# Sanitation, Water and Health

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ABSTRACT

This article focuses on sanitation, health and hygiene as themes of the 5th IWHA conference 2007. It investigates how understanding of the key concepts and the links between health, water and sanitation have changed over time. It identifies some of the key drivers that prompted these changes. The history of sanitation and hygiene is the history of epidemiology, medicine and public health, as well as the history of industrialisation, urbanisation and related urban misery. Since the first urban settlements appeared sanitation has also been linked to drainage and flood management. The conference papers and presentations discussed in this theme article provide insights into sanitation, health, water and urban development, including such specific themes as flood and rainwater management. The article initially focuses on early civilisations, then on health, broadening the scope to questions relating to economics and institutions in an attempt to identify a range of other drivers.

KEYWORDS

Health, water, sanitation, history, IWHA

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## 1. INTRODUCTION

Water is about staying alive, about the health and biological needs of living beings. It is also about livelihoods, survival and development of human settlements and civilisations, about power and politics, about wealth and poverty, about 'ease' and 'dis-ease'. Humans use water for several distinct needs: drinking, cleaning, and productive practices such as livestock raising, agriculture, hydro energy production and navigation. All these activities have their impacts, or rather layers of impacts, on health, the environment and overall quality of life and wellbeing. Pollution and deteriorating water quality, flooding and water scarcity, as well as other problems relating to the allocation and distribution of existing water resources to various users and uses, are questions of life and death. Adverse impacts on water bodies and aquatic environments as well as their users are often defined as externalities: they are the unintentional and uncompensated side-effects of one person's/company's activities on another. In a globalising world with an increasing population and increasing complexity of human interaction the negative impacts are also global.

Water issues can arouse strong feelings, and issues like privatisation of water supply services can bring people to the barricades. The other side of the coin is less publicised. An estimated 2.6 billion people – roughly 42 per cent of the world's population – still have no access to improved sanitation.* Unfortunately it is not past history that there are approximately 4 billion cases of diarrhoea each year resulting in 2.2 million deaths, mainly due to a lack of clean water and poor sanitary conditions. These deaths represent approximately 15 percent of all child deaths under the age of five in developing countries. Cholera and typhoid fever also continue to devastate human life[1].

This 5th IWHA conference 2007 theme article focuses on sanitation, health and water. It investigates how the understanding of the key concepts and the links between health, water and sanitation have changed over time, in an attempt to identify some of the key drivers that prompted the change. It has been assumed that since the link between drinking water quality and health was established during the industrialisation period, sanitation and hygiene were of secondary interest. For many, the history of sanitation and hygiene is the history of epidemiology, medicine and public health, as well as the history of urban misery. Sanitation can also be linked to urban rainwater management and drainage. The question is: did sanitation and related public health issues evolve from the medical sciences, or can we distinguish other drivers, such as politics, economics, strive for modern standards of living and convenience, or even religion? Why is it still easier to talk about and invest in water services than in sanitation? What

* The WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) defined improved sanitation as: Connection to a public sewer; Connection to septic system; Pour-flush latrine; Simple pit latrine; Ventilated improved pit latrine

can we learn in the light of the IWHA 2007 Conference from the past efforts and processes of change, successes and failures, for a healthier future?

A total of 132 papers submitted for the IWHA 2007 conference were examined for this article, of which 27 were chosen. The article focuses initially on early civilisations, then on health, broadening the scope to questions relating to economics and institutions in an attempt to identify a range of other drivers. As with the other theme articles, a list of references is attached, including the full papers, abstracts of conference papers, and additional external references.

## 2. SANITATION AND EARLY CIVILISATIONS

Healing and ritual baths, as well as holy lakes and springs, have been thought to contribute to human health and well-being. Water has also captured the imagination of artists from time immemorial. The disposal of human excreta and drainage, on the other hand, has provided much less inspiration. Yet, as soon as human populations organised themselves into densely built settlements, these practical inconveniences had to be solved. Sewerage was closely linked to drainage and overall management of rainwater and flood protection in ancient urban habitats.

One of the earliest systems of wastewater management was constructed by the Harappan civilisation by the river Indus (3000–1500 B.C.). Mohenjo-daro and Harappa have ruins which show the great care taken to construct sewers. According to Hlavinek,[2] even if houses were connected to the drainage channels, wastewater was not permitted to flow directly to the street sewers: it had to pass through tapered terra-cotta pipes into a small sump for settling and accumulation of solids. The liquid overflowed into the drainage channels in the street when the sump was about three-quarters full. The drainage channels were covered by bricks and cut stones which were probably removed during maintenance and cleaning activities. The channel also included a cunnette which, according to Hlavinek, was probably constructed to convey the smaller flows associated with daily wastewater discharges, while the entire channel would only be used during wet weather events.

Another example is the Minoan civilisation which flourished on the Island of Crete from about 2800 B.C. to 1100 B.C. The ruins reveal an elaborate system of stone drains for sanitary sewage, roof runoff, and general surface drainage. These drains emptied into a main sewer that disposed of the sewage a considerable distance from the origin of the wastes. Furthermore, the ruins of the palace of Knossos reveal a two-conduit system: one conduit collected sewage and the other rainwater (Hlavinek). The motivation behind and financing of these structures is not clear, but one can presume it was convenience and water security, considering that rainwater was clearly collected to be used.

Drainage systems were also constructed during the Etruscan period; the same structures were later improved by the Romans. Hlavinek notes that ‘the engi-

neers of Rome were excellent developers of technology rather than originators'. Eventually, based on earlier experience on a smaller scale and the upgrading of the Etruscan structures, Roman engineers built probably the best known major public sewer in antiquity, the Cloaca Maxima – the Great Drain – to drain the marshy areas which eventually became the Forum (Fig. 1).

FIGURE 1. The Cloaca Maxima in Rome (Photo: T. Katko).

The Cloaca Maxima is a huge covered drain which, by the time of the late Republic, functioned both as the main storm sewer and a means of sewage disposal. The drain had a significant flow of water from the low-lying swamplands and as such, provided also a convenient medium for transporting waste. It drained into and consequently also polluted the River Tiber, which was used for drinking, bathing and swimming. Hlavinek points out that the Romans knew of the need for 'clean' water and the need to dispose of wastewater away from the source of drinking water – at least from the source of their own drinking water. Were the Romans concerned about those who drew their drinking water from the Tiber? It must be noted that what Romans considered 'clean water' would hardly be considered clean today. They shared the common belief of antiquity that good potable water must be running, odourless, colourless (clear) and tasteless (or good tasting). Stagnant, marshy water was to be avoided.[3]

## 3. DRIVERS FOR IMPROVED SANITATION AND WATER FOR HEALTH

Word origins: The word 'hygiene' derives from *Hygieia* (Ὑγιεία), the Greek goddess of health and the daughter of *Asclepius*, the god of medicine. In Rome Hygieia was associated with the goddess *Salus*.

### *3.1 Rise of the scientific era and the germ theory of disease*

In the light of the examples of the previous section, urban drainage systems were viewed as serving the dual purposes of waste and storm water conveyance. The need to protect urban environments from flooding remained the main driver until the industrial revolution (c.1750–1850). Between the fifteenth and seventeenth centuries, towns in North Italy started cleaning the filth and rubbish from their drains to prevent diseases,[4] but it was only in the nineteenth century that hygiene and sanitation occupied the forefront in the struggle against illness and disease.

In Europe pollution and the need for sanitation were mainly brought to attention by industrialisation; to a lesser extent also by the development of modern agriculture. The Age of Enlightenment introduced the idea that science was an instrument of progress, and the subsequent rise of the 'scientific' era of medicine in the mid-nineteenth century finally also put sanitation and hygiene on the political agenda. This development was strengthened by the emergence of the idea of specific aetiology of diseases (in connection with the discovery of specific germs as a cause of specific diseases) in the late nineteenth century. Beveridge and Pflug,[5] among others, note that the beginnings of the modern organisational framework of water and sewage services in London can be traced back to the 1840s when the health of the city's population was seriously threatened by industrialisation, heavy pollution of the Thames and outbreaks of cholera resulting in demands for reform of the ways in which water was supplied, treated and disposed of within London.[6] Numerous other European towns and the rivers running through them, such as Paris and the Seine, faced similar problems in the mid-1800s. At that time, the Seine was truly a multi-purpose resource, suitable for both drinking and waste disposal as well as navigation. Euzen and Haghe[7] describe the eighteenth century as a key period in the relationship between Parisians and the river, which was such an integral part of their lives, but whose waters were becoming increasingly polluted.

### *3.2 Public opinion and the true incentives – Chadwick's report*

The nineteenth century was a period of unprecedented and rapid population growth in the newly developing industrial towns of Europe. Fisher[8] identified three main drivers behind early public health initiatives in Britain during this period: the concern with public health; seminal events; and changes in governance.

There was a growing concern over the state of working class living conditions and public health in the 1830s. Fisher suggests that this was partly due to the reporting by Royal Commissions, journalists, social commentators and writers such as Dickens, Gaskell and Engels,[9] together with improved statistical evidence that the poor were increasing and dying younger.[10] Public opinion urged authorities to take action, shocked by Chadwick's Poor Law Commissioners' *Report on the Sanitary Conditions of the Labouring Classes* (1842) which made a link between unsanitary conditions and poor health. This was uncommon at the time, although similar claims had also been raised earlier, for instance in the context of prisons, slave ships and army camps. The view was further strengthened by such people such as Florence Nightingale whose remarkable work in nursing sick soldiers during the Crimean War (1854-56) has been extensively chronicled.[11]

The Chadwick report leaves room for debate. Some authors note that by establishing a connection between unsanitary conditions and poor health, it managed to divert attention from the fact that poverty and health are linked in a number of ways. Hamlin,[12] for instance, demonstrated how Chadwick ignored medical reports showing that disease among Britain's working classes resulted from a variety of conditions: destitution; horrible housing; poor water and sewage systems; long working hours in dangerous, toxic workplaces; and little education or training. Porter,[13] in reviewing Hamlin's work, noted how

> sewer construction appealed to middle-class sentiments. Sewers improved the town, and could be built without actually dealing with the dangerous classes. Clean water would bring clean morals. The subjective misery of destitution was replaced by the objective language of dirt, stench, pipes, drains, and dwellings. Often spurious data and projections suggested extraordinarily far-reaching benefits: Sanitary reforms would pay for themselves in lower rates of crime, disease, and political agitation.

### *3.3 Seminal events and political will*

Fisher further identified seminal events which have influenced the political will to improve public health. They are related to experiences with and fear of death and disease such as cholera across all classes. According to Fisher, cholera first arrived in Britain in 1831, with subsequent major outbreaks in 1848, 1853 and 1866. At the time the medical profession strongly believed that it was transmitted via foul air. The view of Dr John Snow that it was far more likely to be transmitted by contaminated water was confirmed in 1854 when 500 deaths occurred in Soho, London, in the space of ten days in what is known as the Broad Street Pump Incident.[14] Snow identified one contaminated well by mapping out the cases. Yet, the prevalent belief in disease transmission through noxious vapours remained powerful till the late nineteenth century.[15] Dr Snow

also demonstrated that water drawn downstream of Thames, into which many sewers flowed, caused a death rate 14 times that of water drawn from upstream. In 1859, the water supply intakes were finally moved upstream of sewerage outlets and an intercepting sewer system was built on the Embankment to improve the flow of water.[16]

In Finland health became a factor in water supply and sanitation discussions when the 1879 Public Health Decree, containing provisions on pollution control, was enacted in response to the growth of industry and built-up areas. The country's wastewater treatment practice was primarily determined by public health engineering concerns. Over the last few decades environmental pollution control in Finland and other developed countries has become almost the sole driver for improved wastewater treatment.[17]

### *3.4 Cleanliness and hygiene*

To Florence Nightingale (1820–1910), sanitation was a symbol of Western civilisation. After the Crimean War and the rebellion in India in 1857, Nightingale declared that 'it would be a noble beginning of the new order of things to use hygiene as a handmaiden of civilisation'. Nightingale was not alone: it has been argued that army medical officers had long been raising their voices in condemnation of sanitary conditions in military cantonments. Nightingale also made the still highly relevant observation that it was cheaper to promote health than to maintain people in sickness.[18]

The IWHA 2007 Conference papers introduced country- and city-specific cases, rather than individuals associated with breakthroughs. For instance, Malinova[19] describes how along with urbanisation and the development of science and technology in the second half of the nineteenth century, the mindsets of city inhabitants also changed. Malinova focuses on St Petersburg and its *dacha* territories in the 1840s to 1910s. New ideas on health spread among the educated layers of St Petersburg society, where the idea of the suburban *dacha* played a major role. To live in a *dacha* meant breathing fresh air that safeguarded health.

Alakbarli[20] introduced a tradition from Azerbaijan, Persia and Turkey where during the ninth to fourteenth centuries the aromatic oils of about 50 species of herbs and flowers were added to bath water or applied externally. Bathing and saunas were associated with good health and wellbeing from early on: Alakbarli writes how 'to maintain health, it was recommended that a person visit a bathhouse at least two or three times each week'. He further notes how these bathhouses served as both beauty parlours and health clinics.

Merviö,[21] in turn, introduced a well-established bathing tradition from Japan. It was a means of improving public health. Merviö provided an example from the city of Edo, Japan (later named Tokyo) to illustrate how a country that by definition was supposed to be pre-modern, and that due to its security concerns had limited foreign contacts, was still able to design large-scale sys-

tems that effectively minimised health risks, contributed to public health and cut environmental pollution and wastage of scarce natural resources. In Edo, the old system was so effective that when it was modernised at the end of the nineteenth century, the only major work required was to replace the wooden pipes with metal ones.[22]

### *3.5 Flood management and rainwater harvesting are still relevant*

Rainwater management has regained interest in various parts of the world: it is still a relevant factor in managing drainage and sewerage and pollution control and water security. Koch introduced the debate in Germany sparked off by river pollution due to sewer overflows – especially from combined sewer systems – in the mid 1960s, which was a severe problem throughout the 1970s.[23] Similar debates could and should be conducted in numerous other countries as well: the choice between combined and separate sewerage is still relevant. Water security adds another dimension to the need of managing rainwater with more care: groundwater recharge and rainwater harvesting for direct use have potential. An example was presented during the IWHA 2007 conference by Wagle.[24] The warming climate has brought up this issue in areas like Scandinavia where winters seem to be getting wetter. Because rainwater enters sewerage by different routes, treatment plants may receive increasing volumes of cold water that reduce the efficiency of the biological process.

Drainage and flooding can also be seen in a broader context, such as the one presented by Germano,[25] who claimed that few historians have studied the social significance of urban flooding. Germano presented a case study of the 1913 flood in the city of Indianapolis, USA, and claimed that 'responses to flooding hold the power to reshape the cultural future of cities worldwide. Without acknowledging this power, communities echo and repeat responses to flooding that result in disjointed urban sprawl, unhealthy sections of cities, shifts in social power, and other undesired and unintended changes'.

## 4. SPECIFIC HEALTH HAZARDS AS DRIVERS

### *4.1 Discovering microbial life and understanding water quality*

Establishing the link between microbial life, poor water and non-existent sanitation took a long time. Vesilind[26] points out that micro-organisms remained a mere scientific curiosity for some 150 years after Anton van Leeuwenhoek first discovered the microbial world with his simple microscope in the late seventeenth century. The idea that these small organisms could cause disease was considered unlikely. While all European cities suffered periodic epidemics of cholera, typhoid fever and other diseases in the nineteenth century, there were many theories of why these epidemics occurred. For instance, Chadwick,

like many others at the time, believed that odour was to blame: 'All smells, if it be intense, initiate acute disease'.[27] It has been argued that Chadwick and his contemporaries did not see odours themselves as the cause of the illnesses, but rather as an indication that *miasma* was present, that the disease causing agents were present in the air.[28]

Until the 1840s, when the first scientific analyses were carried out by pharmacists and chemists, knowledge about water had been exclusively based on sense perceptions and subjective experience: sight, smell, taste and touch made it possible to elaborate and regularly re-evaluate a certain hierarchy of different qualities of water. Perceptions concerning the quality of water were based not only sense impressions, but also on its origin, the nature of the terrain it traversed, and how rapidly it flowed.[29]

Drinking water standards were developed nationally in different industrialised countries during the early twentieth century. The need for safe and potable water became urgent with the increase in travel, particularly air travel, especially in the 1950s. Safeguarding of public health in the international community was entrusted to the World Health Organisation (WHO). WHO played an active role in developing international standards for drinking water, and sponsored a series of expert consultations and meetings in the 1950s. WHO also published a special water sanitation issue of the *Bulletin of the World Health Organisation* in 1956. After several years of preparation, WHO published the *International Standards for Drinking Water* in 1958, followed by revised editions in 1963 and 1971. The WHO Regional Office for Europe was active in the preparation of international standards and had *European Standards for Drinking Water* published in 1961, followed by a second edition in 1970. WHO further elaborated the international standards in the *Guidelines for Drinking-water Quality*. These appeared in three volumes: the first edition in 1984–1985, the second in 1993–1997, and the first volume of the third edition in 2004.[30]

Many countries are taking steps towards WHO drinking water quality standards. During IWHA 2007, Chikhladze and Dadiani[31] presented the case of Georgia, dividing the history of water quality in Georgia into three periods: The Soviet period (before 1990), the period of transition (1990–2000) and the period of development (2001 to present). During the Soviet period, Georgia had a lot of normative documentation but nothing conforming to international standards. During the transition period, existing normative documentation was unusable, but new documentation was not elaborated. The new water law was adopted by the Georgian government in 1997. From 2001 on a lot of documentation was elaborated concerning the epidemiological and hygienic norms of water, and in 2005 the Safety and Quality of Food Act was adopted and responsibility transferred from the Ministry of Health and Social Care to the Ministry of Agriculture of Georgia, Department of Food Safety. The statutes are not in perfect accordance with the guidelines set by EU and WHO.

Wastewater standards involve an altogether different dimension of water quality. Vesilind[32] points out that the initial objective of wastewater treatment was the destruction of microbial life, based on the realisation that infectious diseases, such as cholera and typhoid fever, are caused by microorganisms. Vesilind's paper focuses on the man credited with first realising the benefits of microbial action, William Dibdin, who in the late 1880s designed the first large-scale biological wastewater treatment plant. By 1900 Dibdin's reputation was established, and wastewater treatment plants using biological treatment processes were constructed in Great Britain and the United States. The British press hailed biological treatment of wastewater as a significant advance, but could not understand why it took so long to discover such a simple thing.[33]

Wartiovaara[34] noted how definitions of pollution link the concept of water quality to different human needs. He concluded by explaining how in the past the sector was characterised by low technology, low-intensity competition and unlimited abstraction rights, whereas presently high technology, insistence on high water quality and tough competition are the norm. For the future, Wartiovaara envisions application of simple technologies, regulated competition and global competition at various levels. Water, sanitation and related water quality and usability are no longer local issues.

### *4.2 Typhoid fever*

Typhoid fever was one of the diseases which by the 1870s were considered to spread through contaminated water. In the late 1800s and early 1900s, typhoid fever was also a common disease in the United States. Kent[35] introduced the case of the City of Boise in Idaho, USA, where typhoid fever rates were similar to other cities. At one point, Boise's water supply was demonstrated to be the source of the disease, while at the same time the private water company was complimented for its efforts in controlling the spread of typhoid fever. Yet the City took no action to take over the supply. In 1900, a higher than average number of contagious disease cases were reported in the north end of Boise. This time the public water system was not blamed for the outbreak because many residences obtained water from private wells 'into which flows the slimy, germ-breeding corruption from cesspools and closets' (*The Idaho Statesman*, 4 February 1900). Typhoid fever outbreaks continued to plague Boise also later, and although the water supply was generally thought to be the basic cause, other sources were also identified, including vegetables, natural ice and dairy products. In 1905, 44 cases of typhoid fever were diagnosed in a two week-period. Eventually it was found that the source of the typhoid fever was untreated sewage from a small town upstream of Boise.[36]

### *4.3 Cholera*

Cholera is another widely known and feared disease which still continues to kill. William Farr, one of the greatest public health physicians in mid-nineteenth-century Britain, believed that cholera was contracted through the atmosphere, via something he called 'cholerine', a zymotic material of cholera. Vesilind notes that Farr was an excellent epidemiologist and one of the first to apply statistics to disease prevention.[37] He plotted the incidence of cholera in London as a function of elevation above the River Thames. Yet, he concluded that cholera must be contracted via the air, the 'miasma' evaporating from the river that carries the 'cholerine' particles with it.

Now that the cause of cholera is well established, it appears to have become another key 'disease driver' in various countries for water and sanitation related development. Cholera makes news because severe, untreated cholera can lead to rapid dehydration and death: if untreated, 50 per cent of people with severe cholera will die. In numerous now-developed countries, cholera gave a boost to the development of modern water and, indeed, sewerage systems, as epidemics effectively forced water quality and sanitation issues on the public and political agenda. Yet cholera continues to be a real threat. In 2000 cholera cases and deaths were officially reported to WHO from 27 countries in Africa, 9 countries in Latin America, 13 countries in Asia, 2 countries in Europe, and 4 countries in Oceania.[38]

### *4.4 Lead*

Lead is a toxic substance which, when present in drinking water, seldom originates from natural sources. Lead was well known already in antiquity, and because pipes can be quite easily made of it, it was widely used in water supply systems. It was, however, considered hazardous to health already in antiquity, and for that reason it was not a recommended material for water pipes. Despite several reports of waterborne plumbism (chronic lead poisoning), especially in the nineteenth century, the use of lead in plumbing systems continued. After the Second World War it was recognised that old lead pipes can expose people to elevated lead concentrations in water, but the major health threats from lead were found to be occupational exposure and children's exposure to old plasters and paints containing lead.

Replacement of old lead pipes, which are still part of many old water supply systems worldwide, has been considered too expensive.[39] Firstly, lead is a fairly durable pipe material. Secondly, it is believed that lead does not necessarily dissolve into the conveyed water if a protective layer forms on the inner surface of the pipe. The validity of that belief has not been established.

## 5. POLITICAL AND INSTITUTIONAL DRIVERS AND OBSTACLES

### *5.1 Reconstruction and urge for modernity as drivers*

The history of sanitation is also the history of rising standards of living, modern housing and convenience. Sanitation is linked to the striving for modernity. Large European cities faced the challenge first, followed almost a century later by smaller cities. The conditions in London in 1858 were captured by the term 'Great Stink', which referred to the appalling smell of the heavily polluted Thames. It was increasingly felt that it was not acceptable in a modern city.[40] Vesilind[41] describes how 'the stench from the Thames was so bad that the House of Commons, meeting in the Parliament building next to the river, had to stuff rags soaked with chloride of lime (calcium hypochlorite) into the cracks in the shutters to try to keep out the awful smell.'

In many European cities sanitation was closely linked to the 1950s post-war reconstruction. The Second World War was a turning point also from the engineering point of view. Reconstruction and modernisation led to technical changes. Bertrand-Krajewski[42] lists the following factors which might explain these changes since the end of the 19th century:

- the increase of domestic and industrial water consumption, leading to larger flows in sewers with higher transport capacity;
- the development of asphalted roads with less solids entering the sewers;
- the decrease of large solids inputs (better waste collection);
- the lack of reliability of flushing systems;
- the high operation costs, especially when drinking water is used;
- the dilution of sewage, which has negative impacts on the efficiency of downstream wastewater treatment plants;
- the development and use of other more efficient devices using less water with a higher efficiency, like e.g. high-pressure jetting or vacuum suction used in upstream sewers where most tanks were installed.

Aarnio[43] notes how Finland, among others, wanted to be a welfare state after the war. Water supply and sewerage systems of towns were seen as symbols of modern Finland in the same way as railways. Aarnio writes:

> the new buildings were equipped with all modern conveniences. Apartments were warm, sunny and clean. Many former back-breaking works became easier with the water pipes and sewers. People who moved into their new homes described them as a paradise or a heaven. There were bathrooms, water closets and modern kitchens with sinks of rustless steel.

Aarnio also points out how 'housing comforts were part of the bigger whole; both materially and mentally, when people were at the beginning of a new era'.

Aarnio describes how the coverage of water closets in the City of Turku, Finland, evolved from 2.3 per cent in 1910 to 29 per cent in 1950 and to 96.7 per cent in the 1970s. Wastewater treatment, however, did not evolve at the same pace. The first wastewater treatment plant was completed in 1972, and by 1976 practically all households were connected to the system.[44] Before then, septic tanks were used following the example of Stockholm, Sweden. Already in 1905 each house with a WC was expected to build a septic tank system, and in 1919 the city established the post of an inspector who monitored the condition of septic tanks.[45]

The relatively late introduction of the flush toilet system in Finnish and other Scandinavian cities resulted from the fact that, before about 1905, most city officials opposed the building of water closets, fearing water pollution and related health risks. The first water closets in Finland were built in Vyborg and Helsinki by rich businessmen in the 1880s, but the Finnish Senate forbade their use. In the early 1900s the practical arguments put forward by the proponents of the flush toilet system already overshadowed the more diffuse health arguments supported by scientists which started the cultural revolution of moving the toilet from the backyard into the house.[46] One might argue that it was a manifestation of the engineering profession overriding the wishes of the medical profession in sanitation.

### *5.2 Sanitation – an economic driver or obstacle?*

Many international stakeholders today agree that inaction on sanitation and hygiene is not a viable development option: failure to invest in the improvement of sanitation and hygiene will undermine any efforts to promote economic growth and poverty reduction. Of course, that idea is nothing new, as shown above: a modern city just cannot allow a 'Great Stink' within its borders. Sanitation is an economic question, of which reformers such as Nightingale were well aware. McDonald[47] described Nightingale's profound understanding of the political process as he wrote: 'In a democracy there must be political will to achieve change: questions in the House of Commons, media coverage and the good will of the relevant professionals and opinion leaders.' According to McDonald, Nightingale actively approached both royal commissions to have the right people review the reports in the right journals: she knew the circulation of the major periodicals, and she understood the importance of getting a story or letter-to-the editor into *The Times*. Nightingale essentially conceptualised the welfare state with her vision of a profoundly reformed system. In her vision, the private sector was largely running the economy, while necessary measures were taken for income security, savings and pensions, employment stimulation in bad economic times, better housing, provision for the disabled, aged and chronically ill, and a comprehensive system of public health care. We may take

this as an example of how sanitation and hygiene indeed are embedded in the broader context of the economy of a state.

At the IWHA 2007 Conference, Mäki,[48] among others, linked water and sanitation to economics. He raised important questions relating to municipal sanitation and even water improvements in his comparison of two South African cities: Grahamstown and Cape Town. There the supposed beneficiaries were not very enthusiastic about the reforms, and Mäki wondered why the working class was against improvements that were supposed to improve its living conditions. Why did they not see it in their interests to get drains and sewers working properly? Mäki pointed out that even the expected improvements in the health situation did not change the attitude of the working class:

> 'the 'conservatives' resisted reforms because they realised they would have to pay for them; the underclasses rejected water schemes because they feared an increase in rents, and similarly saw water schemes to be in the benefit only of the merchant and commercial interests.'

Mäki continued, 'there were allegations that municipal leaders were just thinking about their own interests'. In Grahamstown, where political and social distinctions between different groups were not very clear, municipal conflicts were mostly based on personal and religious grounds.

In a European perspective, an additional, seldom recognised driver could be identified, i.e. the 'business' driver or the need for fertilisers for the fields around growing cities. The idea of collecting biological waste for farm use was suggested already in late-eighteenth-century Paris. Later, the push for separate collection of biological waste was discussed in the context of water pollution control and the need for sewers and thus became a health-related issue.[49] The health issue is still relevant in many peri-urban areas in the fast growing metropolitan cities of developing countries which rely (partly) on peri-urban agriculture for food security. Reuse of wastewater, usually in an uncontrolled manner, is a daily practice. There are certain drivers for increasing safe hygienic use of excreta and wastewater in agriculture worldwide. These include increasing water scarcity and stress, degradation of freshwater resources resulting from the improper disposal of wastewater and excreta, population increase and the resulting higher demand for food and fibre products, and the growing recognition of excreta as a nutrient resource.[50]

### *5.3 Institutional fragmentation as an obstacle*

Institutions are often defined as formal and informal collective rules of behaviour involving laws, contracts, conventions and codes of conduct, which regulate human interaction and limit individual choices. An additional dimension of that framework is good water governance, which 'refers to the range of political, social, economic and administrative systems that are in place to develop and

manage water resources, and the delivery of water services, at different levels of society'.[51] The key determinants of good water governance are protection of public health and safety, environmental protection, accountability, transparency, user participation, gender and equal opportunities, balancing equity, efficiency and effectiveness of performance, financial sustainability and transparency.[52] All are highly valid dimensions of sanitation and wastewater management. Yet, in the case of sanitation, good governance has been and still is difficult to define. Sanitation has often been viewed as an add-on to water supply, but as became evident earlier, sanitation also includes drainage and rainwater management in urban areas, as well as solid waste management and vector control. The institutions in charge of these multiple tasks are equally varied, from those dealing with public health to those dealing with infrastructure services (water, drainage, waste) or the environment.

Beveridge and Pflug[53] described the institutional development of water services in the UK and Germany. In London, private water companies, operating under a competitive system, supplied water to the city since the late eighteenth century, while wastewater and river management services were not yet fully developed.[54] As indicated earlier, the growing population and economic activity led to increased pollution and problems in supplying clean water, and eventually to the 'Great Stink', which referred to the appalling smell emanating from the heavily polluted Thames around 1858.[55] The response at the time was a gradual shift towards municipalisation of water services throughout the second half of the nineteenth century. Water was increasingly considered a public good, and local authorities began supplying water free of charge to the city's poor. At the same time, legislation prompted the development of London's water supply and sewage system as well as the creation of a regulatory framework to tackle the problems of sanitation and pollution, which were increasingly regarded as unacceptable in a modern city.

There are also rare cases where wastewater management has been managed by private operators. Britto[56] introduced such a case from Brazil, where Rio de Janeiro had private, mostly British, companies operating public services in the mid-1800s. Interestingly, in 1876, the city's water supply was run by the state, whereas its sewerage was run by a private company created in 1857 by the association of British and Brazilian capital, under the concession of the monarchical national government. One of the main reasons for direct state intervention was the rapid growth of the urban population and the sanitary problems associated with it, such as cholera and smallpox, which threatened the entire population irrespective of social class.

Britto identified two co-existing drivers of sanitation in the last decades of the nineteenth century and the beginning of the twentieth century: 1) *public health* which was promoted by the medical professions and associated with the control of diseases originating from environmental conditions; and 2) *city expansion*, i.e. the idea of preparing space for city expansion, filling up flood

plains, channeling rivers, controlling landfills and eliminating risk areas like wetlands and ponds, which due to environmental conditions were potential sources of epidemics. Later on, by the mid-1950s, a new concept of sanitation, designated 'basic sanitation', arose, introducing a new group of specialists, the sanitary engineers. More recently, in the 1990s, a new dimension has been added to environmental quality: the concept of environmental sanitation. Britto focuses on the historical evolution of these concepts using Rio de Janeiro as an example.

Bohman[57] argued that institutional change in the water supply and sanitation sector must be considered in the context of broader societal trends, as a mirror of the country's economic and political history. Bohman analysed the institutional changes in Ghana, from 1965 when the Ghana Water and Sewerage Corporation (GWSC) was established until 2005 when a contract was signed with a Dutch-South African joint venture.

> In line with general efforts of decentralization, responsibilities for sewerage were now devolved to the waste management departments of the district assemblies. All other aspects of waste management including liquid waste from septic tanks, were handled by the waste management departments, hence it was expected that this aspect would be better taken care of at this level. (…) While the initial argument for a common water and sewerage authority was that water and sewerage require joint planning, it is now believed in the principle of specialization and decentralization, hence local authorities through their waste management departments are expected to handle the sewerage aspect better than central government bodies. My impression is that in the decentralization process there is also an element of 'getting rid of the unwanted' (…).[58]

Wastewater remains the unwanted in numerous cases.

### *5.4 Sanitation and hygiene in developing countries – history in the making*

Before the industrial revolution, people of the northern hemisphere lived in health conditions comparable to those of the rest of the world: trachoma, tuberculosis, typhoid fever, malaria and leprosy were as common throughout the world as they are today in the developing world. Kabange and Mara[59] refer to a classic work which presents deaths by age in London in October 1764. It found that 50 per cent of the deaths occurred among children under five years, a situation worse than that found in the poorest nations of the world today. Because of the extremely high childhood mortality, life expectancy at birth in the industrialised towns of England in 1840 was 17 years.[60] Lack of clean water and sanitation, inadequate personal hygiene, poor housing and malnutrition were identified as the fundamental reasons for the high prevalence of diseases. The situation in developing countries is today as alarming as in England then, if not worse.

Kabange and Mara,[61] as well as Fisher,[62] compared the case of present day developing countries to those of industrialising Europe. Several other presenta-

tions focused on the more recent history of sanitation and health in developing countries. Adane[63] presented experiences from the development and implementation of a rural sanitation strategy in the Amhara Region of Ethiopia. Ferede and Suominen[64] provided further dimensions by describing the development of community financing and experiences from its implementation in rural water supply and sanitation in Ethiopia. Dukuduku[65] described how water supply, sanitation and hygiene education have been integrated in Tanzania. Rautanen- showed that sanitation and hygiene promotion (Fig. 2) have remained an add-on to water supply projects and development plans without very much substance or budgeted funds.[66] For instance, in Nepal the importance of sanitation was acknowledged very early in national development plans, but focused action is very recent. Skyttä[67] outlined the lessons learned in World Bank funded projects over the past decades, noting how sanitation has proven to be a complicated component to implement.

FIGURE 2. Local latrine builders in training in Nepal (Photo: S-L Rautanen).

## 6. CONCLUSIONS AND RECOMMENDATIONS

A number of presentations dealt with large water systems, such as transboundary waters, dams for hydro power and/or irrigation, and related ancient systems. The majority of the papers acknowledged the problems related to deteriorating water

quality, pollution and scarcity. They very rarely mentioned health, sanitation, wastewater or generally the need to manage both point and non-point sources of pollution. Quite surprisingly, the classical nineteenth century authors, who have been considered fundamental for the history of sanitation, water and health, were very seldom referred to at IWHA 2007. The British Edwin Chadwick (1800–1890) and John Snow (1813–1858) were represented, but such important individuals as the Germans Max von Pettenkofer (1818–1901) and Robert Koch (1843–1910) were not mentioned at all. Both the groundwater theory of von Pettenkofer and the bacteriological theories based on Koch's findings have had a great influence on the practical implementation and scientific justification of building sewers. All in all, the presentations at the congress on the development of different aspects of personal and public hygiene during the nineteenth century – the most important epoch in the modern history of sanitation, water and health – covered the subject field to a quite limited extent.

The question posed was: Did sanitation and related public health issues evolve from medical sciences, or can we distinguish other drivers, such as politics, economics, the strive for modern standards of living and convenience, or even religion? We did! The earliest driver appears to have been the need to remove human excreta and other wastes from densely populated urban areas. It is as ancient as urban environments and city states themselves. Urban drainage systems were considered to serve the dual purposes of waste and storm water conveyance. The need to protect urban environments from flooding continued to be the main driver until the industrial revolution (c.1750–1850).

Improved public health became a significant driver in the nineteenth century, first based on the miasma theory, and later based on the germ theory of disease. Improvement of public health should be a strong driver, but it often came second to those with obvious, direct economic benefits. In Europe and the United States public health was closely linked to industrialisation and the rising standards of living in urban areas which made 'modernity' and convenience into strong drivers, as hinted by a number of authors. The concept of 'modernity' is still a significant driver. Yet, can we see alternative courses of action towards that which is perceived as 'modern' today? We would recommend more detailed research into antecedent circumstances and contemporary factors contributing to problems and alternative courses of action – how and by whom were the alternative scenarios discussed – if at all?

What can we conclude about our future health in light of the IWHA 2007 Conference, based on past efforts and processes of change, successes and failures? First, that the debate is not over, not even from the purely technical point of view. The debate is also closely to the economic aspects of sanitation and health. For instance, sanitation and wastewater management have suffered from institutional fragmentation from very early on and still do. Whilst water supply has been a pleasant and potentially profitable activity, wastewater management has not. Many countries still face the dilemma: who should be in charge of

sanitation and wastewater management? Why is it still easier to talk about and invest in water services than in sanitation?

Theoretically, sanitation planning and wastewater management interventions and policies (public health goals and pollution control) should be integrated into urban and environmental/river basin development, even into water resources management. Ideally, holistic thinking results in the most effective identification of infrastructure needs, control, incentives, interventions, and allocation policies. It should also address social objectives within the framework of particular social, economic, political, technical and environmental constraints. From the economic point of view, this is too big a task, as it raises sensitive questions about land and property rights and sparks off environmental debates.

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