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# Wastewater Governance and the Local, Regional and Global Environments

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ABSTRACT: This paper introduces the themed section featuring selected papers from the 2017 World Water Week. The Week focused on 'Water and waste: reduce and reuse', in line with a circular economy, and embraced a broad set of perspectives relating to the challenges of water, sanitation and waste management. This paper reflects on the World Water Week theme and selected papers in the context of broader socio-environmental transitions, and how the governance of wastewater plays out at the local, regional and global levels. The papers explore the construction of engineering knowledge and its implication in pollution management, the monitoring of accountability in the provision of sanitation and water services and the way the equitable distribution of these services can improve girls' educational attainment. This introductory paper reviews trends in water use, wastewater and reuse, and situates these within an environmental transition framework, showing how pollution burdens and risks are displaced onto the poorest or more distant populations. While these socio-environmental transitions are fuelled by economic growth, it is the policy actions or the overarching framework of governance that set the direction. Broader political alliances can put the necessary regulation in place and channel investments towards the cleaning or protection of the local, regional and potentially also the global environment. Lessening the burdens on disadvantaged people, by extending services, and fragile ecosystems, by curbing pollution, would be the purpose of a socially inclusive, circular, green economy.

KEYWORDS: Wastewater, reuse, sanitation, governance, environmental transitions

## INTRODUCTION

Under the theme of 'Water and waste: reduce and reuse' the 2017 World Water Week[2] discussed water quality, sanitation and waste management as part of an overall focus on the circular economy. This themed section, featuring selected papers from the deliberations at the Week, considers knowledge of and approaches to recycling, waste and resource management and the role of accountability in water governance, as well as issues of basic sanitation and its critical importance in the educational attainment of schoolgirls. This introduction links these matters to broader socio-environmental transitions through which societies evolve, in terms of resource use and how pollution is handled or displaced. The distribution of benefits as well as burdens of resource use is determined by policy actions in close interplay with what is possible at different levels of economic development. A larger,

[1] The views expressed herein are those of the author(s) and do not necessarily reflect the views of the United Nations Development Programme.

[2] The World Water Week (WWW) is the largest annual global event on water. It focuses on policy-related issues and is celebrated in Stockholm in August/September every year. It is organised by the Stockholm International Water Institute (SIWI). Every year eight or nine seminars, based on the abstracts submitted, are organised by the Scientific Programme Committee (SPC) of the WWW.

more circular economy has the potential to satisfy human needs more equitably without overburdening ecosystems.

Like the World Water Week conferences, this themed section takes a policy-oriented and broad perspective on the water resources and waste management challenges ahead of us, with due recognition of the political, social and economic issues implicated in the water and waste nexus. The World Water Week also relates to the annual theme of UN-Water,[3] albeit with a slightly broader focus. UN-Water's World Water Development Report in 2017 focused on *Wastewater: The Untapped Resource*, suggesting that:

> In the face of ever-growing demand, wastewater is gaining momentum as a reliable alternative source of water, shifting the paradigm of wastewater management from 'treatment and disposal' to 'reuse, recycle and resource recovery' (…) In the context of a circular economy, whereby economic development is balanced with the protection of natural resources and environmental sustainability, wastewater represents a widely available and valuable resource (World Water Assessment Programme, 2017: 1).

This introduction first reviews global trends relating to global water use, pollution and reuse and then reviews how these tendencies and the related thinking have evolved over time. This is then put into the perspective of socio-environmental transitions: how pollution, wealth production and distribution are intrinsically related but differently according to the geographical scale. It links this to how environmental injustice and intersecting inequalities must be addressed through purposeful and participatory, transparent and accountable governance. The conclusions argue for greater resource reuse in a socially inclusive, green, circular economy, harbouring the potential to enhance social and environmental justice.

## GLOBAL WATER, WASTEWATER AND REUSE TRENDS

The per-capita availability of water is continuously reduced as a consequence of global population growth. Yet, the major pressure on the world's water resources and ecosystems is exerted by continuous intensive use by high-income and high-consumption societies in conjunction with increasingly intensive use in growing economies. This intensification is partly due to new consumption patterns, involving increasingly water-intensive diets of people in regions that may be distant from the areas of production.

Two-thirds of the world's population live in areas that experience severe water scarcity – in terms of withdrawing more than is returned or replenished by a factor of two or more – for at least one month a year (Mekonnen and Hoekstra, 2016). Beyond this, discrepancies between water demand and availability stand to increase with increasing spatial and temporal variations of water cycle dynamics (IPCC, 2013; cited in World Water Assessment Programme, 2017).

According to AQUASTAT calculations from 1900 to 2010, the global population increased 4.4-fold, while water withdrawals increased 7.3-fold (from just over 500 $km^3$ to some 4500 $km^3$ during the same period) (FAO, 2016; cited in UN-Water, 2018). Yet, the trend of increasing water withdrawals has slowed down (UN-Water, 2018: 145). Present global water withdrawals are estimated at 4600 $km^3$ per year and are projected to continue to increase by some 20-30% to between 5500 and 6000 $km^3$ per year by 2050 (World Water Assessment Programme, 2018: 11; citing Burek et al., 2016).

The largest global water-using sector is irrigated agriculture, which, including livestock and aquaculture, accounts for nearly 70% of total withdrawals. Industrial water use accounts for nearly 20% and municipal uses nearly 10% (World Water Assessment Programme, 2017). Regional variation is huge, as sectoral use reflects climatic conditions and the structure of the economy, particularly the role

[3] UN-Water is the United Nations Inter-Agency mechanism for the coordination of the UN's work on water and sanitation.

of irrigated agriculture. Hence, agriculture represents over 80% of water use in Asia and Africa but just over 20% in Europe (FAO, 2016; UN-Water, 2018, Fig. 33, p. 150).

At the global level almost half of the abstracted water (44%) is estimated to be consumed by the product or the production process (in agriculture, principally through evapotranspiration). More than half (56%) is estimated to be returned, as drainage, runoff or effluents, to the environment and subsequently available for reuse by the same or other sectors. The agricultural sector is estimated to consume over half of the waters abstracted, whereas industry returns over four fifths of withdrawals and municipal users nearly three quarters (World Water Assessment Programme, 2017, based on; FAO, 2016; Mateo-Sagasta et al., 2015, and; Shiklomanov, 1999). The quality of the return flow greatly determines the possibilities for reuse.

With increasing water scarcity, return flows have the potential to become an increasingly important and reliable source of water. Water reuse for agriculture has, of course, been practised for thousands of years (Angelakis and Gikas, 2014; Cairncross and Feachem, 1993; Jaramillo and Restrepo, 2017; Tzanakakis et al., 2007; World Water Assessment Programme, 2017). While the understanding of, and concerns around, the safety of reuse is growing, its practice is fundamental in addressing water scarcity and continuously increasing demand.

Given that a large share of the world's cropland is situated relatively close to urban areas there is a potential for increased wastewater reuse, albeit with a commensurate risk of the unsafe practice of irrigation with untreated wastewater. An assessment by Thebo et al. (2017) suggests that over a quarter of irrigated croplands are located downstream of, or within, an urban area and two thirds of these have high levels of dependence on urban wastewater flows. There is a strong likelihood of untreated wastewater being used for irrigation in these areas, most of which are located in countries such as China, India, Mexico, Pakistan and Iran. The use of untreated effluents for irrigation is also a concern in the Sub-Saharan Africa region, where fertiliser use is very low, and the scant information about reuse relates to the use of polluted water (Sato et al., 2013). In Latin America, where the sewage connection rate is generally high, there is great potential for safe reuse (Mateo-Sagasta, 2017). Yet, at present, rather than being driven by water scarcity, reuse in this region is seen as a low-cost source of plant nutrients (Jiménez, 2008; cited in Sato et al., 2013).

The most intensive and increasing reuse – commonly with treatment (of variable quality) – seems to be undertaken in water-scarce countries in North Africa and the Middle East. According to Sato et al. (2013), over half of the treated wastewater in these areas is being used for irrigation. Several countries have proactive policies and monitor water scarcity and reuse. Some carry out at least secondary treatment prior to use in agriculture (League of Arab States et al., 2016; UN-Water, 2018).

While the earliest and most common use of recycled water is agriculture, the range of areas for reuse widens with economic diversification. This includes urban landscape irrigation, groundwater recharge (including as protection against seawater intrusion), commercial and industrial use and environment and recreation, as well as energy production and further treatment for direct potable use (NRDC and Pacific Institute, 2014; Angelakis and Gikas, 2014). The most intensive reuse is undertaken in water-scarce countries. In Israel over 80% of treated wastewater effluent is reused, with Spain as the runner-up, recycling some 20-25% of its water (Angelakis and Gikas, 2014; Walton, 2016; Fluence, 2017). Namibia and South Africa have pioneered the reclamation of water for direct potable use, and the internal treatment and recycling in industry (World Water Assessment Programme, 2017). In Singapore, where recycled water is treated to drinking-water standards, NEWater meets 40% of the nation's water needs (Angelakis and Gikas, 2014; PUB Singapore's National Water Agency, 2018).

While treatment and reuse are on the increase it is nevertheless estimated that over 80% of the world's wastewater is released without treatment. Whereas data is scarce and regional variation is large, the global review by Sato et al. (2013) suggests that high-income countries on average treat 70% of the wastewater generated (from domestic, commercial and industrial effluents, storm water and other urban run-off), followed by upper-middle-income countries treating some 38% and lower-middle-income countries 28%. In low-income countries it is estimated that only 8% of wastewater is treated. The regional variance outlined by Sato et al. (2013) points to important differences between countries of different levels of income. Thus, part of the challenge is to implement affordable sewage treatment so as to increase treatment and safe reuse of wastewater.

The lack of treatment or general load of pollutants to the world's water bodies is not only an opportunity lost in terms of unrecovered resources; the build-up of pollutants affects the functioning of the water-related ecosystems. While the increasing dependence on fertilisers containing nitrogen and phosphorus since the 1950s has increased agricultural yields, it has also contributed to substantial releases into waterways and groundwaters. Combined with comparable losses from livestock (manure) the nutrient loads in rivers, lakes and coastal zones have contributed to eutrophication, algal blooms and hypoxic, deoxygenised dead zones in freshwater and marine ecosystems (Hudson and Whalley, 2012; Vitousek et al., 2009). Dead zones due to nutrient overload are proliferating in the coastal waters of long-established economies in Europe, North America and East Asia. Areas starved of oxygen in open ocean and coastal zones have soared since the 1950s (Breitburg et al., 2018; Carrington, 2018).

There is large variation in water and wastewater management practices. The sustainability, acceptability and safety of practices of reusing the water, nutrients and other resources contained in wastewater are intrinsically linked to the broader system of water supply and sanitation system management, which varies greatly according to income level. Such systems are a manifestation of societal development and produce differing sets of social, economic and environmental challenges over time and as economies grow.

## THE DISTRIBUTION OF POLLUTION AND WEALTH OVER TIME

The linear metabolic flows introduced by modern water pipes and sewers have greatly supported the epidemiologic and demographic transition to today's substantially healthier societies. Yet, modern sewers are also responsible for severing the links between the production and consumption of food and depriving agricultural systems of necessary nutrients and waters. These broad socio-environmental transitions have many stages and evolve as a consequence of the prevailing economic system, in iteration with engineering approaches and the environmental policies in place to govern it.

In this volume Beck et al. (2018, this volume) review historic and contemporary conceptions of water and environmental engineering. They look at how different schools of thought, or rationalities, referred to as hierarchist, individualist, egalitarian and fatalist, have influenced choices. One question they ask relates to the importance of language in thoughts and choices: what difference does it make whether we refer to 'wastewater treatment plants' or 'water resource centres' (or 'sewage farms')? The authors discuss plural rationalities, i.e. multiple ways of seeing the world and acting in it, as well as how plural voices come to the table. They argue that recognising the many viewpoints and voices increases the set of possible pathways and that this is needed with respect to pollution control and resource recovery. Hence, rethinking and(re)testing of dry sanitation and the recovery of nutrients from urine should be able to challenge the centralised wastewater infrastructure that has developed since the introduction of the water closet – locking large parts of the world into the water-based paradigm of sanitation (Beck et al., 2018).

In their historic overview of sanitary engineering Beck et al., outline the previous 'symbiotic' recycling loop in Paris, where waste matter, particularly excreta, was considered raw material, and generated real profit. As explained by Barles (2007), discharging excreta into the river was out of the question in the early 1800s. During the latter part of the century this came to be upset by domestic water supply, making night soil increasingly liquid and difficult to handle and turn into fertiliser. By the 1920s domestic water supply had become standard, and excreta were considered worthless waste, leading to the long-lasting pollution of the Seine.

The severing of the link between sanitation and food production was very much lamented by Victor Hugo, who, in 1862, reflected on the political economy of the newly constructed sewers of Paris:

> Each hiccup of our cloaca costs us a thousand francs. From this two results: the land impoverished and the water contaminated. Hunger rising from the furrow and disease rising from the river (Les Misérables, p. 1257 in Signet Classics paperback edition).

However, as excreta came to be displaced from the human living quarter to the ambient waters the threat to human health was actually reduced. Also, while local nutrient cycles were indeed severed, during the coming centuries agricultural production was to outpace food demand by far, initially with nutrients from imported guano and later through the production of synthetic fertilisers. Despite the severity of present-day ocean pollution, and the fears expressed by Victor Hugo, this transition was to be called the 'sanitary revolution'. Largely produced by the extension of modern sewers, it was chosen as the greatest medical advance since the 1840s, as voted by readers of the British Medical Journal in 2007 (Ferriman, 2007).[4]

This complicates matters, as the sewers removing faeces from urban neighbourhoods have been life saving at one end, while undermining aquatic life and (by extension) human livelihoods at the other. Also referred to by Beck et al., the river Rhine is another illustrative example of how excreta from urban settlements came to be deposited in rivers, with far-ranging effects on river water quality. The British poet Samuel Taylor Coleridge reflects on this in the last verses of his poem 'Cologne' (cited in McGranahan et al., 2001):

> The river Rhine, it is well known,
> Doth wash your city of Cologne;
> But tell me, Nymphs, what power divine
> Shall henceforth wash the river Rhine?

According to Beck et al. (2018), the activated sludge process was to become, if not a divine power, at least the signature technology of 20th-century municipal wastewater treatment. The focus was on reducing the pollution of the receiving water. Hence, nutrient *removal* came to be a cornerstone of the command-and-control (hierarchist) paradigm, substantially locked into the technologies of the water closet, sewers and centralised wastewater treatment plants. Resource *recovery* seems to have been put on hold in modern 20th-century economies.

Since then an enormous increase in artificial fertiliser production, made possible by the Haber-Bosch process producing ammonia from atmospheric nitrogen, has altered the nitrogen cycle at a global scale (Hudson and Whalley, 2012). The cheap nitrogen fertilisers produced in this way did not put any pressure on society to reuse or recover nitrogen from wastewater. It seems that before natural resources run out society has to deal with the disposal of waste. Markets provide little incentive to restrain disposal, so, with regard to fertiliser pollution, restraint must be guided by regulation. The necessary reduction in nutrient release into water bodies is more likely to be driven by environmental concerns about pollution and eutrophication rather than the scarcity of resources or rising fertiliser prices. Although dispersed, the looming disposal crisis is approaching at an alarmingly persistent pace (Wärneryd et al., 1995).

The issue of chemical pollution also gives rise to a need for agreed water quality goals and accompanying regulation. In relation to the Rhine, events like the Sandoz chemical spill in 1986 (where

[4] "A total of 11,341 people voted on the shortlist, which was chosen by a panel of experts from a list nominated by readers. Almost a third of the voters were doctors […] The work of the 19th century lawyer Edwin Chadwick, who pioneered the introduction of piped water to people's homes and sewers rinsed by water, attracted 15.8% of the votes, while antibiotics took 15%, and anaesthesia took 14%. The next two most popular were the introduction of vaccines, with 12%, and the discovery of the structure of DNA (9%)" (Ferriman, 2007).

toxic agrochemicals were released into the river, causing it to turn red and killing some half a million fish, including entire species (BBC, 1986)]), spurred action and broader collaboration in the protection of riverine ecosystems. In the water sector, this also made way for more 'egalitarian' thinking with regard to 'ecological' engineering, and some rediscoveries of forgotten thinking (Beck et al., 2018). For pollution management to be effective, broader societal goals around water quality objectives are critical (World Water Assessment Programme, 2017).

Since the 1970s the modern environmental movement has increasingly influenced (environmental) politics and policy. The treatment of wastewater has faced increased regulation (Finger and Allouche, 2002).[5] Rivers are also significantly cleaner in many affluent cities, as citizens want to enjoy fishing and recreation. When the cleaning of the Thames began in London most of the complaints recorded in 1866 by the Royal Commission on the Prevention of River Pollution were from amateur and professional fishermen claiming that their sport or livelihood was endangered (Kjellén and McGranahan, 1997; Wohl, 1983).

Nitrogen concentrations in surface waters are often persistent, so remedial action is always urgent. The Baltic Sea suffers from eutrophication reflected in recurring algal blooms; yet, despite concerted efforts since the 1970s, the problems remain. While the total input of nutrients to the Baltic Sea has reduced since the late 1980s – currently at a level equal to that of the early 1960s (HELCOM, 2015) – the concentration of nutrients in the sea has not declined accordingly. Groundwater releases and other factors affect concentrations (UN-Water, 2018).

The Black Sea, on the other hand, experienced unprecedented degradation in the 1990s, with widespread nutrient loading causing a large dead zone. The main sources were agricultural runoff and domestic and industrial waste, principally from the Danube River. This caused losses of aquatic life and a reduction in the total fish catch from 850,000 tonnes in the mid-1980s to 250,000 tons by 1991. Thanks to investment in pollution-reduction measures, nitrogen and phosphorus emissions fell by 20% and 50% respectively between 2003 and 2018. The efforts have resulted in a reversal of the massive dead zone at the northwest shelf of the Black Sea (UNDP, 2015).

## STYLISED SOCIO-ENVIRONMENTAL TRANSITIONS: SHIFTING ENVIRONMENTAL BURDENS

Looking at the broader changes in water and environmental management, burdens and risks fall differently on different constituencies across geographic scales. As summarised by McGranahan (2013), what is most striking about the urban environmental-risk transition – a socio-environmental transition – is its shift from local environmental burdens, which pose direct health risks to humans, to global burdens, which pose indirect health risks through their effects on life-support systems. This shift was originally conceived as a stylised summary of available empirical statistics showing how (mostly urban) environmental burdens vary with per-capita national income (McGranahan et al., 2001).

At one end of the spectrum the main household-level (localised human health) burdens, including ill health produced by a lack of access to potable water and sanitation, tend to diminish as national per-capita income rises. At the other end the main global burdens – those imposed on a global scale by a nation's economic activities, including greenhouse-gas emissions driving global warming and causing sea-levels to rise, and hypoxic zones in the ocean – tend to increase with income.

In between, city-scale or regional burdens, such as the pollution of urban waterways beyond local neighbourhoods, in many cases correlate with the nation's level of economic activity in an inverted U-shape when plotted against per-capita income. That is, river pollution typically increases first with growing economic activity but then decreases with further economic growth. In low-income societies

[5] More stringent environmental regulation also added to the investment needs of water utilities, contributing to the drive towards privatisation in the 1980s and 1990s (Finger and Allouche, 2002).

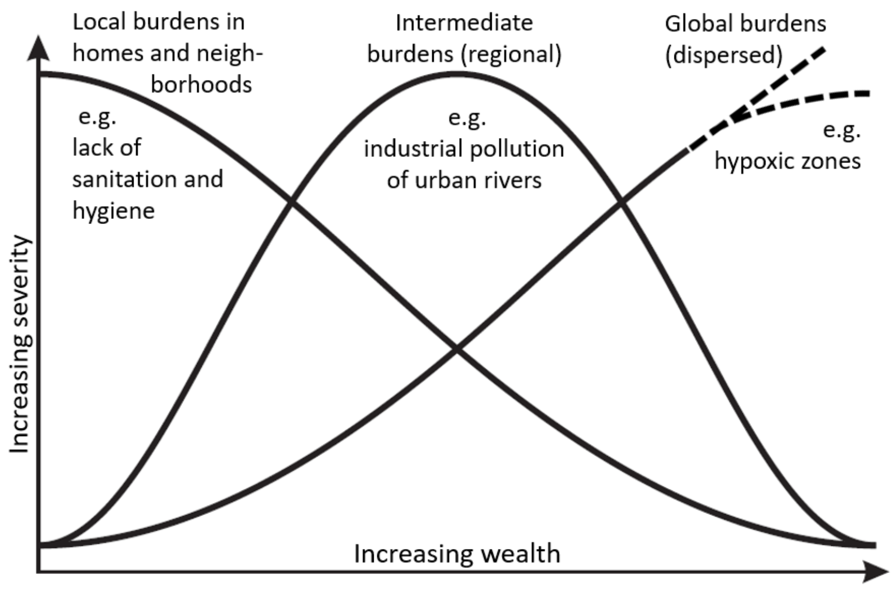
without extensive sewers excreta are retained in homes and neighbourhoods, producing local burdens, while the 'intermediate'-scale burdens remain low. With incipient growth – often accompanied by the extension of sewers and sewer connections – the capacity to displace pollution burdens from the local to the regional increases. This reduces local health risks, but unless sewage is treated it will be at the expense of the regional environment. In wealthier societies (with high consumption though not necessarily production) there is compelling popular pressure to ensure cleaner surroundings beyond the local neighbourhood (Marcotullio and McGranahan, 2007).

High-income countries tend to have more stringent environmental regulation and greater investment in wastewater treatment. Whereas the imposing and enforcing of environmental regulation can lead to the displacement of polluting industry (which may then continue operations in countries with less stringent regulation or enforcement), well-crafted regulation should also encourage additional investment, e.g. into sewage treatment or 'cleaner production'. In effect, these trends taken together lessen the regional environmental burdens, as high-income societies often improve the water quality of their rivers. (Marcotullio and McGranahan, 2007; McGranahan, 2013; McGranahan et al., 2001). A similar tendency can be found in relation to plastic pollution, where the top polluting rivers, as modelled, are found in Asian middle-income regions where there is greater mismanagement of plastics (Lebreton et al., 2017)

Historically, wealthy societies have contributed the most to the contamination of the broader environment. While today's high-income societies typically present the healthiest local living conditions, and more recently with river clean-ups also cleaner regional environments, they continue to contribute to the global pollution burden by consuming imported goods. The pollution released in the process of export production contributes to local and regional environmental burdens far from the point of consumption.

The displacement and shifting of environmental risks or burdens across geographical scales also involve qualitative shifts with regard to the type of problems or issues at hand. Figure 1 stylises the shift of issues and their severity across scales, from the local to the global, in relation to economic development.

Figure 1. Stylised environmental transitions on different geographic scales.




Source: Adapted from McGranahan et al. (2001), Figure 2.1, p. 17.

The logic of displacing environmental burdens spatially, which to some extent also relates to the sheer size of settlements, is fairly straightforward:

> Cities and their citizens cannot sustain themselves by drawing only on the resources within the city boundaries, and with increasing water use, sources further and further afield are tapped. Similarly, the wastes cannot be absorbed within the city, but are displaced to the surrounding ecosystem. In the quest for new clean water and ways of disposing wastes, cities may appropriate both historical and spatial hinterlands, and through over-exploitation or pollution, undermine ecosystems and people's livelihoods far away in space and into the future. The capacity to displace environmental burdens increases with wealth and the development of centralized water supply and sanitary systems" (Kjellén and McGranahan, 1997: 21).

Spatial shifting enables people to avoid the environmental consequences of increased production and consumption – at least locally (McGranahan, 2013). Generally, it is the same type of pollutant that has a different effect depending on where it 'surfaces' and in what processes it is used. Human excreta spread disease in the local environment, over-nutrify and foul local and regional rivers and contribute to algal blooms and dead zones in the distant ocean. Wealthy societies have the capacity to displace pollution problems, for example with long sewage outfalls dumping into the sea, but also to solve them through treatment and reapplication into the economy.

With increasing wealth societies have consistently managed to clean their living environments and then beyond this to the regional level. To a great extent pollution has been resolved with dilution, or displacement and dispersion onto broader hinterlands. However, the safe reuse of water and nutrients represents a solution to the problem of dispersion, which is reaching its limits as dead zones build up along coasts and in the ocean (Breitburg et al., 2018; Hudson and Whalley, 2012). In Figure 1 above, the third graph depicting 'global burdens' has an open-ended trajectory as the fate of the continued increase of globally dispersed pollutants is uncertain, and the examples of reversals of hypoxic areas are few. However, the United Nations Special Envoy for the Ocean, Peter Thomson, feels that matters will be resolved:

> I am confident that, by 2030, we will have reversed the negative cycle, and that we will restore our relationship with the ocean to one of respect and balance. My confidence is based on the fact that we have a comprehensive plan to save the ocean, agreed to by all 193 UN member states in 2015 – the Paris climate agreement and the UN's sustainable development goals (SDGs). Fidelity to these is the prime responsibility of all us living in the 21st century. I do not doubt the force of that fidelity, for humankind always bends in the direction of survival (Speaking at World Economic Forum in May, 2018).

A belief that humanity will solve the problem of global pollution can be built on examples of how it has already resolved many local and regional environmental issues. Indeed, this is depicted in the first two burden graphs in figure 1 that turn down as economic development progresses. This broader tendency fits well with the 'ecological modernisation' school of thought, which suggests that environmental improvement and economic growth are mutually supportive.

However, what makes economic growth compatible with environmental improvements lies in the broader realm of regulation, spearheaded by government authorities, which can serve to internalise the otherwise externalised costs of environmental pollution. Again, guiding economies to become greener or more inclusive, for example by redistributing benefits, requires state action, and political alliances to bring that action about. One of the few global environmental issues that has been 'resolved' or at least reversed is the 'ozone hole'. Global emissions of ozone-depleting substances fell dramatically after the adoption of the Montreal protocol (Cole et al., 1997; Marcotullio and McGranahan, 2007), as halons and chlorofluorocarbons were phased out of production and consumption. This was a feat of concerted national efforts and exceptional international collaboration.

Prioritising circular over linear approaches will involve learning, re-learning and the re-discovery of traditional knowledge. A range of papers at World Water Week explored institutional arrangements for managing water quality, as well as for addressing potential hazards relating to wastewater reuse. Several Nordic initiatives for and research into the reduction of pollution and enhancement of circular flows were presented (Gadegaard, 2017; Thomsen, 2017). The roles, responsibilities, beliefs and actions of governments, companies and citizens are all important. The UNDP-SIWI Water Governance Facility (2018) summarised a set of experiences presented at the Week, with lessons on balancing different interests in wastewater governance.

The example of Bhuj was presented. This experience from a city of some 200,000 people in the semi-arid region of Kutch in Western India illustrates the transition from a locally supplied urban area to one drawing from distant sources (Mehta et al., 2017; C-WAS, 2017). For centuries adjoining catchments had been linked up to supply the city, as managed by local rulers also looking into the potential for water harvesting. With the introduction of piped water in the 1960s, however, per-capita water use increased significantly, and water came to be drawn from increasingly distant sources, including the Narmada River some 900 km away. At the same time the historic system of interlinked lakes became highly polluted from wastewater discharge, or filled up altogether by debris and made available for urban expansion.

In recent years Bhuj's water system has failed to cope and citizens have suffered from poor water quality and insufficient quantity, for example with intermittent supply. The authors suggest that the disintegration of the traditional water system and the higher dependence on external sources are the main reasons for the present crisis. The solution is seen to lie in the retention and reuse of existing water sources and improving groundwater quality, as well as in the regulation of the losses and thefts from the piped system. Further, regulations now demand greywater recycling and reuse for newly developed large institutional and commercial buildings (Mehta et al., 2017; C-WAS, 2017).

Another example of a much larger city having far outgrown its local water sources, Mexico City has been dubbed the "epitome of regional environmental displacement" (McGranahan et al., 2001: 62) for the way it pumps its waters from distant basins, overcharges its aquifer and releases effluents into other basins (Anton, 1993; Connolly, 2007). Despite the increase in wastewater treatment capacity, most of the wastewater produced by Mexico City is still discharged without treatment and used downstream for agricultural irrigation in the Tula River Basin. CONAGUA's 2030 water plan for Mexico City proposes the integrated and sustainable management of basins and aquifers, improved efficiency in the use of water resources and increased water quality in basins and aquifers (CONAGUA, 2012). There is also general agreement on the need to implement innovative management practices for the safe utilisation of the large sewage flows generated by the city. In order to succeed, however, it is necessary to resolve issues of policy, administration (such as fragmentation and jurisdictional conflicts) and public participation (Martinez and Bandala, 2015).

Obviously, the broader trends and tendencies obscure societal inequalities in access to basic services. In relation to Mexico City, while many areas are well supplied with water others suffer chronically poor water services to the extent of causing social conflict (Martinez and Bandala, 2015). In terms of socio-environmental transition, societies with greater inequality tend to have the full set of issues to grapple with at the same time.

## GOOD WATER GOVERNANCE: REDUCING INEQUALITY AND ENVIRONMENTAL DAMAGE

Environmental governance – not least water governance – has emerged as a key concept over the past few decades. This is in recognition of the changing role of the nation state, with its reduced influence in a globalised and interconnected world. At the local level it is reflected in how citizens often do not rely on the state alone to provide for them but draw on networks, alliances and partnerships to access services (Franks and Cleaver, 2007). The term 'governance' (rather than 'government') denotes the importance of this wider set of actors that co-create development outcomes along with new forms of process-oriented societal co-steering through partnerships and dialogue (Tropp, 2007).

In relation to water, the government – governance transformation is not only linked to the search for alternative forms of social organisation but also to the increasing pressures on and conflicts around the resource. As traditionally water-abundant and open river basins have closed, meaning that no more (new) water is available to allocate (Comprehensive Assessment of Water Management in Agriculture, 2007), the debate shifts from a technical/physical one of how to abstract, use and 'develop' available waters to a political one about "who should get how much water" (Niasse, 2017; citing Chartres and Varma, 2010). Following Beck et al., in this volume, increasing water scarcity has contributed to a move from ('hierarchical') water management, focusing on technical, hydraulic engineering solutions, to broader (potentially 'egalitarian' or inclusive) water governance processes and responses.

Regarding the global governance of water and related service provision, the most recent decade has firmed up a set of frameworks: the 2030 Agenda (United Nations, 2015b) and the recognition of the human rights to water and sanitation (United Nations, 2010) affirm the importance of universal access to safe drinking water and sanitation. The human rights to water and sanitation include normative standards for the substantive contents (what kind of services are citizens entitled to?) and procedural rights, such as the principle of non-discrimination and the access to information, which regulate the process of how such services are provided. The recognition of the human rights to water and sanitation also reaffirms the role of the nation state – the primary duty bearer – as the guarantor of these rights.

While state actors need not directly provide services, they are responsible for assuring the adequate enabling environment so that everyone is able to access sufficient, safe, acceptable, physically accessible and affordable water (United Nations, 2002) and sanitation which is safe, hygienic, secure, socially and culturally acceptable and which provides for privacy and dignity (UN-Water, 2015). Whether governments are (progressively) putting (all available) resources into this endeavour is being monitored, for example by the UN-Water Global Analysis and Assessment of Sanitation and Drinking-water (GLAAS), which releases periodic reports on issues of water governance, financing and related 'means of implementation' (World Health Organization, 2010, 2012, 2014, 2017).

The article in this section by Jiménez et al. (2018) analyses the 2014 GLAAS questionnaire, looking into quantitative and qualitative responses relating to 'accountability'. It explores accountability in terms of how elected officials or 'those in charge' of providing access to water supply and sanitation services are to be answerable to those they serve (UNDP Water Governance Facility and UNICEF, 2015b). Accountability is crucial in the provision of services, since they must continue to function effectively, and the sustainability of service provision is highly problematic, particularly in poor, rural areas (European Court of Auditors, 2012; RWSN, 2010).

The discussion, which focuses on 'responsibility', 'answerability' and 'enforceability' (categories also found in a related reference guide for programming, see: UNDP Water Governance Facility and UNICEF, 2015a), finds (national) sector leadership to be fragmented, with incomplete definition of roles, and external support agencies to be trapped in a choice between supporting existing (national government) systems or working through (presumably more efficient and reliable) parallel systems. Again, rural sanitation falls behind: Jiménez et al. (2018) find the absence of a clear service delivery framework for rural sanitation to prevent progress towards a safely managed service.

Accountability also relates to the importance of moving from words to action, i.e. proactively taking responsibility for action (or inaction). The latest version of GLAAS (World Health Organization, 2017) focuses on the critical aspect of financing. Whereas policy-implementation gaps have multiple and contextual explanations, the 2017 report illustrates how financing, as well as monitoring, falls short of proclaimed policy goals. Of the 74 responding countries 74% had policies and plans specifically aimed at reaching poor populations. However, when it came to monitoring, only 55% tracked and reported the progress in extending services to poor populations in relation to water, and 47% in relation to sanitation. The greatest gap, however, was found in the application of financing to target poor populations. For water, the consistent application of means towards the poor was present in 27% of the countries, but for sanitation only in 19% (World Health Organization, 2017, Table 12, p. 42)

Good governance should in general help investment in water and sanitation services to become more equitable, targeted and sustainable. This means that systems should be managed in such a way that they continue to deliver services to those in need. In addition, a well-governed system of service provision should be able to expand with population increase and respond to new values and demands. With faltering management, often due to an unsupportive governance framework, service coverage diminishes as systems fall into disrepair. Hence, investing in institutional capacity may be a more efficient way to achieve sustained growth in service coverage compared to direct investment in physical infrastructure (Water Governance Facility, 2015).

Since 1990 2.6 billion people globally have gained access to an improved drinking water source, and 2.1 billion to an improved sanitation facility (WHO and UNICEF, 2015). Starting from a lower level of access the rate of increase is more rapid for sanitation, but basic sanitation service coverage remains lower than for basic water. The present rate is insufficient to reach universal basic sanitation by 2030 (WHO and UNICEF, 2017: 14). As the priority remains to provide services to the 'have-nots' and the consequent elimination of the practice of open defecation, the 2030 Agenda and the recognition of the human rights to water and sanitation have also turned the focus towards inequalities.

The gaps between rich and poor are generally larger for sanitation than for drinking water (WHO and UNICEF, 2017: 38). Many countries also have one or two geographical regions that stand out for notably higher or lower coverage than the national average, which is an important measure of inequality (p. 30). There is a very clear connection between household income and the relative level of access to water and sanitation services: listings by wealth quintiles clearly show how the poorest are deprived of services in conditions of inequality. Again, the gaps are generally larger for sanitation (WHO and UNICEF, 2017: 52-53).

The lack of access to water and sanitation services produced immediate burdens on human health locally, as discussed above. Cholera is a case in point, whose "hotspots" are "specific and relatively small areas where the cholera burden is most concentrated (…)" (GTFCC, 2017: 7). The Task Force Roadmap also illustrates the link between lower use of basic drinking water and sanitation services and the presence of cholera (at the national level, Figure 1, p. 7). In terms of socio-environmental transitions, to escape from the situation with localised human health burdens, authorities need to extend and maintain basic services to those who need them. This points to the importance of (transparent and participatory) governance in assuring that human and financial resources are spent in ways that fulfil their purpose.

Global poverty has been greatly reduced in both absolute and relative terms over the past few decades (United Nations, 2015a). Yet, it remains multifaceted and involves much more than the lack of income. Endeavours to capture the more complex view of poverty and inequality, with multiple and intersecting deprivations (Narayan, 2000), include the multidimensional poverty index, which combines measures of health, education and living standards – including water and sanitation (UNDP, no date). The greater concern for multidimensional deprivation and disparities between socio-cultural groups is similarly reflected in the monitoring of access to water and sanitation. As well as looking much more closely into the disparities between and within countries, the whole area of access to water and sanitation in the public sphere is now included in global monitoring. Some 'institutional WASH monitoring' relates to Agenda 2030 and highlights interlinkages between goals and targets, as, for example, between educational efficiency and the provision of water and sanitation in schools (WHO and UNICEF, 2017).[6]

While still in the process of expanding its data bases, serious shortcomings relating to water and sanitation service coverage in schools and health centres are being found. Preliminary data suggest that the provision of water and sanitation (particularly sanitation) is more neglected in schools for younger children (WHO and UNICEF, 2017). This is congruent with global poverty data suggesting that young children are overrepresented among the poor (Newhouse et al., 2016; World Bank Group, 2016).

In this themed section Agol and Harvey (2018) put the spotlight on the importance of water, sanitation and hygiene in schools and how they affect educational attainment, in particular that of girls. Their study touches upon one of the lynchpins of sustainable development, as they test the hypothesis that improved water, sanitation and hygiene in schools can improve education for teenage girls. They draw on data from over 10,000 schools in Zambia. As found in a previous analysis by Agol et al. (2017), the study suggests that improving sanitation services in schools means girls especially will be less prone to drop out or repeat years. While less dramatic, this supports results like those of Freeman et al. (2012) which suggest that (in the case of Kenya) appropriate hygiene promotion, water treatment and access to sanitation substantially increase the school attendance of female students.

The additional importance of convenient and safe sanitation for females relates in part to gender-based violence and the additional risk of assault or stigma due to a lack of privacy (House et al., 2014) and partly to the additional needs of menstruation hygiene management (Sommer et al., 2013). Greater privacy was put forward by Cambodian schoolgirls as something that would allow them to comfortably and confidently manage menses within the school environment (Connolly and Sommer, 2013). The lack of convenient facilities for adolescent girls can make this vulnerable group feel isolated in schools, with a potential impact on enrolment, absenteeism and a lack of pupil safety (Antwi-Agyei et al., 2017; UNICEF, 2011).

The gender inequalities in water and sanitation permeate society, be it domestic water-fetching chores (Geere and Cortobius, 2017) or the existence and accessibility of services in institutions such as schools and work places or in public spaces (House et al., 2014). Gender roles are also evident in work practices and the safety of wastewater use: in many cultures women are responsible for wastewater application (World Water Assessment Programme, 2017, Box 2.2, p. 27). One example is the division of labour in parts of China, where the responsibility for carrying the household's excreta from the home to the field was assigned to the daughter-in-law (Cairncross and Feachem, 1993).

Governments have a central role to play in water governance in order to create an enabling framework for all other actors to work more constructively, as well as to ensure that the qualities of non-discrimination, equity and sustainability are applied (Comprehensive Assessment of Water Management in Agriculture, 2007; Mitchell et al., 2017). Again, it is governance actions that can steer development towards the minimising of environmental pollution, the decoupling of water use from production and, above all, ensuring that the benefits are more equally distributed throughout society.

## CONCLUSION

Being a policy-oriented conference, the World Water Week in 2017 showed that planning, action and monitoring, as well as the building of alliances to overcome diverging interests, are needed to ensure success in achieving the SDGs and to address problems ranging from water scarcity to the lack of dignified sanitation facilities in schools.

[6] The WHO/UNICEF Joint Monitoring Programme also collects data for Sustainable Development Goals indicator 4.a.1 "Proportion of schools with access to […] (e) basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions)".

The intersecting inequalities manifest in the neglect of the sanitation needs of girls and the way that household chores fall hard on women. They highlight the need for socio-environmental transitions towards universal access to basic services. At the same time accountable governance – not only to the present mandates but also for wisely pursuing long-term sustainability – should pursue greater resource use efficiency and ecosystem protection, including the safe reuse of water and related resources.

The papers in this section demonstrate how different ways of thinking about water, wastewater solutions and the broader socio-technical systems influence the choices that are made and the infrastructural paths being trodden. With regard to wastewater and health, several interventions at the Week focused on the fact that too much pollution, both chemical and pathogenic, enters the water cycle today and remains untreated before disposal or reuse (SIWI World Water Week, 2017a). The conference emphasised the importance of understanding all dimensions of wastewater management to progressively reduce health and environmental risk and optimise control throughout reduction, removal and reuse (SIWI World Water Week, 2017b).

A whole palette of policy instruments will be required for society to move towards a greener economy (World Water Assessment Programme, 2017). Merely raising the environmental standards of national regulatory frameworks faces the problems of poor compliance, weak enforcement and illicit practices. When rigorously pursued it may also affect the local economy, if industry relocates or if larger businesses with a greater capacity to invest and comply are favoured at the expense of small-scale enterprise (Blomqvist, 1996). Environmental regulation also requires international coordination and coherence to avoid the simple relocation of polluting activities.

Wastewater, however, is not only a source of pollution but can be, and often is, turned into a resource. With escalating water scarcity, principally from population increase, economic growth and changing consumption patterns exacerbated by changing climates and land degradation, wastewater is *the* water resource yet to be tapped (World Water Assessment Programme, 2017). Whereas climate change renders many freshwater sources less reliable, wastewater is geographically near, contains valuable energy and nutrients and may be unique in that it increases with additional use.

Building on cyclical rather than linear resource flows, we must convert to a greener economy not just to ensure sufficient resources for the world's growing population but to avert the ills of increasing pollution loads. Unless pollution is significantly reduced the water bodies it contaminates will become overloaded. The disposal crisis is already visible in vast areas in the oceans and beaches covered in plastics and is directly felt by way of collapsed fisheries in the hypoxic dead zones of lakes and seas. The long-term public benefits of a green economy are clear, but translating those benefits into short-term private interests – internalising environmental externalities – remains a challenge.

Purposefully crafted and skilfully implemented regulation and supportive policy measures are needed. The political alliances required to push these through vary at different scales. The local burdens caused by a lack of services invariably affect the poor, meaning a political commitment to 'leave no one behind' or 'go the last mile' must be made. This may be pushed by alliances with low-income communities but generally requires a broader social agreement on the way that benefits in society are to be distributed. At the regional level, the constituencies that have a direct interest in cleaner rivers or ambient water environments are those who rely on them for their livelihoods, as well as a broader public looking for recreation. Petitions by fisher communities or tourist operators may be important, but, again, concerted policy action for pollution reduction requires a broader social agreement on the value of a cleaner environment (World Water Assessment Programme, 2017).

Unfettered economic growth may lead to extremes of inequality and hubs of pollution. In the short run the flush-and-forget is a relatively inexpensive option that allows for rapid urban expansion without massive public investment. The dilution, dispersion and displacement of pollution, however, is no solution in the long run. It also contributes to environmental injustice by taking pollution away from wealthier settlements, where sewer connection rates are the highest, for release in areas with less influential citizens. The release of untreated wastewater, at some point, also increases the cost of drinking water treatment. While perhaps not the most powerful in society there are many groups that have a direct interest in a general reduction of pollution.

Infrastructure and technological advances have their path dependency as they build on past investments and lines of thinking. Plotting a course for the future, meanwhile, requires action in the political realm, which – in line with the shift from 'government' to 'governance' – will have to rely on broader social alliances. A broad-based social agreement is the best foundation for the crafting of regulation to guide the subsequent collective behaviour of independent economic and social actors in line with generally agreed values. The role of transparent and accountable governments is critical for an open public debate to determine sustainable paths for social services and environmental management. While the governance of wastewater may be complex, it harbours solutions for resolving problematic areas of water scarcity and achieving social and environmental justice.

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