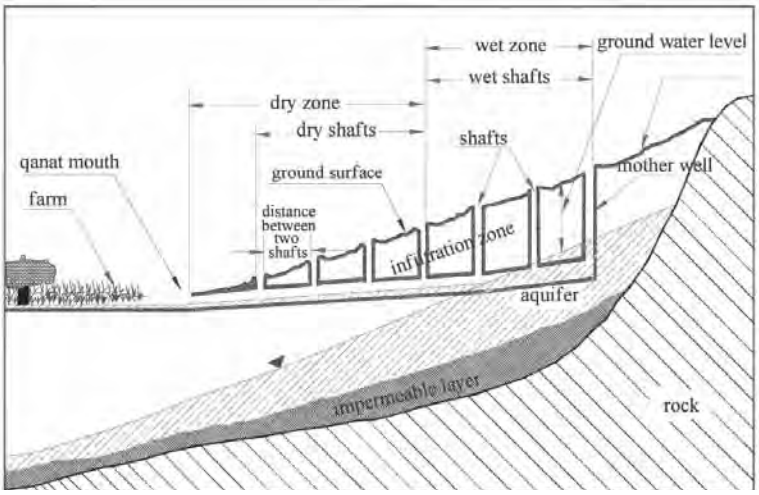

FIGURE 2. Longitudinal section of a qanat (Semsar and Khaneiki).

In addition to qanats, Iran has a long experience of using other traditional water sources such as wells, storage of water behind dams and construction of diversion weirs. Hand-made water transmission channels, especially in the south of Iran – such as the 'Daryoun' channel dating back 2500 years; bridge-weirs such as the 'Mizan', the 'Khak' and the 'Shadervan' dating back to the Sassanian dynasty (226–652); and the 'Dara' weir built during the Achaemenian dynasty (550–330 B.C.) – are examples of such early hydro-structures. The Chogha Zanbil water treatment plant beside the ancient Chogha Zanbil ziggurat is considered the oldest one in the world, dating back 3,250 years.[17]

Working from the premise that the chemical compositions of water from different sources leave traces in the infrastructure, Keenan-Jones, Hellstrom and Drusdale[18] had done investigative research to determine which ancient towns of Campania (including Naples and possibly Pompeii) were supplied by the Augusta aqueduct. Their report suspected that it formed part of a great central network of aqueducts. Sinter deposits of calcium carbonate were investigated using a range of techniques to help understand how the Romans planned their

water systems. All in all, it is evident that the ancient systems also reached their limits. Larger systems especially had to bring water from sources further away.

4. MANAGING URBAN WATER SYSTEMS

Technological breakthroughs

In one of the conference papers, Vernon Scarborough[19] provided a general framework of how to gain deeper understanding of the past into which today's structures are embedded. He outlined how archaeology leaves us with material evidence of technological breakthroughs – the related social structures can be explored by drawing on ethnographic research. He bases his anthropological and archaeological approach to water history on three elements: (i) economy, subsistence or exchange, in dry or wet environments; (ii) politics, relating to the control of water, including power over sluice gates; and (iii) ideology, where views and values related to water are expressed through religion and water use is provided with legitimacy. Scarborough contends that water plays a prominent role as a 'prime mover' in the economy and other spheres of human activity. Its special physical characteristics provide a platform for comparison across time and cultures. Water predictably nourishes or erodes the landscape in accordance with physical laws.

In nineteenth-century urban Europe a number of factors played a decisive role in the shift from a multi- to a sole-source water supply system. It had to take place to end drinking water shortages and provide fire-fighting water. Health protection was also a key motivation. Piped water connections and improved network pressure led to an increase in household water consumption which created the demand for sewerage systems to get rid of the huge amounts of harmful wastewater.[20]

Historical experiences in the field of sanitation in England were evaluated by Vesilind.[21] In a presentation on the main actors contributing to improvements in sanitation, he considered the evolution of sanitation up to the time of the pioneer Dibdin, who initiated the idea of using micro-organisms in wastewater treatment. Indeed, the recognition that water treatment should use natural micro-organisms – instead of killing them – was a watershed in the development of environmental engineering. Judging the aquatic past merely from a western perspective can be illusive. In his presentation Merviö[22] reminded the audience of how the emergence of sophisticated systems of hygiene and sanitation contributed to public health in East Asian societies well before historians usually mention the existence of modern environmental policies in Japan and China.

In respect of sewage, the nineteenth-century hydraulic flushing approach in Europe replaced manual cleansing for the most part. The devices did not, however, evolve further, and were finally substituted by other techniques. The amount of solids in sewers has also decreased since those days. Yet the need for cleansing

sewers has, up to the present, not disappeared. Instead, it is rather increasing while the relative quantity of wastewater is decreasing. According to Bertrand-Krajewski,[23] views on the technical and economic effectiveness of wastewater treatment need to be reviewed. Sediment problems still remain unsolved and are getting worse; some old devices, especially, need to be modernised.

Sanitation in the Netherlands also received attention. Two early alternative excreta disposal systems were developed there and used in the first half of the twentieth century, namely the barrel system (Fig. 3) and pneumatic sewerage. The rapid and wide-scale introduction of both systems can be explained by (i) increasing pressure from hygienists and public opinion to improve public health in the rapidly growing Dutch cities, (ii) the lobbying of hygienists and agricultural chemists to introduce systems considered beneficial for public health and agricultural recycling of nutrients, and (iii) the liberal political climate in most urban councils in that period. Their gradual disappearance can be explained by (a) the introduction of chemical fertilisers, (b) the gradual diffusion of piped water systems and WCs in the 1890s, (c) the growing wealth of cities, and (d) the fact that both systems could only provide a partial solution to surface water pollution problems. In addition, water-borne sewerage systems became more affordable and attractive due to economic growth and changes in government.[24] Yet, development was not always straightforward, and the best available technology or solutions were not necessarily chosen. Often the second best solution, referred to as a 'temporary solution', was selected.[25]

FIGURE 3. Barrel collection of waste in Alkmaar, the Netherlands in 1954 (Photo: Regionaal Archief Alkmaar, The Netherlands).

Two particular issues concerning more current doctrines on water services were raised. A safety classification of water works based on four categories was recently prepared in Finland. The aim is that by 2012 all systems serving more than 5000 people belong to the first category. Another current piece of legislation from 2004 concerns buildings not connected to centralised sewerage systems. By 2014 such buildings must be linked to an acceptable wastewater system – either have a sewerage connection or acceptable on-site treatment. In 2004 some 20 percent of the population (one million people) lived outside sewerage systems, as did some 450,000 summer cottage dwellers.[26]

One of the biggest current global challenges is ageing infrastructure. The service life of networks and asset management vary greatly in Finland according to local conditions and should be therefore locally determined. Failure data may be used to schedule maintenance and renewal. Decision methods used in other sectors need some modification to make them suitable for water and wastewater networks. There are some problems regarding data availability, especially the inadequate hierarchy of stored data. They can make cause-effect relationship analyses difficult. There is also an abundance of empirical tacit knowledge that needs to be recorded before the retirement of old workers.[27]

Integration of systems

According to Koch,[28] the urban water cycle, especially the issue of 'who should take care of storm waters' is under debate: how to divide responsibilities between various administrations. The important starting question is: why is storm water disposal part of sewage management and not water supply? Koch focused on the views of historians and engineers, but the presented idea could be applied to other parties, too. The key finding is that the solutions and discussions related to the alternatives of treating storm water are based on existing structures. Thus administrative boundaries and 'sector-thinking' hinder 'free' discussion. Technological changes should also take into consideration cultural changes in a social context. One might also ask whether we should try to integrate water, storm-water and wastewater management – as the Nordic countries have to a large extent done with their urban water and wastewater management (editors' note).[29]

As to the management time frame, the paper 'Futures thinking in water services management' related observations about Operative Management from a period of less than one year, about Strategic Management from close to 3 years, and about Visionary Management from 6 to 20 years. Seppälä[30] argued that futures thinking is needed in water utilities particularly for (i) safeguarding the availability of water resources; (ii) guaranteeing long-term investments; (iii) identifying irreversibility and path dependence; (iv) foreseeing the need for possible regional cooperation. Futures thinking and related tools are especially valuable for utility managers and decision makers when the water utilities are owned by municipalities. Tipping[31] accentuated the historical relationship

between public health and water services. It was shown that they have always been inter-connected since sanitation systems are the foundation of global health programmes and their implementation. Examples from history show that lessons can be learned, which is why history should not be forgotten.

Water can also substantially contribute to processes of modernisation. This is apparent from Aarnio's presentation on the changing everyday life in Turku, Finland since the 1950s when water became available on tap. It ushered in a totally new set of cultural circumstances. The idea of modernisation included a sort of paradisiacal myth, according to which, (i) by leaving the old wooden houses without modern plumbing, and (ii) by freeing especially housewives from the hard work of cleaning and washing, everyone could start a new happy life. Yet, from a philosophical point of view, the idea of continuous growth as a sign of modernisation may need to be reformulated.

Regionalisation of systems

In the late twentieth century, German water supply experts and environmentalists had different attitudes and ways of addressing the technical and scientific issues related to water supply – just like a century earlier. This was shown by a case study on a regional water supply system in the Rhine region that relies on artificial recharge. Unexpectedly, it was opposed by farmers, municipal and regional authorities, and particularly environmentalists. The positive emphasis on technology worked as long as it was endorsed by influential actors in society. For several reasons the situation has changed. Stippak[32] argued that experts' opinions and insights are no longer accepted as such. Their views are consistently challenged in the public sphere. Therefore, both groups will now have to learn to speak the same language. The situation is not confined to Germany. Also in Finland there have been and are cases where large scale artificial recharge projects have been delayed for years, due to opposition. Researchers are keen to find a way to make the processes more participatory or otherwise to assess, avoid or alleviate such contradictions and identify potential bottlenecks or constraints (editors' note).

Another case of regionalisation of water systems by Keskisaari[33] showed that water resources are limited in the Lapua-Seinäjoki region in Southern Ostrobothnia, and that innovative public-private solutions have been in use already for decades. The region is predominantly rural with small towns and rural villages of 50–300 people as far as 15–25 km apart. A bulk water supply company was established in 1975 to supply water to four municipalities. Municipalities and water cooperatives run their own systems for local consumption. There are altogether 16 water supply undertakings operating within the Lapua municipality with 16,000 people, mainly cooperatives. There are also interesting inter-municipal arrangements for joint municipal and agro-industrial wastewater collection and treatment (editors' note).

The process of merging and up-scaling water entities in the Netherlands has been fundamental in long-term perspectives. Just before the Second World War, the number of utilities was 230, while by 2004 it had declined to ten. At the provincial level, outsourcing of operational activities, research and development (R&D) and laboratory and customer management are characteristic. Supporting infrastructure is considered a key factor in determining the level at which activities can be most efficiently organised, as is the scale of an activity. Finally, the question was raised whether such up-scaling processes could be considered as a form of self-protection against foreign competition.[34]

Finland – as well as many other countries (editors' note) –- has a large number of water and wastewater undertakings, most of them quite small. The undertakings and their assets are owned by municipalities or, in the case of co-operatives, directly by the users. According to Piekkari,[35] strategies may fail if they are too complicated, or there is a lack of motivation. As for Helsinki Water, the company recognises the following future challenges: (i) a possible need to merge; (ii) staff retirement – how to get skilled staff; (iii) ageing network and asset management; (iv) focusing on core business; (v) maintaining customer satisfaction. For a strategy to be implementable, it must be clear-cut and should involve: (i) education at all levels; (ii) all staff members; (iii) close interaction between management and performing staff; (iv) information specialists for translating engineering 'slang' to the public; (v) focus on the main activities. A proper strategy should establish the roles of top management, office managers and performing staff. A water company strategy should also take into account the strategy of the city, the owner of the company.

Flood control

In their presentation Massop and Gaast[36] explained how water management practices in the Netherlands were related to different land use and production forms. From 1850 to 2000 the Dutch landscape was transformed from heaths and forests to farmlands, roads and built-up areas. The transformation of the land and its water supplies was partly driven by population growth and the increasing use of chemical fertilisers, instead of animal manure, on the heaths. Over a period of 150 years, the length of watercourses increased four-fold, and their cross-sectional surface areas two-fold. The ponds of the heath lands of former times, which functioned as a 'hydrological sponge', had provided a form of flood control, suggesting that earlier land use regimes probably provided better flood protection. In recent times there have been many severe floods, and currently there are fears that the present dikes may break, particularly as a result of increased precipitation due to global climate change.

There is growing awareness also in the USA of the manner in which management strategies of the past influence present conditions. In former times Indianapolis, Indiana, south of the Great Lakes, passed flood control legislation

and implemented flood control measures which brought unintended changes to the city. According to Germano,[37] the results of these responses continue to be seen and felt throughout the city today. A city's relationship with its water source and the ways in which it responds to flooding are crucial. Flooding can also establish the identity of a city.

As for more recent developments, the Duchesne County Water Conservancy District in rural North-Eastern Utah, USA and the Bureau of Reclamation are using real-time technologies to make the river and its tributaries more accessible to water users. The system makes collaboration between various interest groups easier, and allays the 150 years of mistrust between various water use and environmental groups. The possible uses of this kind of system are multiple and allow improving the management of a river system that is over-allocated.[38]

Policy and politics

In their paper on Barcelona, Spain, Sauri, March and Domene[39] showed how water supply is only to a limited extent a technological issue – it is more a question of national politics and social conflicts. Larger schemes need acceptance not only on a transnational level, but also on the level of local culture. The need was stressed for a new 'water culture' where the emphasis is on demand management rather than supply enhancement. The culture could also been expanded from the administrative level to the lowest grass-roots level of consumers.

Phumpiu and Gustafsson[40] compared water policy reforms in Honduras adopted in the liberal (1873–1919) and the neo-liberal period (1990s–). It was suggested that the success of reform depends on how well the reform is adapted to the local context. Unfortunately, most reforms are externally imposed and top-down, which is largely the case also in Honduras. When compared, the two reform periods in Honduras had many similarities, such as an emphasis on commercialisation and lack of political leadership, but they also differed in many aspects.

Challenges in developing and transition economies

According to Rautanen, water governance faces many challenges in Nepal. She provided an overview of the four main phases of development between the 1950s and 2005 while Das gave an update of the present situation.[41] Phase 1 (1951–1970) focused largely on urban areas and emphasised the health aspects of water supply and sanitation. Phase 2 (1971–80) moved the focus more on regions and shed light on water projects in rural areas. Phase 3 (1981–1990) was related to the objectives and approaches of the International Drinking Water Supply and Sanitation Decade (IDWSSD), and Phase 4 (1991–2005) gave more attention to remote areas and poverty issues.

In Africa, urban water supply and sanitation services are still the subject of extensive experimentation, as a result of the planning and development challenges in one of the most rapidly urbanising regions of the world. Post-apartheid Cape Town (since 1994) has faced a number of bottlenecks preventing the proper implementation of conventional water supply and sanitation infrastructure in the informal settlements of this oldest South African city. Population growth, migration patterns and complex socio-economic conditions have put conventional approaches to water and sanitation services to the test. Informal settlements in Cape Town face and suffer most from the consequences of rapid urbanisation. Escalating water demand, unplanned and irregular settlement layouts, ageing infrastructure, increasing poverty and difficult settlement patterns are some of the challenges that urban planners have been unable to manage effectively with traditional management models.[42]

Experience suggests that the water infrastructure of East African cities – both contemporary large- and small-scale systems – have critical weaknesses. Consequently it appears as if 'modernised mixtures' (modern combinations), suitable for medium to large-scale operations, have to be developed. In order for this to take place, four dimensions need to be explored simultaneously: low-cost and flexible systems; centralised high-cost systems; decentralised systems with involvement of the inhabitants; combined or separate sewerage. Policies and technologies need to be developed, systems analysed and management options identified.[43]

In Tanzania, East Africa, the future of water is at stake due to rapid population growth and an increase in economic activity as well as recurring droughts: the general rainfall pattern has become erratic in recent years. Effective assessment, planning and management of water resources are therefore needed.[44] Historically there are also some lessons to learn. In 1967, the Tanzanian Government embarked on a large and ambitious programme for Kilimanjaro, according to Bender.[45] That programme, based on gravity-driven pipelines and public taps, had features of government-sponsored projects and social and political transformation. A product of the ideology of 'Ujamaa villagisation' it was largely intended as a means of consolidating national control over water resources, of undermining local forms of political authority, and of building loyalty to the nation.

As for transition economies, the recent political changes in Estonia have had significant impacts on the water sector, e.g. by introducing water fees and the principles of full cost recovery. The decrease in water consumption caused also technological problems and a critical deterioration of water quality. As a result large pipes functioned as sediment tanks, and corrosion became an urgent problem. The Tallinn case is a good example of how most technological systems are built believing in steady growth without considering a possible decline in consumption. It would serve other sectors well to put to good use in their strategic planning the important 'lessons learnt' by the water sector.[46]

Ukraine has a substantial shortage of water resources, high specific water consumption and high water losses. These have contributed to several environmental problems. Thus, a systematic programme to alleviate the problem was launched, called 'Sustainable Water Industry Asset Resource Decisions (SWARD)'. Its objectives were to find measures for reducing consumption and losses and to define sustainable criteria for water use minimisation[47].

Sanitary and Environmental Education

As to the historical background of sanitary engineering, Hendricks[48] noted the importance of the Massachusetts Institute of Technology (MIT) in developing sanitation engineering across the USA, and how the field was further developed by former MIT students who spread the knowledge around the country after 1962, when the courses at MIT were terminated. The paper also showed the dynamics of the development of the sanitation field and the role of academia. For instance, a doctoral degree has been considered a major advantage by recruiters of water utility managers in the US since the 1970s, while in Europe and the Nordic countries their mindset has probably started to change only recently (editors' note).

Two papers dealt with the educational features of BSc programmes at TAMK University of Applied Sciences, and MSc and doctoral programmes at Tampere University of Technology. Dyer pointed out how putting the engagement of individuals in the development of the sanitation field into historical perspective was a very effective way to make a general introduction and to identify the basic characteristics of the topic. Such simplified lectures were regarded as very useful, especially for young students and the non-professional audience.[49] It was further noted that the core values of environmental engineering are as follows: (i) transparency, (ii) honesty, (iii) commitment, (iv) collaboration, (iv) consistency, (v) professionalism, (vi) 'only the best is good enough', and (vii) openness to development.

According to Katko,[50] Environmental Engineering Education is a complex field that requires a holistic approach based on the understanding that: (i) Technology is as important as the social and other dimensions like, for instance, the PESTEL (political, economic, social, technological, ecological, legislative aspects) framework; (ii) Inter- and multidisciplinarity are necessary to cover the field properly; (iii) Holistic perceptions and approaches need to accompany specialisation – hopefully producing a more balanced combination and recognition of other disciplines and approaches in education and research.

5. WATER PRIVATISATION

The debate on the privatisation of urban water has been going on in water management circles for many years. French companies are nowadays the dominant multinationals operating in Africa – not only in the former French colonies but also elsewhere – while UK, Spanish and Portuguese companies have a presence only in their earlier colonies. After the First World War, Germany lost her colonies, but German companies have maintained management contracts in their former colonies. Portuguese and German companies have signed contracts for providing services abroad, although water services in their home countries are publicly managed.

The colonial heritage is in many ways still evident in Africa as viewed from a water perspective. The paper entitled 'Undercurrents of empire' showed and analysed the colonial sources of water privatisation.[51] In 1858 the Compagnie de Suez was established to build the Suez Canal. It was initially controlled by French and Egyptian investors, and later by British and French investors (50:50). In 1956 Egypt nationalised the canal, and two years later paid compensation for it which formed the initial capital for the water company of the same name. The Societe Generale de Belgique, founded in 1822, invested, for instance, in the Belgian electricity sector. It also invested in Congo, where it used cheap labour in poor working conditions, and later became a water company. Thus, both companies have their origins in colonial times.

Colonial governance has also left its mark on Australian water management. Although the Adelaide area in colonial South Australia was subject to a waterworks act early on, the development of water supply systems took time and suffered from the colonial relationship between Britain and Australia. In 1855 South Australia gained self-government, and by 1860 a new water system with a surface water reservoir was built for Adelaide City. The ideological debate about whether water is a commodity was already taking place in the mid-nineteenth century – it became an issue again in the twenty-first century. Stakeholder participation and governance were also topical issues at the time.[52]

Da Silva[53] gave an interesting exposition of the reason why the water supply of Lisbon was not municipalised in the nineteenth century, despite the prevailing trend in other Portuguese towns and cities. He suggested that in the late 1800s state intervention increased as a result of market failures, abuse of market power and problems due to disadvantageous contracts with the private sector (transaction costs). Also, the failure of arms-length regulation led to municipalisation in many cities, but not in Lisbon. Financial factors were responsible for the trend. Municipalities had weak taxation powers and hardly any financial resources. But technological reasons also played a role. Ironically, a waterborne system was not considered a practical option for waste removal.

In recent history several private operators in the UK, as well as elsewhere, have been sold to private equity funds. Their equity structures bear strong re-

semblance to certain public organisations. The increased debt financing raises the question about the motive behind private ownership, especially as complex financing structures also require complex regulation. The Finnish Water Services Act is a good example of legislation that allows a public utility to operate effectively in terms of rate of return to the owners, quality of service and charges. Yet, even public utilities need some economic regulation. The water framework directive does not prevent 'milking' of funds from the water sector as intended. Vinnari and Hukka argued that public ownership of infrastructure assets will in the future be a more rational option than private ownership. The claim was supported by financial data on Finnish publicly owned water services utilities.[54]

In his presentation of his socio-political analysis of the international debate on water policies since the early 1990s, Vargas[55] presented an analytical framework consisting of five axes of long-term institutional change: public–private, local–central government, public authority–operator, operator–regulator, and operator–users. According to Vargas, the ongoing international debate still remains biased, and the institutional dimensions along the five axes are complex and interrelated, and can have long-term complementarities.

From a historical perspective, one of the striking examples has been the promotion of private ownership, concessions and large-scale operators by international financial bodies in the 1990s, especially in Latin America. A decade later the representatives of the same bodies have noticed, for instance, that 'the private financing mobilised for urban PPI has been quite limited and undeniably disappointing in relation to the high expectations prevailing in the 1990s'.[56] Thus, remunicipalisation has been put on the agenda as an option.[57]

6. DISCUSSION AND CONCLUDING REMARKS

As stated in all papers, water and city is a theme which was already relevant thousands of years ago and still denotes a vital struggle for at least half of humankind. The importance of the theme will even grow as the urban population increases further. By 2007 more than a half of the world's population were living in urban areas, and growth was fastest in third world cities. That fact poses huge challenges for extending systems and services. At the same time, the water infrastructures of many developed societies are ageing and will need increasing repairs and renovation.

Historically the growth of urban centres has been a continuous and even escalating trend. Most of these centres are located in developing economies where the ensuing problems affect the poorest people the most – as always. The most severe constraints include poor living conditions, lack of democracy, poor hygiene, illiteracy, corruption and lack of proper water and sanitation services. Women and children suffer most from these constraints.

Several presentations showed that the decisions on and management of water resources and services are to a large extent public by nature – at least on a larger scale. As for decision-making regarding regional water systems, Grigg[58] notes how institutional issues are the greatest impediment, and success is based on '70 per cent politics, 20 per cent engineering and 10 per cent luck'. Considering the historical experience from private ownership and operators, at least in the case of large systems, as indicated by several conference papers and other literature (e.g. http://www.prinwass.org), one has to wonder why even some professionals do not make use of the accumulated experience and historical evidence instead of uncritically experimenting with 'imaginary new innovations'.

The conventional wisdom used to be that systems will expand forever as will water use and consumption. Yet, there is evidence that the era of ever increasing consumption is over. In several European countries water consumption per capita started to decline after the oil crisis of the early 1970s and is now clearly lower. The same phenomenon, though partly due to different reasons, was recognised in many transition economies in the 1990s. The strive for more efficient water management instead of automatically expanding systems was also one of the key reasons for the European Declaration for New Water Culture, signed by about 100 scientists in Madrid, Spain, in 2005.

When planning the water resources or services of urban areas, several options should be considered and explored. It might be true that historically alternatives have been explored and debated relatively more before establishing water supply and sewerage systems than has been the case later. Yet, we should also remember to consider traditional technologies and systems that may have important policy implications in terms of sustainability. Since we now recognise and accept the need for biodiversity, why is it so difficult to apply the same principles to other fields – like insdiversity?[59]

As Kuivamäki,[60] the managing director of the water utility of the host city, pointed out, we are now living between past and the future. With our knowledge of the past, we have to look into the future and try to forecast the possible and, especially, the desirable options and strategies for them. The relevance of our decisions – whether minor or major – will be assessed by future generations.

As concerns the future, one would imagine that due to climate change the role of storm water management will become increasingly important, although water history appears to have ignored it to a large extent.

Finally and fundamentally, everything focuses on the citizens who receive the services and who may have various roles as payers, beneficiaries, consumers, customers, voters and citizens. Probably none of them plays just one role. Since the vast majority of the world's water utilities are publicly (local government) owned, we can say that the residents of communities are in most cases the actual owners of the systems. This should be kept in mind when exploring future challenges and alternative means of meeting the desired goals. Understanding

of the past is also a basic requirement for any useful strategic and visionary thinking of preferable futures.

NOTES

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