



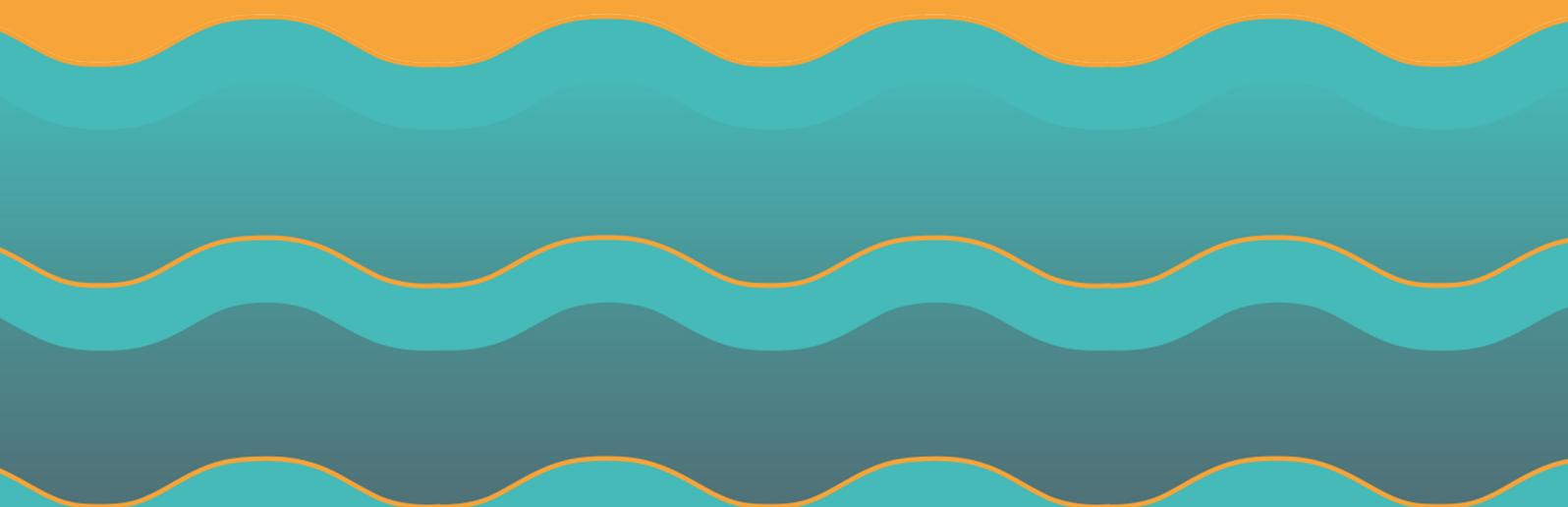
Working paper 520

# Future flows

## Global trends to watch on water and sanitation

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## Abstract

Global shifts in water and sanitation will have a profound effect on societies and economies. Other transformations are shaping these shifts, including where people live, what they expect from governments and markets, their productive and polluting activities, how they innovate and whether they pursue conflict or peace. Understanding these shifts and their interplay is important to achieving all of the Sustainable Development Goals, not just goal six on water and sanitation. In this paper we introduce ten global shifts that, in our analysis, present both challenges and opportunities for sustainable development, to 2030 and beyond.

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# Introduction

Water and sanitation will play a defining role in achieving the Sustainable Development Goals. From eliminating poverty and hunger to tackling climate change, water is central to tackling our biggest sustainable development challenges.

In this paper we identify ten global trends and issues in water and sanitation that are often overlooked by wider audiences. We draw on the work of others, but the paper also brings together over a decade of work undertaken by the ODI Water Policy Programme. This work is undertaken in collaboration with other ODI experts on topics from governance to humanitarian response, and from energy to gender. The paper follows on from another broad review of drivers and challenges relating to water and sanitation, focusing on equity and produced in 2014 (Calow and Mason, 2014).

The paper is primarily aimed at non-specialists, with an emphasis on overlooked issues and common misconceptions. We focus on issues that are plausible and important – changes that have a degree of path dependence from recent history and will have a meaningful effect on the lives of a large proportion of the global population.

Many projections point to a narrowing window of opportunity, whether to halt devastating climate change;

revolutionise food production systems; prevent further species loss, or reverse a tightening spiral of poverty and conflict which limits human potential in large parts of the world. Yet recent decades also show significant progress. Since 1990, the number of people living below the current international poverty line of \$1.90 per day fell from 1.85 billion to 0.77 billion in 2013 (World Bank, 2016a). 2.6 billion people gained access to an improved source of drinking water from 1990-2015, while in the same period 2.1 billion gained access to an improved sanitation facility (WHO and UNICEF, 2015a). We err towards optimism, and wherever possible, point to ways to manage challenges and make the most of the opportunities.

The rest of this report is organised into two halves, each with five short chapters. The first half identifies five challenges: enabling access to better services; tackling inequality; coping with demand and variability; managing water quality; and responding to conflict and migration.

In the second half we look to opportunities: harnessing water and sanitation for inclusive growth; using secondary cities to rethink service delivery; taking advantage of innovation in energy and communication; making water and sanitation services more effective in protracted conflict; and tapping the power of business.

# 1. Services

## The sustainable development goals signify a huge increase in ambition to unlock the benefits of water and sanitation

In the Sustainable Development Goal focusing on water, number six, there are two targets that aim for universal access to safe and affordable drinking water – target 6.1 – and adequate sanitation and hygiene (WASH) – target 6.2. The goal – ‘Ensure availability and sustainable management of water and sanitation for all’ – also covers many more water issues besides sanitation and drinking water. Yet these two targets are our starting point because they illustrate the level of ambition at the heart of the 2030 sustainable development agenda. They also relate to how most people interact with the resource in their daily lives, in meeting their most basic personal needs.

Targets 6.1 and 6.2 can also be compared to equivalent targets on drinking water and sanitation (although not hygiene) under the Millennium Development Goals (MDG 7c; See Table). Other aspects of water management did not have corresponding MDG targets. We have unusually good data for MDG 7c, and thus targets 6.1 and 6.2 across countries and over time, via the UNICEF and WHO Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene.

One increase in ambition applies across the SDG agenda: ‘universality’. That means the targets apply to all countries and aim to ‘leave no-one behind’. The emphasis on equity implies a fundamental rethink to both the political and practical challenge of meeting water and sanitation rights and needs. Because this is so important we will give it dedicated attention in the next section. For now, we will focus more on the aggregate numbers: the gap between current levels of access to quality services, and the 2030 targets.

The sanitation MDG target was always one of the most off-track. By the 2015 deadline 5 billion people had access to ‘improved’ sanitation (WHO and UNICEF 2017), which means they had access to a toilet, for their household



alone, of a certain technology type. Yet a third of the global population, 2.3 billion people, were left without access to improved sanitation.<sup>1</sup> That comprised everyone who shared an ‘improved’ facility (600 million); used an unimproved technology (856 million); and defecated in the open (the biggest share at 892 million).

The new emphasis on a ‘safely managed’ sanitation service in SDG target 6.2, and the higher service levels implied, mean a shortfall of 2.3 billion people nearly doubles, to around 4.5 billion people. That equates to more than three fifths of the 2015 global population – in other words, more people in the world currently lack safely managed sanitation than have it. That is because the ‘safely managed’ requirement asks, for the first time at the global level, what happens to human excreta once it goes into a toilet or latrine.<sup>2</sup> For a sanitation service to qualify as safely managed, excreta must be safely disposed of in-situ (in a pit that can then be sealed off, for example); or transported away in sewers, trucks or other means, and treated. Looking out to 2030, a conservative estimate puts

1 Technologies classified as ‘improved’ included flush toilet systems connected to sewers, tanks or pits; better categories of pit latrines; and composting toilets (WHO and UNICEF, 2015a). Improved technology types are more likely, but not guaranteed, to separate people from contact with faecal matter.

2 There are only 70 countries with comparable data on access to handwashing facilities with soap and water. In Sub-Saharan Africa available estimates suggest only 15% of the population have access to a basic facility to wash their hands (WHO and UNICEF, 2017).

**Table 1. Radical ambition: Comparing the drinking water and sanitation MDG and SDG targets**

	SDG Target	SDG Indicator	MDG Target	MDG Indicator
Drinking water	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services	7c Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation	7.8 Proportion of population using an improved drinking water source
Sanitation and hygiene	6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.1.2 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water		7.9 Proportion of population using an improved sanitation facility

Source: [www.washdata.org](http://www.washdata.org)

the number of unserved people to reach at 5.2 billion or more.<sup>3</sup>

On the water supply side, ‘safely managed’ services are again a step-change compared to what is currently on offer for nearly a third of the globe. In contrast with sanitation, the drinking water MDG target 7.8 was achieved at global level, but by 2015 over half a billion people still lacked access to an improved water supply.<sup>4</sup> A safely managed drinking water service is, however, one that is located on premises, available when needed and free from contamination. Once the ambition is extended in this way from access to a type of technology, to a service of a certain quality, the number unserved again jumps, this time nearly four-fold to 2.1 billion (30% of the global population). Again, a conservative estimate would put the number to be served by 2030 still higher, at 2.5 billion due to population growth.

Upping the ambition ups the costs. The World Bank estimates that basic services for all, a slight advancement on the old MDG ‘improved’ definitions, could be achieved with investments of around \$30 billion per year (within a \$13.8-46.7 billion range).<sup>5</sup> That is roughly in-line with total annual sector investment in the MDG period. Safely managed water and sanitation services require a threefold increase – closer to \$90 billion per year (\$60.9-122.8 billion). Costs for operations and maintenance are also significant and will become more and more so, as a proportion of total costs, as fewer people are left unserved. Costs may also be underestimated for two other reasons. First, service sustainability is already a big challenge

within the existing stock of infrastructure but the extent, alongside repair and rehabilitation needs, is not fully accounted for.

There are implications for natural resources, too. On the water side, getting everyone a safely managed service will likely increase domestic water consumption. Though difficult to test empirically, water on-premises leads to higher consumption. A recent cross country study found that households with a water supply on their premises used about 11 litres more per person per day, on average, than those collecting water from elsewhere (Evans et al. 2013). The higher standard of service will also require more energy for pumping and treatment, and more infrastructure to deal with wastewater in urban areas. On the side of sanitation, it is possible that safely managed services could recover water, nutrients and energy so that they have little additional impact on natural resources. But this kind of circular economy model represents a major break with the past.

Is the world prepared to spend \$90 billion per year to achieve this huge ambition? It is a sum equivalent to 0.4% of global product.<sup>6</sup> Those championing other basic and not-so-basic human needs will have their own bills to present. It is therefore imperative for the water sector to set out the benefits and opportunities if we are to persuade people and political leaders to meet the challenges and costs. That work must start now, at the beginning of the SDG era. We point to some of the ways to do that as we turn to opportunities in the second half of this report.

3 Assumes a share of the additional population to 2030 is born into households with access to safely managed sanitation, in line with the share of the current population with access to such services. This is likely to underestimate the number unserved because population growth will be concentrated in regions that currently have lower levels of access. The JMP must also rely on administrative data and assumptions to compute estimates for safely managed sanitation in many countries. We used data on WASH from the 2017 JMP update ([www.washdata.org](http://www.washdata.org)) and data on population projections from the 2017 World Population Prospects (<https://esa.un.org/unpd/wpp/>).

4 Including piped water within a household, yard or plot, public taps and standpipes, tube wells and boreholes, rainwater collection and wells and springs with a certain level of protection (WHO and UNICEF, 2015a).

5 Basic sanitation services include unshared improved facilities, with no criteria specified on safe containment, transport and treatment of faecal waste; basic water services include improved sources within 30 minute round-trip, with no specified criteria on quality or reliability. Basic hygiene services include simple handwashing facilities with soap and water. Achieving universal access to basic WASH services will be monitored as part of progress towards SDG Target 1.4: ‘By 2030, ensure all men and women, in particular the poor and vulnerable, have equal rights to economic resources, as well as access to basic services...’ (WHO and UNICEF, 2017).

6 Global product is the global equivalent of gross domestic product (GDP) at the country level.

# 2. Equity

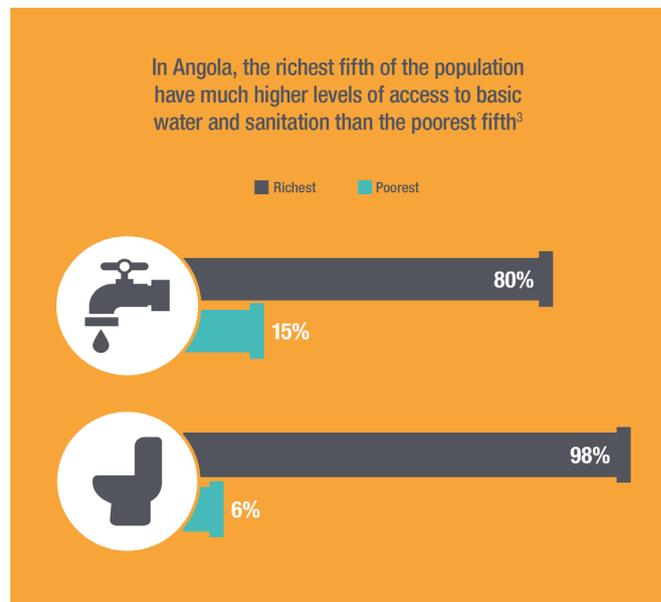
## Water and sanitation must leave no-one behind, but incentivising governments to lead requires new approaches

Poor people are almost always worse off in terms of access to water supply and sanitation. In Angola, for example, 15% of the poorest fifth of the population have access to basic drinking water services, compared to 80% of the richest fifth. For sanitation, the gap is even wider - coverage for the poorest fifth is only 6%, while for the richest fifth it is 98%. There are many other kinds of exclusion. Some we can track across countries: people in rural areas are generally worse off than those in urban areas, for example. Urban dwellers in Angola are nearly three times as likely to have a basic water supply service. The gap is even greater between the capital Luanda with access close to 80%, and the North-Western Province of Uíge where barely 20% have access (WHO and UNICEF, 2017). Often limited access to WASH, wider poverty and geographic location are related, but numerous other factors affect the relationship between where you live, what you have in terms of wealth and income, and what you get in terms of services. Within households, communities and societies, personal and group characteristics including sex, age, ethnicity, migratory status, disability and sexual orientation pose barriers to getting equitable access.

The problem will not go away by itself – in many countries, the gap has widened. In around a third to half of 73 predominantly low and middle income countries, for which access is broken down by wealth quintile, the poorest fifth gained access to an improved facility at a slower rate compared to their wealthiest counterparts from the mid-90s to 2012.<sup>7</sup>

Furthermore, countries that have achieved greater equity in water supply and sanitation have rarely done so as part of a government-owned and led strategy within the sector. Progress may be just as often attributed to wider economic growth and poverty reduction, or to narrow, donor-driven programmes (Mason and Mosello, 2017).

Even where there has been some proactive government-led targeting of harder to reach groups, it hasn't necessarily reached the very poorest. In Cambodia's urban sanitation sector, alongside some patchy investment by the Government



to attract foreign investment and tourism, households have invested in latrines. The second poorest fifth are catching up with other wealth quintiles in terms of levels of access, but the poorest fifth still lag way behind (Mosello and O'Leary, 2017). In Nepal, the Government and development partners have invested substantially in rural water supply. But to date a similar pattern plays out as in the Cambodia example: the poorest fifth are side-lined from politics by poverty but also by caste and geography, and they have lower levels of access (Sarwar and Mason, 2017).

Because the MDG targets didn't require universal access (but rather a reduction by half in the proportion unserved), debates about equity could be largely avoided. Many countries could achieve MDG7c by targeting the easiest to reach, to push up aggregate numbers as quickly as possible, rather than the poorest or most marginalised. On this basis, the cost and effort required to reach each excluded person has become higher, even as the overall size of the unserved group diminished. It is therefore very unlikely that poor and vulnerable populations will be lifted on a rising tide to obtain access to safely managed water and sanitation. Instead, affirmative action is needed, to put the poorest households at the front of the queue.

<sup>7</sup> 30% of countries in the case of the urban sanitation sector; 36% and 41% in the case of urban and rural water, respectively, and over half (56%) in the case of rural sanitation. Based on 73 country-level datasets made available by the JMP in 2015, including time-series estimates for levels of access to urban sanitation, urban water supply, rural sanitation and rural water supply by wealth quintile. As of 2017 80 such country-level datasets are available for the most recent year for which survey data could be obtained (WHO and UNICEF, 2015b).

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That agenda is likely to be politically radical because, to be effective at the scales required, it must be led by governments and based increasingly on domestically mobilised resources – in other words, redistributed taxes and user fees. International aid transfers are a small share of the \$90billion/year in capital investment required to achieve the drinking water and sanitation SDGs (UN-Water and WHO, 2017). Insofar as they are available, international transfers will increasingly need to be prioritised for the most fragile countries where domestic resource mobilisation is least feasible.

For more stable low- and middle-income countries, progressively channelling taxes and tariff revenues to extend access to the poorest people is not a technical challenge. It is a fundamentally political one. Dysfunctional politics were an acknowledged barrier to achieving the MDGs on water and sanitation (World Bank, 2004; UNDP, 2006). Yet we are still some way from knowing how to turn dysfunctional political relationships around – between citizens and politicians; between different groups of citizens, between public officials and politicians; and between the public sector and markets.

Part of the problem is that the terms and labels associated with water supply, and to some extent sanitation, lead to lazy assumptions about their inherent political importance: an ‘essential service’ or a ‘public good’. But the mechanisms that ought to incentivise government, and particularly politicians, to provide those services are often broken. Expectations of a straightforward ‘social contract’, whereby government delivers services to win votes or, in autocratic regimes loyalty, are often misplaced. The expectation that everyone’s vote (or loyalty) counts equally is especially misplaced.

The structures that work against a social contract that could support equitable outcomes are often deep rooted, and play out in complex ways. In Cambodia, for example, while political salience varies between sectors, patronage relationships and business interests still strongly shape allocation of goods and services. Reform in urban water supply has been driven by an experienced leader with the networks and influence to insulate the utility from patronage networks and associated political interference. In health, a programme of free services has significantly widened access, but jobs bestowed as political favours, and rent-seeking by those in office to pay back patrons, undermines service quality. Meanwhile urban sanitation lacks much political

attention at all, except in some towns where tourism is big business (Mason and Mosello, 2017; Kelsall and Heng, 2014).

There are no simple recipes for changing political behaviour and relationships to advance socially equitable outcomes. At least recent elections in rich countries, which have confounded the expectations of experienced pollsters, offer a timely reminder that we can’t make lazy assumptions. In the face of uncertain politics, what are the lessons for those seeking to galvanise the ‘affirmative action’ we need to achieve universal access?

Recent evidence suggests we may need to pay more attention to the ‘when’ (sequencing) and ‘how’ (method) of reform efforts. On sequencing, support that is targeted to poor people, and support targeted to improve services in general, will need to be carefully timed. Because power and resources are often stacked against poor people and communities, it is essential to keep a strong and clear focus on their rights. But improvements to services in general will also be required if wealthier people (often not much wealthier) are to feel included and support reforms. Research across a number of water utilities in Africa shows that pro-poor reforms tended to start with wider performance improvements. These reinforced positive political relationships around water supply in general, which then opened the space for dedicated (and well resourced) strategies to serve poor people (Heymans et al., 2016). Maintaining a constant focus on enabling poor people to claim their rights and working on system-level service improvements is a delicate balancing act.

On methods, findings of recent panel surveys looking at service delivery and state legitimacy across 5 fragile contexts both reinforce and provide nuance to this point. The survey results showed that having access to services makes very little difference to people’s positive views of government. Yet people are more likely to report favourable views towards government where they feel their experience of accessing services has been ‘fair’. More concretely, that could mean they get opportunities for complaint that yield observable redress, and that they don’t feel victimised by corruption or patronage. Put another way, it’s often not what you do, but rather how you do it, that matters – a lesson that applies to service delivery for poor and non-poor people alike (Nixon and Mallett, 2017).

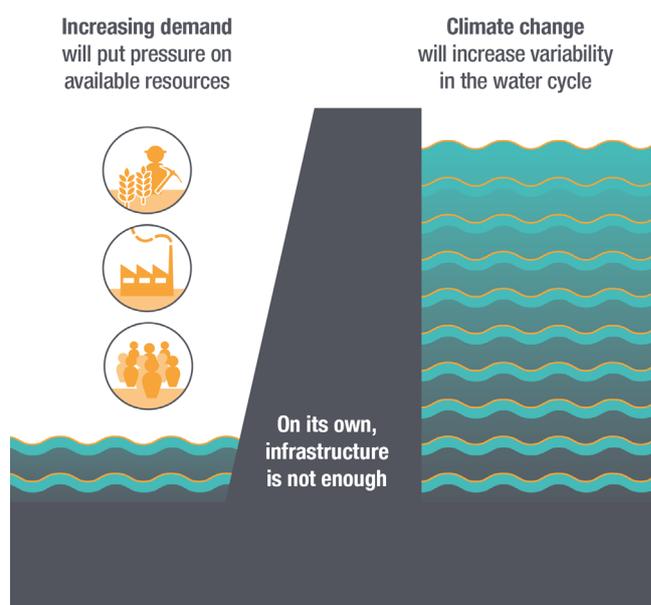
# 3. Availability

## Demand hotspots and supply side variability will be the key challenge for managing water resources

Water scarcity or stress is often calculated using two variables: demand and supply. The simpler the arithmetic, the more alarming the forecasts. By 2050, the OECD projects that global water demand could increase by 55%, set against available resources that are finite even if they are renewable. Many experts agree that expansion of irrigation is unlikely due to land, accessible water and institutional constraints, so this increase is attributable mainly to industry, thermal power cooling and domestic demand (OECD, 2012). Zooming in from the global level to individual river basins the picture remains concerning. 1.6 billion people now live in river basins that are severely water stressed, meaning 40% or more of available water (precipitation less evapotranspiration) is withdrawn from rivers, lakes and groundwater. Under business as usual, that could increase more than two-fold to 3.9 million people by 2050 (ibid).

These sorts of projections are useful to galvanise global concern, but don't tell us much about precisely where and how water resources management challenges will arise. For this, we need to look at a more granular scale and get to grips with variation between places and over time. That can help us to tackle two myths, which do little to guide our response to managing water resources. The first myth is that stress is increasing everywhere – it isn't, and we need to focus on basins and environments (particularly cities and food production areas) where there are unusual pressures. The second myth is that the biggest threat on the availability or supply-side is climate change. Climate change will reduce availability in some regions, but a much more widespread effect will be to amplify the variability that is already inherent in the water cycle.

To take the first myth in a little more detail: aggregate water demand is driven by two main factors, population growth and the water-intensity of consumption. Population growth is heading for more than 8.6 billion by 2030 (UNDESA, 2017), but the world is also becoming more urbanised and wealthier. The resulting shift in standards of living and lifestyle preferences means that water demand accelerates faster than population growth. For example, across many growing economies a higher proportion of meat in diets is having an important knock-on effect on water consumption. Meat and dairy require more water



than grains and vegetables to produce the same number of calories. Increasing water demand in our food economy is matched by other changes in energy and industry.

Again, these drivers do not arise to the same extent and in the same ways everywhere. Of the water that is withdrawn from the environment for human use, roughly 70% is used in agriculture (primarily irrigation), 19% for industry (including energy generation) and 11% to meet domestic needs. Yet throughout much of the low rainfall areas of the Middle East, North Africa and Central Asia, for example, irrigation accounts for 80-90% of total withdrawals (FAO, 2016).

The distribution of water resources is also a key concern and varies significantly between locations. Yet understanding of what is available, and where, is limited. Part of the reason is the sparse coverage of functioning monitoring stations and administrative systems to aggregate data on water resources (WWAP, 2012). But an arguably bigger problem is conceptual: the bias towards water resources on the earth's surface (lakes, streams and rivers).

Water below the surface, groundwater, accounts for roughly 96% of freshwater, excluding the share of surface water locked in glaciers (Gleick, 1993). Yet groundwater does not figure prominently in assessments of global, regional and national water availability, except the portion

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of groundwater which flows relatively rapidly through the sub-surface and into surface water bodies (called ‘baseflow’, see e.g. Vorosmarty et al., 2010). Groundwater stored over much longer periods of time is overlooked. This can be significant volumes, even in countries that get counted as water scarce because a limited amount of water is ‘renewed’ through rainfall and other precipitation each year.

The bias towards surface water and short-cycle renewable groundwater is understandable. Over-exploitation of slower to renew and ‘fossil’ groundwater reserves can leave economies trapped in an unsustainable model. Over the 10-year period 2003-2013, water levels fell in 21 of the world’s 37 largest aquifer systems (Famiglietti, 2014; Smith et al., 2016).<sup>8</sup> Nearly all these systems underlie some of the world’s most important agricultural regions, with over-pumping for irrigation the primary culprit.

However, large scale and intensive groundwater use has also provided the springboard for many Asian countries to transform from agrarian to industrialised economies, helping millions of poor farmers escape poverty (Giordano, 2009). Much of the research on water resources management focusses on overuse and abuse, but many countries designated water scarce in terms of *annual* flows have significant groundwater reserves that could, potentially, be developed for relatively modest domestic demands – including parts of Africa and even India, where groundwater resources are under greater pressure (MacDonald et al., 2012 ; 2016). By ignoring the potential of groundwater storage, rather than systematically measuring, monitoring and regulating its use, we only reduce the chance of sustainable outcomes.

Turning to the second myth, climate change will not be the leading driver of water scarcity on a global scale over the next 30 years. Its effects on water scarcity in this timeframe are more modest than the demand-side drivers already described (Vorosmarty, 2010; Niang et al., 2014; Luck et al., 2015). Climate change will, however, alter the timing, amount and intensity of rainfall, while changes in evaporation resulting from the combined effects of shifts in temperature, radiation, humidity and wind speed will modify surface and groundwater availability. Specific outcomes are difficult to predict, particularly for rainfall and its secondary impacts on runoff and recharge. In broad terms, however, water availability is expected decrease over some dry regions at mid-latitudes and in the dry tropics, but increase at high latitudes and in some wet tropical areas. This reinforces the need to identify likely hotspots, not make sweeping generalisations about a hotter world being uniformly dryer.

The most widespread expected change, moreover, is an increase in variability (daily, seasonal and decadal) and in the frequency and intensity of extreme events like droughts and floods (Cisneros et al., 2014). Inability to manage the variability of precipitation and other hydrological processes is already costly. In Sierra Leone, up to 40% of water points either fail completely towards the end of the dry season, or provide insufficient water for basic needs (MWR and WSP, 2014). In Ethiopia, even in communities that notionally have access to water supplies, households can struggle to obtain the minimum amounts of water recommended for emergency situations, particularly in the dry season (Tucker et al, 2014).

Variability over time – between seasons, years and decades – is a bigger challenge for most water managers than limited availability, and may need different responses than managing scarcity. It makes it hard to design allocation regimes that provide assured and equitable supplies from dry to wet seasons or years. It makes it much more expensive to design dams and other infrastructure that function in floods as well as droughts. Climate projections are often not good enough to tell how key elements of the hydrological cycle will evolve once we get down to the spatial and temporal scales at which societies tend to plan (Conway, 2013).

The knee-jerk response for most national and sector leaders when confronted either by accelerating demand and increasingly variable water supplies, is to commission large infrastructure projects. Often, these are ultimately driven by money and prestige, with little space either to do the necessary planning to future proof against variability, nor to consider risks to people and ecosystems (Crow-Miller et al., 2017). A resurgence in lending and investments in large water infrastructure projects, from dams to coastal defences, is already underway (ibid). Ethiopia, for example, has financed its huge Grand Ethiopia Renaissance Dam, including via a bond issued to its citizens at home and abroad (Berndtsson et al., 2017). The Grand Renaissance Dam’s reservoir will hold 74 cubic kilometres of water, more than thirty times the flow of the Thames in London. New methods aim to support better planning for large water infrastructure in the face of this uncertainty (e.g. Ray and Brown, 2015). Incorporating these techniques into policy and investments will be an ongoing challenge.

The social, environmental and economic costs of poor governance for large water infrastructure are well documented (WCD, 2000), including lessons from Europe, the US and China. Yet it has long been the case that investments are more easily routed to hard concrete, than the softer things like institutions and capacity development. Even where policies are there on paper, they may not be implemented. ODI’s work with the Ministry

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<sup>8</sup> These include the North China Plain, the Guarani aquifer in South America, the western Sahara and Nubian sandstone aquifers of North Africa, aquifers of the Arabian peninsula and the Levant, and the aquifers of the Indus and Ganges basins, as well as those in central and southern India (Smith et al., 2016).

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of Water Resources in Ethiopia, for example, suggests that while the country has technically sound water policies and legal frameworks, based on principles of ‘integrated water resources management’, these don’t translate to functioning systems that can allocate water efficiently and equitably. The sustainability of the water management system is hampered by staff turnover and gaps in human and technical resources (Mosello et al., 2017).

The world faces a major challenge in adapting to a future where demand for water is accelerating, concentrated in certain places, while supply remains essentially fixed and increasingly variable. Concrete alone is not the answer. Indeed, it is more of a problem if it is not matched by the human skills and institutional rules to balance demand against supply, in ways that ensure equity in the face of variability.

# 4. Quality

## Contamination of ground and surface water will threaten major economies and huge populations, without action to monitor and manage the risks

While climate change puts pressure on supply-side availability of water resources only in certain regions, the pressure from degrading quality is more widespread. It is obvious that water availability in broad terms is reduced by pollution that renders water unusable for its intended purpose. So why has quantity always captured more attention than quality when it comes to narratives about scarcity? Part of the reason is that it's easier to paint a picture of scarcity – from the Yellow River failing to meet the sea in some years, to the retreating outline of the Aral Sea. In contrast, many forms of biological and chemical contamination of water are hidden, especially where they affect groundwater, and go undetectable to human sight, smell and taste. Water pollution captures media attention when rivers and lakes turn lurid shades or become clogged with plastics. When Taiwanese students made lollipops out of various polluted water samples, the sudden visualisation of an often overlooked issue went viral (Everington, 2017).

Even among water specialists there is arguably a bias to water quantity over quality. The most commonly used water scarcity and stress metrics add up renewable annual water resources without discounting for any contaminated volumes, and set these against withdrawals, or population. Part of the problem is the very limited data on water quality (WWAP, 2017). There are also important nuances to how contamination affects usability, which make it harder to get a grip on the issues. Degrading quality may not write off resources altogether – water bodies have some capacity to absorb and attenuate pollution. The extent to which pollution presents a problem also depends on the type of contamination versus what water is used for – growing food, industrial processes, or drinking, for example.

Contamination risks nonetheless affect significant volumes of our water resources. For example, among biological contaminants, the faecal waste produced by over 60% of the global population is, as noted, discharged to the environment rather than being safely biodegraded in-situ or transported to a treatment plant (WHO and UNICEF, 2017). Among chemical contaminants, one of the most dramatic manifestations is the arsenic crisis in South Asia. Shallow boreholes, constructed to supply



safe drinking water, have frequently been found to have high arsenic concentrations. Arsenic in drinking water is responsible for illness and death from wide range of health problems. While the scale of the threat has been best assessed in Bangladesh (though too late, for many), it extends to many other countries including India, Myanmar, Nepal, Pakistan, Cambodia, China and Vietnam. In total, an estimated 60 million people may be at risk, with 0.7 million people already thought to be afflicted with the symptoms of arsenicosis (World Bank, 2005).

The scale of the issue becomes more apparent when looking at the fate of important groundwater reserves. In China, well-publicised surface water pollution incidences are the tip of an iceberg that extends deep into aquifers. There has been a reported improvement in surface water quality since 2003, but in 2012 about 30% of river samples from 10 of China's major river basins were still classed as 'heavily polluted' (MEP, 2003; 2012). The widespread quality problems for surface water have pushed farmers, industries and utilities to resort to intensive pumping of groundwater. This in turn, has drawn contaminated water down from the surface. There is increasing evidence that deep as well as shallow groundwater reserves in China are severely affected. In a recent study 25 out of 36 shallow groundwater basins, sampled from across the country, had nitrate levels above

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the threshold that would be deemed safe by US regulators. The same issue affected 10 out of 37 deep or karst aquifers, which may have replenishment cycles of many thousands of years (Han et al., 2016).

In South Asia's Indo-Gangetic Basin, over-abstraction and falling groundwater tables lead to a focus on aggregate availability (Rodell et al., 2010). There is justifiable concern. These water resources support millions of people in Pakistan, Nepal and Bangladesh, and store more than twenty times the annual flow of the Indus, Brahmaputra and Ganges rivers. More detailed assessment up to a depth of 200m nonetheless suggests water levels in the majority of the aquifer are stable or rising (70%). Quality is a more widespread issue, affecting 60% of the groundwater that is potentially available in the basin. Salinity levels above 1000mg/l are estimated to affect 23% of groundwater reserves, impeding use for drinking and irrigation. Arsenic at toxic concentrations is estimated to affect a further 37%. Contaminants are naturally present, but exacerbated by human activity including water abstraction, application of fertilisers and mining (MacDonald et al., 2016).

Remediation of water contamination is typically more expensive and technically difficult than prevention. Groundwater pollution, however, can be difficult to detect within timeframes that would allow both preventative and remedial action. Pollution of groundwater can remain a problem for decades after the polluting activity has stopped, but equally may not be detectable for decades after the pollution starts (MacDonald and Foster, 2016).

This magnifies the case for a precautionary approach. Technical solutions to prevent or reduce both point-source and diffuse pollution risks are available. Agricultural and land management policies can reduce the risks posed by fertilisers, sediments and pesticides. Local bye-laws and investments can do much to reduce the amount of faecal waste that seeps into ground and surface water, particularly in cities. Vulnerabilities to groundwater reserves can be mapped, monitored and regulated. Yet anyone who has worked on these issues knows that the problem is not just technical. Solving it involves confronting vested interests and generating political commitment to tackle issues that are often invisible – and easier for politicians to leave that way.

The main task for water specialists, then, is to use evidence to generate public and political concern over the global water quality challenge. Recent experience suggests people can care deeply when they are confronted with evidence of invisible threats to their health and wellbeing. The rapid rise of concern over air quality is forcing rethinks on transport and industrial strategies for countries, cities and businesses. The nearer term health impacts of poor air quality have also been instrumental in making the threat from climate change more tangible. Given pressures, emotional connection and difficulty of substitution, pollution of water, and particularly groundwater, may yet become the next decade's big environmental concern.

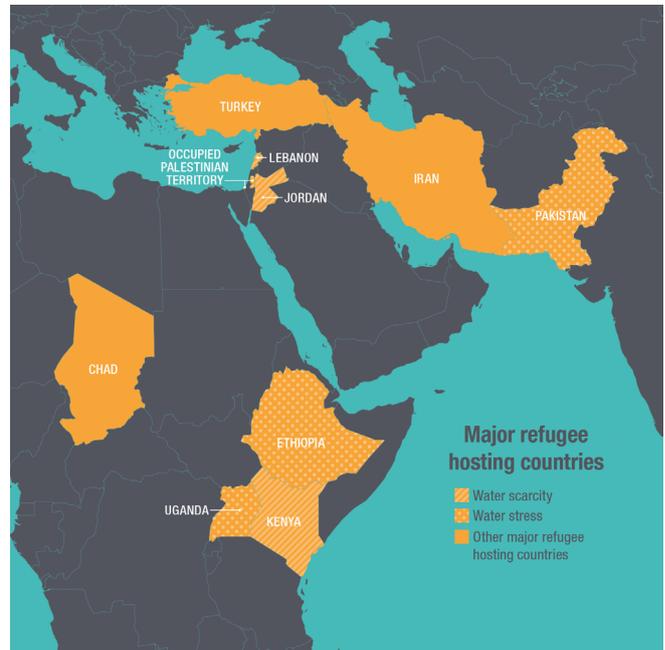
# 5. Migration

## Water insecurity isn't yet a leading cause of state fragility, but the risks will grow if we don't help water insecure countries that are doing the most to help refugees

Labels attached to water – ‘the next oil’ or ‘the new gold’ – imply that competition for water as a strategic resource will inevitably descend into conflict. Despite the fixation with war wars, however, the risk of interstate conflict over water remains overstated (Zhang, 2015). What, then, is the relationship between conflict and water insecurity? Water insecurity may be one of several factors sparking violence *within* countries. For instance, it has been argued that the 2006-2009 drought catalysed the rising food prices and societal stress that ultimately led to the conflict in Syria (Sadoff et al., 2017). The indirect impacts of water shortages on livelihoods, food prices and economic growth also drive poverty and, with it, migration (World Bank, 2016b). However, it is difficult to verify that water has been a major contributor to state fragility or disintegration to date.

The link seems to run more strongly the other way. Damaged institutions, information, infrastructure and human capacity, resulting from conflict and political instability, make it harder to deliver water and sanitation services, protect people from water related disasters and preserve resources (Sadoff et al., 2017). People in fragile situations are more than four times as likely to lack basic drinking water, and more than twice as likely to lack basic sanitation (WHO and UNICEF, 2017). High numbers of internally displaced people, with many cut off from water access, intensify water provision challenges. These challenges can take years to solve, even after the cessation of conflict. Half of the world's poor people will live in fragile contexts by 2030 – many of which are currently water scarce (World Bank, 2011; World Bank, 2017).

The need to meet immediate water and sanitation needs in conflict-affected areas is indisputable on the grounds of basic human dignity and survival. Also indisputable is



the case for rebuilding water and sanitation sectors and services as quickly as possible. Flexibility is key, with projects that can start alongside and complement relief efforts, and be easily scaled up or down in anticipation of conflict flaring up again. The alternative is to fall into traditional divisions of ‘humanitarian’ and ‘development’ WASH, which often undermine each other through their approaches to funding and implementation (Mason and Mosello, 2016).

More often overlooked, and just as serious, is that the geography of instability means people displaced by conflict are often migrating to countries with their own water challenges. Of the ten countries that have ranked consistently as the major refugee hosting countries between 2013 and 2016,<sup>9</sup> four face water scarcity (Kenya, Jordan, Lebanon and Occupied Palestinian Territory)<sup>10</sup> and a further three are water stressed (Pakistan, Ethiopia and Uganda)<sup>11</sup>. Over 25% of the total population of the nine

9 Pakistan, Lebanon, Islamic Republic of Iran, Turkey, Jordan, Ethiopia, Kenya, Chad and Uganda – original analysis of UNHCR data (mid year trends for 2013, 2014, 2015 and 2016).

10 Populations face water scarcity when total annual renewable water availability drops below 1000m<sup>3</sup> per capita per year. Jordan and the Occupied Palestinian Territory face absolute water scarcity with total annual renewable water availability below 500m<sup>3</sup> per capita per year. (FAO, 2015).

11 Populations face water stress when renewable water supplies drop below 1,700m<sup>3</sup> per capita per year (FAO, 2015).

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countries do not have access to basic drinking water, and over 45% do not have access to basic sanitation.<sup>12</sup>

As noted, a fixation on simplistic national level averages can overstate the risks of water scarcity or inadequate services. A grasp of the situation *within* countries – overlooked by national-level averages – is crucial to understanding any risk of localised competition for resources and services between refugees (and internally displaced people) and host communities. This can highlight where spikes in demand are most acute. For instance, in Jordan, high numbers of Syrian refugees are concentrated in urban areas near the border in the northern governorates. In such areas, demand for water has reportedly increased by more than 40% (MPIC, 2015). Inadequate water supplies have been linked to rising tensions between refugee and host communities impacted by the increased demand on limited basic services (Boustani et al., 2016). Jordan already faces tough choices over its water. The biggest water using sector is agriculture, at 60% of total national water needs. Over 90% of treated wastewater is re-used in agriculture, freeing up water for domestic use (MWI, 2016). These efficiency gains help buy time, but don't get around the problem of whether to prioritise human consumption over productive uses, which was an issue even before the crisis in Syria.

Moreover, as the refugee crisis in Europe has amply demonstrated, perceived competition for resources is often a bigger threat than actual competition and can drive disproportionate and ultimately harmful political responses. Bold responses from the neighbours of countries in conflict are needed to avoid large-scale migration overwhelming already struggling resource management and service delivery systems. Uganda, the recipient of 900,000 refugees from South Sudan, has been praised for its progressive policy stance (Amnesty International, 2017). Refugees are given relative freedom of movement, freedom to work and own a business, as well as access to basic services. However, to sustain these responses, the international community needs to step up. Despite promises, only 17% of Uganda's refugee response needs have been funded and water services are severely stretched (MSF, 2017).

The prevailing patterns of crisis and resulting migration require rich countries to provide timely funding and support to countries that take on the burden of meeting refugees' immediate and long-term needs. By reducing the risk of further conflict or fragility, money spent wisely on improving water and sanitation services and resource management would be a down payment worth billions in the future.

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12 Estimated as total number unserved as proportion of total population, across all countries. By country, access to basic water supply ranges from 39% (Ethiopia, Uganda) to 99% (Jordan, Turkey). Access to basic sanitation ranges from 7% (Ethiopia) to 97% (Jordan). Data from WHO and UNICEF 2017.

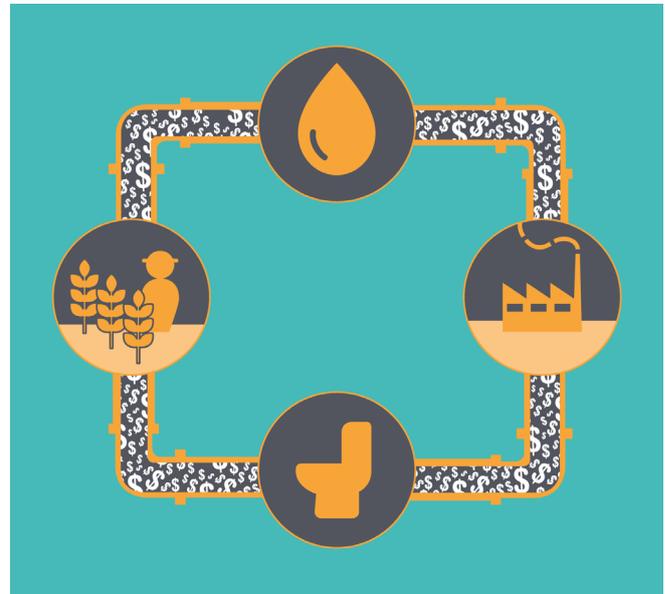
# 6. Growth

## Water and sanitation have struggled to get much profile in ministries of finance. A new emphasis on the quality of growth and, particularly, jobs, could change that

Voters around the world are questioning whether they are sharing in the gains from growth, as they see living standards squeezed and decent jobs become scarcer. There is much to be concerned about, amid nativist economic and employment policies that don't offer credible answers, and a lack of serious political engagement with future shifts in automation and digital technologies. A 'youth bulge' in many countries, particularly in Africa, causes concern even if it could, equally, be an enormous opportunity (UN-DESA, 2017). Yet the search for a better kind of growth, one that is more inclusive and resilient, may provide the opportunity to frame water and sanitation's importance to the economy in new ways. That could, for example, involve acknowledging their importance to the day to day business of making a decent living, rather than assessing them solely on their contribution to gross domestic product (GDP). In the case of water, the opportunity comes from the fact that it is a direct and hard-to-substitute input to such a wide range of jobs and livelihoods. For sanitation, it comes from the sheer size of the potential market.

Attempts to link sanitation and water to GDP have been made, with some success. Often these are in terms of avoided losses, or spending required to address a problem. The World Bank, for example, has estimated that GDP losses associated with inadequate sanitation across a number of Asian and African countries ran to billions per year: \$5.5 billion across eighteen African countries, \$9.2 billion across five countries in East Asia and \$53.8 billion in India alone (WSP, 2008; 2011; 2012). The consultancy McKinsey put the capital spending required to bridge water resources availability gaps in what it argued was the most efficient way at \$19 billion/year for four global regions, or 0.06% of their combined forecast GDP in 2030 (2030 WRG, 2009)

Although such economy level estimates require many assumptions, they can be influential in advocating for action. Yet it is still the case that the most important decisions about water and sanitation are being made not by the heads of relevant line ministries and their civil servants, but instead by ministers of finance, presidents and prime-ministers. Other sectors make competing claims about their contribution to GDP and growth. A wider



range of arguments, evolving to meet the preoccupations of our times, is needed to bring political attention to water and sanitation. That is a first and crucial step to solve the significant challenges identified in sections 1-5.

For many poorer countries, the focus is not so much on protectionist measures to secure existing jobs against globalisation, as it is on a more outward-facing focus on how to transform their economies. This is especially the case in sub-Saharan Africa; while some economies are diversifying beyond an agricultural base, growth tends to be concentrated narrowly in extractive and emerging service sectors. This generates a limited number of jobs with high entry barriers for many poor people in both rural and urban areas. As a result the benefits from productive employment are narrowly confined, and gains are fragile from year to year. The concept of 'economic transformation' can be defined in different ways but a central feature is the allocation of labour, capital and other resources towards high productivity activities (across sectors, firms and farms) and production lines. The benefits include greater employment intensiveness of growth, distributing income more widely, and greater diversification making growth more resilient (McMillan et al., 2017; ACET, 2014).

Water stands out among the 'other resources' that must be allocated, besides labour, to enable economic transformation. Firstly, because water is a crucial input to economic activity across sectors, from agriculture

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to high-tech manufacturing and services like tourism. Secondly, because it is crucial to economic activity across income distributions, from a subsistence farmer to a factory or hotel manager. As a resource which is a direct (and indirect) input to such a broad spectrum of economic activity, water allocation decisions and efforts to improve productivity will have immediate consequences across income groups and between sectors, with implications for the distribution of benefits and resilience of growth.

Serious engagement with economic transformation could therefore bring new attention to water. For example, should a country like Ethiopia, with its huge water endowment, prioritise irrigation, hydropower or municipal supplies from its dam building? That's a much more pertinent question if the aim is not just to grow the economy, but also to spread the economic benefits of investment as widely as possible in the form of water-dependent jobs and services. It is also pertinent if the aim is to ensure that the economy can, year on year, weather economic shocks and natural disasters.

If water has received limited attention in the top echelons of most governments, sanitation has been still more marginalised. Many advocating for greater political attention have identified fragmentation between different ministries – health, water, planning, education – as a key problem. As a result of lobbying from donors and NGOs, in several countries it now falls under the remit of health ministries, but this is not always an advantage given the bias towards curative healthcare, and preference for interventions with easily evaluated impacts. The causal pathway between environmental health interventions like sanitation and hygiene and impacts on mortality and morbidity is much more complex than, say, vaccines. This is despite the fact that there is convincing evidence that adequate sanitation, alongside water supply and hygiene, could prevent the deaths of 361,000 children under five every year (Prüss-Üstün et al., 2014).

There are, however, a few countries waking up to the wider contribution that sanitation could make to their economies. Central to this process are arguments that look beyond human health. In Ethiopia, for example, some recent sector initiatives focus on the jobs potential offered by a largely untapped sanitation market. In a country where youth unemployment is high on the political agenda, this has reportedly had traction with politically influential ministries responsible for enterprise development (WaterAid, 2016). Globally, the 4.5 billion people currently without a safely managed sanitation service represent a vast market. There is also huge potential for segmentation

and new revenue streams as households progressively move up a sanitation 'ladder' from the most basic latrines with low or no margins, to premium sanitary ware. The value of jobs and services in safely managing faecal waste could also be significant, to say nothing of the revenue from better capturing nutrients and energy from the waste.

Another key contribution sanitation makes is in freeing up productive time. The benefit of bringing water closer to the home is well documented in terms of alleviating the drudgery of collecting from and queuing at distant sources. But the equivalent time savings from improved sanitation are less often measured or reported. Crude estimates suggest that on average, 30 minutes per person per day could be saved in moving from open defecation to using a latrine (Hutton, 2012). In India, which has put a sanitation campaign at the heart of its goals for modernity and economic competitiveness, that could free up 260 million hours every day.<sup>13</sup> Time that people don't have to waste in finding a place to defecate in the open could be spent on education and other productive activities.

It is important not to overstate the benefits. Many of the employment opportunities created by sanitation could end up being low-skilled and transitory, open to replacement by automation. Water allocation decisions that could be good for rural farm and non-farm employment will require careful trade-offs with those that would bring competitive advantage in manufacturing or more mechanised commercial agriculture. It is important, too, to anticipate the risks: framing water as a fuel to economic growth and transformation could expose it to further commodification and over-exploitation. But this does not remove the fundamental point – that considering the full range of ways in which water and sanitation can support inclusive, resilient growth, is important.

To borrow from recent thinking in resilience, there is a 'triple dividend' available to economies from investments in water and sanitation (Tanner et al., 2015). The first dividend comes from avoiding losses, for example the costs of curative healthcare to deal with water-related diseases, or of repairing preventable damage from floods. The second comes from directly stimulating micro-economic activity – opportunities created in terms of available time and health. The third arises in the form of co-benefits at the macro-economic level – attracting investment and creating jobs. Bettering the evidence and arguments across all three dividends will ensure that sanitation and water secure political attention and play their deserved role in economic transformation.

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13 Extrapolating time saved for each person moving from open defecation to access to a household latrine. Current estimates of open defecation in India taken from WHO and UNICEF (2017).

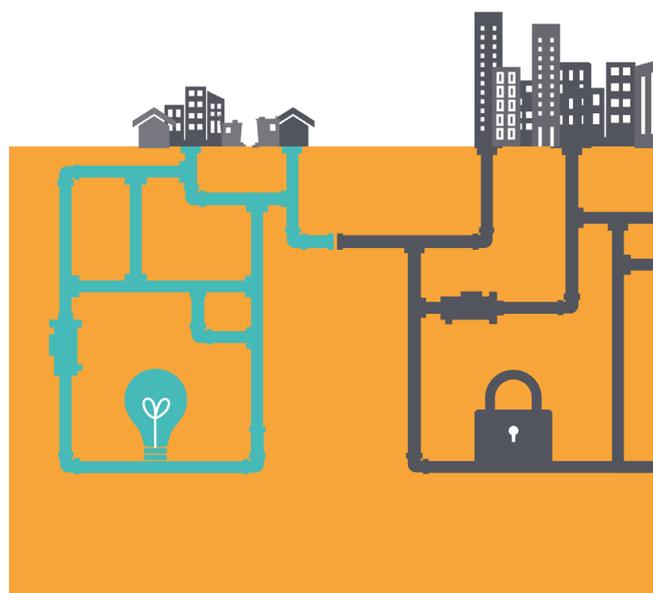
# 7. Cities

## Much growth will occur in smaller cities, with a chance to rethink how we provide water and sanitation services

Utility services are generally viewed as the most economically efficient and environmentally sustainable way to meet water supply needs in towns and cities. Yet utilities are struggling to keep up with urban population growth. In sub-Saharan Africa, access to a piped water supply, whether in the home or outside it (e.g. from a tap-stand) fell from 67% in 1990 to 56% in 2015. In South and Central Asia, the proportion accessing piped water fell from 72% to 67%. In these regions, this trend is accompanied by a rise in the share of the population using non-piped improved sources, like boreholes and private wells (WHO and UNICEF, 2017). The implication is that urban households are increasingly turning to groundwater in the face of unreliable utility supplies. In urban areas groundwater is exposed to a greater range and concentrations of contamination, and is poorly regulated. The options available to many urban citizens – an unreliable piped supply, a private groundwater source or expensive un-improved alternatives like tanker trucks – are a considerable distance from the ‘safely managed’ service envisaged by SDG target 6.1. As noted, that requires a supply on premises, with quality and reliability assured, for absolutely everyone by 2030 (WHO and UNICEF, 2017).

Urban sanitation fares at least as poorly. Basic sanitation coverage in urban areas of sub-Saharan Africa has risen only slightly since 1990, from 39% to 41% in 2017. The JMP has not obtained sufficient data for the region to estimate how many have access to sanitation service that meets the definition of ‘safely managed’, i.e. including safe management of faecal waste. Available estimates put the share at 33% in sub-Saharan Africa, and only 6% in South Asia in 2015 (Hutton and Varughese, 2016). Given recent trends, the SDG targets for urban areas again represent a huge increase on current service levels and, in major global regions, require a reversal of current trends.

Cities are diverse, so we must ask in what kinds of cities will these significant additional service needs occur. Crucially, nearly half the global urban population currently live in settlements of less than half a million people. Only one in eight live in one of the 28 megacities in the world,



which have more than 10 million inhabitants. Globally, larger cities above 1 million people will grow faster to 2030 than cities of fewer than one million people; from 2015 to 2030, 666 million people will be added to cities over 1 million, versus 435 million added to cities of fewer than 1 million people. However, in sub-Saharan Africa, and across low income countries, similar absolute numbers will be added to both cities smaller than 1 million people and cities larger than 1 million people. Moreover, in absolute terms the majority, 55%, will still live in cities smaller than 1 million people in 2030, and 45% will live in cities of fewer than half a million people (UN-DESA, 2014).

On the one hand, this presents a challenge. The service needs of the additional population will hit smaller cities hard, as they are less likely to have large, professionalised utilities or existing networks for water supply, sewerage and faecal sludge management. As nearly half a billion people around the world join cities of fewer than 1 million people, they will need to supply nearly 9 million extra cubic metres of water every day. They will also will need to dispose of over 50,000 tonnes of additional excreta per day.<sup>14</sup> Smaller cities and towns may also more easily maintain links to rural areas, making it easier for incomers

14 For water supply, calculations assume minimum basic consumption needs of 20l/p/d. For sanitation, calculations assume median faecal wet mass production of 128g/p/d (Rose et al. 2015).

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to switch between the two more easily. Proportionally, the impact of one person arriving or leaving a small urban settlement creates a bigger uncertainty for those planning service provision than in a large or megacity.

On the other hand, because small cities may not be as 'locked in' by established infrastructure networks and other elements of the built environment, it opens a window to find new solutions. The challenge is to leapfrog conventional centralised infrastructure technology. In some infrastructure sectors, such as energy, serious consideration is already being given to the alternatives. Yet urban water supply remains locked in to centralised networks. There are good reasons: water is heavy and can't be 'generated' in-situ, so it necessarily needs to be moved around. However, there are several accompanying assumptions that could be tested: that a big network needs a big utility company to manage it; that treatment has to happen centrally; and that, once water passes through a home or business it becomes a homogenous waste stream needing a standard, high level of treatment, whatever purpose it is used for.

These assumptions may hold in formal urban areas where economies of scale justify centralised treatment and distribution to customers who are easily identifiable and billable. But the logic is less clear when dealing with less predictable or planned growth patterns in smaller cities, especially where informal settlements may arise. Even in the cities and towns of high-income countries there are legitimate questions about treating all water to an equal (potable) quality, whether it's used for drinking, or washing cars. Similarly, about the merits of pumping water around big, leaky networks.

Sanitation is arguably doing better at rethinking the fundamental models for service provision. Scepticism about whether sewerage is the most economically and environmentally sustainable way to manage human waste, including in urban areas, has led to innovations in technologies and business models to collect, safely remove, treat and dispose of (or ideally re-use) human waste, without mixing in huge quantities of water and pumping it to treatment works.

Investment and ideas for urban water and sanitation in poorer countries nonetheless tend to flow to big and mega-cities. For the private sector these often represent the most attractive investment opportunities because of economies of scale and existing, often publicly-funded, capital infrastructure. Meanwhile for governments and development agencies the large number of unserved urban dwellers in the slums of large cities is a justifiable preoccupation.

However, if the majority of urban dwellers live, and will continue to live, in small cities we need credible solutions that can meet their needs now, and as they grow. There are both technological and managerial aspects to consider. Innovations in technology could enable households or neighbourhood blocks to treat water to drinkable quality in-situ, and use higher volumes of lower-grade water for other uses. Companies and landowners can be incentivised to minimise pollution of any piped water they use so that it can be reused or recycled. Delegated management models could allow a single bulk water provider to supply many smaller service providers that have the local knowledge to manage 'last mile' provision as settlements expand.

Meanwhile on the sanitation side there is the chance to learn from larger cities' challenges as well as their innovations. This could mean early work to establish appropriate bye-laws to regulate on-site sanitation facilities like septic tanks (to reduce water contamination); offering municipal tax incentives to encourage businesses that can offer households integrated fecal sludge management services; or making the most of segregated waste streams (grey water, fecal sludge, urine) to generate energy and recover nutrients.

While many of these innovations have been explored at pilot scale in large cities and megacities, there is a better chance of scaling them in smaller cities as they expand. A visionary approach to water supply and sanitation will be an important way for town and small-city leaders to meet the needs of their citizens, attract investment, and prepare for future growth. The international community meanwhile has a role to play in supporting networks of municipal governments and utilities to share innovative thinking and provide expertise and finance.

# 8. Technology

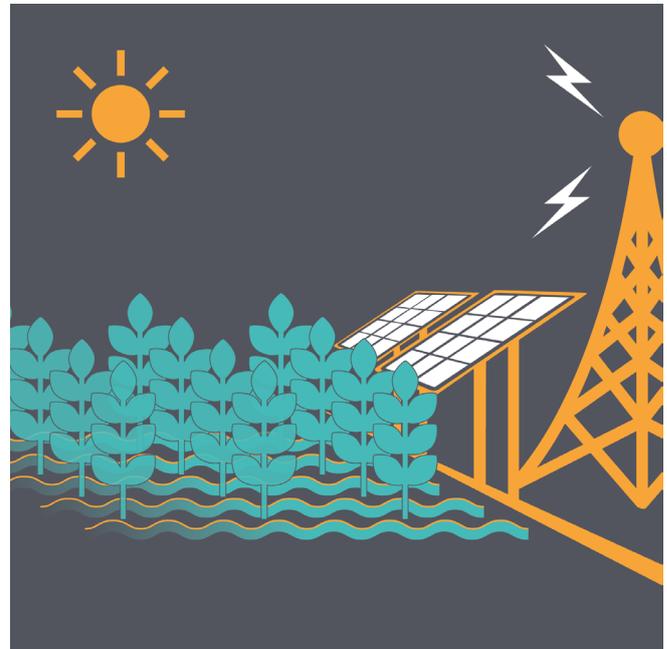
## Technological innovation will transform how water resources are used (and abused), but the most transformative impacts won't come from within the sector

Over millennia, innovations have transformed the way water is distributed, treated, consumed and returned to the environment. Sometimes these innovations don't occur in the water sector itself, but in other areas, with important knock-on effects for how we manage and use the resource. In the coming decades, the technology revolutions already underway in energy and communications in particular will have big implications for water.

Water has long had a close relationship with energy, most obviously as an input to electricity generation – hydroelectric dams and thermal power plant cooling towers being the most visible examples. Water demands for thermal cooling could increase, per kWh, with a new generation of coal technologies incorporating carbon-capture and storage (Byers et al., 2016). And, as noted, large dams may be experiencing a resurgence, globally. Both will require close collaboration between the energy and water sectors to manage numerous trade-offs.

Despite not requiring water for energy production, solar voltaic cells may have a greater impact on the water sector. Costs have declined steeply and power output increased to enable a much wider range of applications – from community or household water wells, to much larger and thirstier irrigation systems (Chandel et al., 2015). Capital costs are still generally higher than conventional, diesel or mains electric powered pumps, but savings on spares, maintenance and above all fuel mean life-cycle costs are lower (Welsien and Hosier, 2015). Solar panels generally have long lifetimes if the risk of theft and vandalism is managed. For farmers, households and communities with available ground or surface water and sunlight, switching to solar powered pumping will make increasing financial sense.

The economic imperative will be especially clear to farmers who need to pump water for irrigation. There is the potential for significant poverty reduction benefits, provided financing is available to spread capital costs and enable poor as well as rich farmers to access the technology. The climate change mitigation benefits could also be significant – the combined contribution of diesel and electric groundwater pumping to India's carbon emissions has been estimated at 5-6% of the total (Shah,



2009). However, there is also increasing anxiety that already strained 'common pool' water resources will come under further pressure. That pressure will come arise from more people being able to pump water for irrigation. Electricity or fuel bills can also provide an incentive to moderate pumping, an incentive that is removed with solar powered systems. In parts of India, subsidised electricity has had an important influence on over-abstraction of groundwater. Now 80-90% subsidies for solar pumping systems offered in some Indian states may be creating a similar problem (Shah et al., 2016).

Where farmers are connected to an energy network, power buy-back schemes can discourage careless pumping, since a farmer will get more benefit from selling excess solar power back to the grid, than flooding fields. The approach is being trialled in India but may be some way off in areas of Africa where rural electrification is much lower (Shah et al., 2016).

Elsewhere, another branch of technological innovation could help: digital communication. Solar systems are already available for domestic power, which can be paid for in instalments or leased via e-payments, spreading capital costs. The systems can be remotely disabled when payments are not made. Systems can be leased to households on an ongoing basis, or become the property of the household, switched on permanently, once a

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certain threshold of payments is reached (Mason et al., 2016). A similar combination of technologies employing digital metering and remotely controlled hardware could address multiple challenges for groundwater management. From the poverty perspective, letting poor farmers pay in instalments could remove barriers to entry, without the need for distorting subsidies. From the resource management perspective, it could allow much more accurate monitoring and subsequent regulation of abstraction rates.

In terms of monitoring, digitally enabled solar water pumps could go some way to addressing the significant gaps in data about groundwater levels. These gaps have only been partially filled by technological developments in other areas, for example using satellites to remotely detect fluctuations in the earth's gravity, which are affected by the mass of water. The scale at which this kind of remote sensing is accurate (400 x 400 km) does not correspond well to the scale of many aquifer systems, and in-situ measurements remain necessary to ground-truth the satellite data (MacDonald et al., 2016). In terms of regulation, advantages from digitally enabled solar water pumps may be harder to secure. Over-pumping using digitally enabled solar systems could be capped remotely,

but it would require a high level of uptake across income groups, to ensure that it is not just poor farmers for whom over-abstraction gets policed. Mechanisms would also be needed to prevent rich farmers from keeping a secondary conventional pumping system, to run once their solar water pumping is capped. Yet it's easier to regulate and enforce against unlicensed pumps, than control how much water unlicensed systems are pumping.

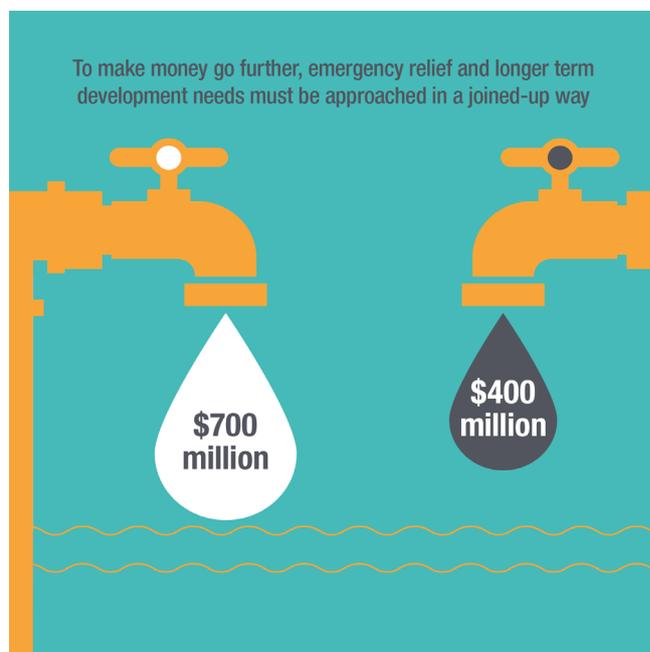
New technologies alone – whether in the energy or communications space – will not solve the complex challenges associated with the management of water, particularly groundwater. Water also offers many examples of where the most urgent need is to make existing innovations work better across contexts, through systems for financing and managing technology. Data from six countries in sub-Saharan Africa shows that only 57-84% of rural water points, often simple mechanical handpumps, are functional at any one time (Tincani et al., 2015); the equivalent data across three countries in South Asia shows 77-90% reliability (Burr et al., 2015). The introduction of new solar and digitally equipped water pumps will present new challenges for distribution, spare parts supply and availability of skilled installation and maintenance support.

# 9. Conflict

## Meeting emergency relief and longer term development needs in a joined up way would make money for water, sanitation and hygiene go further

Humanitarian emergencies are increasingly protracted. 60% of countries that issued a humanitarian appeal in 2014 were in at least their ninth successive year of doing so (Bennett, 2015). These protracted crises are concentrated in 'fragile' contexts, marked by disintegration of the legitimacy and capability of government and repeated outbreaks of violence. Increasingly, poverty is also concentrated in these countries (OECD, 2015), as is lack of access to safe drinking water and sanitation (WHO and UNICEF, 2017). Meeting the needs of unserved people in fragile contexts is difficult and expensive, but is essential if we are to leave no-one behind.

The share of WASH funding going to fragile contexts appears, on the face of it, to be broadly in proportion with the unserved population. The countries and territories classified as 'Fragile Situations' by the World Bank in 2015 make up 21% of the global population without access to basic water, and 12% of the global population without access to basic sanitation.<sup>15</sup> Overseas Development Assistance (ODA) disbursed to these countries for non-emergency water supply and sanitation in 2015 totalled \$715 million. A further share of humanitarian aid, estimated at around \$400 million, went to emergency WASH provision in the same countries.<sup>16</sup> Together, that means these countries received about 20% of total ODA for water supply and sanitation, from both development and humanitarian sources.



This does not mean that fragile contexts are being funded in line with needs. The relative cost of meeting the water and sanitation needs of one unserved person in fragile contexts will often be higher than in non-fragile contexts. Capital costs escalate because of security and logistics challenges and high prices for imports. The costs of sustaining services are increased by the destruction of infrastructure due to conflict and the non-functioning of state and non-state systems that would otherwise support operations and maintenance. Systems for cost-recovery from users can also break down due to lack of trust, population movement and predation. For this reason it is

15 Coverage estimates from WHO and UNICEF (2017) for countries and territories included in the World Bank Harmonized List of Fragile Situations FY15: (IDA Eligible) Afghanistan, Burundi, Central African Republic, Chad, Comoros, DRC, Cote d'Ivoire, Eritrea, Guinea-Bissau, Haiti, Kiribati, Kosovo, Liberia, Madagascar, Mali, Marshall Islands, Federated States of Micronesia, Myanmar, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Togo, Tuvalu, Yemen, (Territories) West Bank and Gaza, (Blend) Timor-Leste, Zimbabwe, (Middle Income) Bosnia and Herzegovina, Iraq, Libya, Syria. Basic water supply coverage not available for Kosovo; basic sanitation coverage not available for Kosovo and Federated States of Micronesia. See: <http://siteresources.worldbank.org/EXTLICUS/Resources/511777-1269623894864/FY15FragileSituationList.pdf>

16 ODA to water supply and sanitation obtained from the Creditor Reporting System (CRS) database maintained by the OECD. Categories of project included: 4020: Water supply and sanitation - large systems; 14021: Water supply - large systems; 14022: Sanitation - large systems; 14030: Basic drinking water supply and basic sanitation; 14031: Basic drinking water supply; 14032: Basic sanitation; and 14081: Education and training in water supply and sanitation. Water supply and sanitation spending categories relating to water resources, river basins and waste management/ disposal were excluded as they are unlikely to have humanitarian equivalents and do not directly relate to service provision. Humanitarian disbursements available from CRS are not broken down by sector and it is therefore necessary to extrapolate to provide numbers comparable to development WASH ODA spending. Applying the percentage of total humanitarian funding going to water, sanitation and hygiene in 2015, as reported by the Financial Tracking Service maintained by UN-OCHA (3.8%), to the global total for humanitarian ODA reported by CRS, results in an estimated \$424 million going to WASH in fragile states. Totalling the humanitarian funding going to WASH in the 19 fragile contexts included in the FTS database (out of 32 on the 2015 World Bank harmonised list) results in an estimate of \$330 million. See <https://stats.oecd.org/> and <https://fts.unocha.org>

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not a simple matter of comparing the share of total WASH funding received in fragile contexts against their share of total WASH need. Other datasets point to significant unmet needs: nearly half (40%) of total funds requested for WASH in UN emergency appeals in 2015 went unmet (Development Initiatives, 2016)

Moreover, irrespective of whether funding is sufficient to meet needs in theory, the respective sources are not being coordinated in practice. In protracted crises in many fragile situations, from South Sudan to Iraq, development and humanitarian funding and programmes operate in isolation (Mason and Mosello, 2016). The protracted and cyclical nature of conflict and other challenges in these countries mean there is no clear division between emergencies and periods of stability. Development agencies implementing WASH projects that are meant to last decades struggle to build resilience to the risk of conflict flaring up again. Humanitarians responding to the needs of those directly affected by conflict provide free or heavily subsidised services, which can undermine the ability of governments and markets to provide WASH goods and services in the longer term.

Making development and humanitarian WASH spending more complementary is challenging. Protracted crises are characterised by insecurity, extreme and unpredictable need, and breakdown of trust between populations, government and external agencies (Mosel and Levine, 2014). Faced with this level of risk, the tendency has been for both development and humanitarian agencies and funders to stick to what they know. Differences in operating approaches on the ground are the most visible manifestation: separate systems for coordination; different recruitment and development pathways for professionals; and different attitudes to working with communities and governments, and to subsidising infrastructure.

Yet these operational differences often arise from incentive structures that have a lot to do with the terms attached to funding – a set of ‘rules’ that apply across different sectors. Humanitarian funds are often short-term and require limited reporting, focusing on numbers reached. Development funding is stereotypically longer term but less flexible, with an increasing emphasis on reporting numbers using services, but more often a restrictive attention to expenditure. At a still higher level, normative differences in mission statements, principles of engagement and standards reinforce the separation in

how humanitarian and development professionals identify themselves and each other (Mason and Mosello, 2016).

Given how deep-rooted the separation is, the temptation in a single sector like WASH may be to wait for reform of the wider humanitarian and development aid architecture. There are occasional glimmers of hope. The ‘Grand Bargain’, for example, represents an agreement between more than thirty of the largest aid agencies and humanitarian donors. It aims to make humanitarian assistance more cost-effective, agile, and better geared to the needs of those facing emergencies, and includes a set of commitments by the signatories to strengthen engagement between humanitarian and development agencies (ICVA, 2017). Aid systems are, however unwieldy, as are the enormous bureaucracies of UN agencies, development banks, bilateral donors and international NGOs. Shifting them will take time, a luxury not available to those in acute need.

Action within the WASH sector is therefore necessary and important, and could demonstrate a pragmatic way forward to others. Working more closely with each other could begin more easily around specific challenges or at local levels, for example. In South Sudan, a task force on cholera has brought together a range of external humanitarian and development agencies, as well as Government representatives from both the health and water sectors. In Lubumbashi, DRC’s second city, the humanitarian WASH coordination group invites development partners to share information on respective activities. Higher level rules can also be worked around, including financial ones. In DRC, a consortium of NGOs has agreed a special window with their donor to allow them to repurpose a portion of funds allocated to a development programme, to respond to rapid onset emergencies if they arise (Mason and Mosello, 2016).

By concentrating initially on their own domain, WASH experts operating on the humanitarian and development sides of the divide can demonstrate what is possible *in spite of* the wider incentives working against greater collaboration and complementarity. That could provide compelling evidence of the possibilities as well as the limits to change, as a way to build coalitions with other sectors. Water, sanitation and hygiene are a good place to start, essential as they are to saving lives in emergencies and unlocking longer term development.

# 10. Business

## Businesses that work to reduce water risks in their supply chains and the wider environment have a chance to jump ahead of the competition

The contribution of business to sustainable development is well-recognised, and increasingly essential given the scale of the challenge. But only a few vanguard companies are taking action in any meaningful sense (Stuart et al., 2016). While this applies across the 2030 sustainable development agenda, it is painfully clear in the case of water and sanitation – despite the materiality of many water-related risks to the bottom line (Newborne and Dalton, 2016; CDP, 2015). With few companies willing to take a lead, being a first mover appears risky. Nonetheless, staying with the pack may be riskier still.

Unmanaged water risks pose significant costs. The Carbon Disclosure Project (CDP) invites companies to report on the scale of water risks they face and the actions they are taking to address them. Over 600 companies responded to the 2015 survey, reporting more than \$14 billion in water related impacts (CDP, 2016). Disclosure is increasing, and with it, reported costs – 405 responded to the 2014 survey, reporting a much lower total of \$2.5 billion in financial impacts (CDP 2015). Extremes, as ever, capture the most attention. Of the sums reported in 2015, \$9.7 billion was reported by a single Japanese utility to address groundwater pollution from a nuclear power plant damaged by the 2011 Tsunami. Companies looking forward to future risks tend to emphasise floods and droughts (ibid; CDP, 2015). Disrupted operations due to water scarcity are also commonly reported, and low flows can also drive up energy bills where hydropower is an important for electricity generation, as in Brazil.

There are also longer term water and sanitation risks that can stress company balance sheets but receive comparatively less attention. One example is the cost of obtaining water of sufficient quality for industrial processes. Where ambient water quality is low, additional plant and energy may be required for treatment. Inadequate water, sanitation and hygiene can also have significant effects on the health, wellbeing and productivity of workers throughout globalised value chains, but the issues are still often overlooked. The impact of improving WASH on human health, as well as reducing time burdens associated with managing inadequate WASH (care



for sick relatives; collecting water; finding privacy for defecation) implies obvious knock-on effects for business in terms of employee attendance, loyalty and productivity. A handful of studies have attempted to quantify the impacts, indicating tangible and less tangible returns on investment, including reduced absenteeism and product quality (WaterAid et al., 2016; WSUP, 2015; BSR, 2011). However, with complex causal pathways and a small pool of examples, the evidence and business case need to be strengthened.

Companies are exposed to water and sanitation risks at a range of scales, from their own production facilities, to distant basins in which their suppliers operate, and the communities in which their employees live. Action to date has been concentrated on the low hanging fruit, primarily mapping water risks and improving water efficiency in company-owned operations. A recent review highlights that where companies do engage beyond the factory fence, it is more often for brand and reputational purposes than to engage constructively in the collective action required to address major water risks like over-exploitation and pollution (Newborne and Dalton, 2016). A few companies have taken a more expansive approach – for example engaging with other management or use interests in water resources to discuss water development and allocation,

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or identifying market opportunities and partnerships in sanitation<sup>17</sup>.

At these broader scales, business interacts increasingly closely with governments, who are normally trusted to act as overall custodians of water resources and associated basic services. Concern can grow about the relative roles and influence of private versus public sector interests. The privatisation of public goods or the commodification and capture of vital resources will secure neither public trust nor equitable outcomes. The business contribution to more sustainable water and sanitation should not be about displacing public governance but complementing and collaborating. Nor should business contributions on specific issues, including water, distract from the need to improve the way in which business delivers on its 'day job': paying taxes, investing, innovating and providing decent jobs (Stuart et al., 2016).

What are the levers that could be pulled to bring about a more transformative shift in business behaviour at large with respect to water (often referred to as 'water stewardship') beyond the handful of pioneers? At a very basic level, compliance regimes set a minimum bar that could be raised in many jurisdictions. However, in countries with low capacity to monitor and enforce their regulatory frameworks, some companies may find it more cost effective to ignore or even subvert the system. Voluntary approaches that attempt to leverage peer competition and brand integrity to create incentives to improve business contribution on water are gradually expanding. These can include voluntary disclosure; standards; pledges and membership platforms. However, such initiatives have even less capacity to monitor and rectify breaches than public governance systems, and no formal powers to do so. They are therefore more appropriate as an entry point for business leaders who are already motivated to act, than to inspire that motivation in those who have other things on their minds.

To bring about a more transformative shift, those interested in water will need to work with others seeking to accelerate business action across a range of issues. Those include agriculture (including food delivery and

consumption, not just production), climate change mitigation and adaptation, and health. The target for these coalitions should not be individual businesses, first and foremost, but the incentive structures under which they operate. That includes helping investors to understand and quantify the returns and risk mitigation potential of more sustainable business practice. It also includes advocating for changes in the corporate legal frameworks in rich countries, which influence the expected size and timeframe of returns and the relative priority given to generating money for shareholders versus maximising wider social value. And it can include identifying and promoting alternative business models, for example circular economy manufacturing and social enterprise (Business and Sustainable Development Commission, 2017).

Individual businesses themselves can, however, take effective action individually as well as in collaboration with others – and it is in their interests to do so. The current set of incentives, combined with an adverse economic climate, do not make this obvious. They encourage business leaders to wait: to sit on cash or buy back shares, artificially inflating their price without creating real additional value. In the water space, more myopic businesses find it easier to do nothing or even to undermine positive change by lobbying against fairer pricing, capturing water allocations through political influence, or competing in a race to the bottom in terms of staff and supplier employee welfare. Yet first movers can also gain competitive advantage in such circumstances. The time taken to innovate on water and sanitation, as well as other development and environmental issues, mean existing business champions of sustainability enjoy a lead of a decade, not a year (Business and Sustainable Development Commission, 2017). Only the next group out of the starting blocks will have a chance of catching up, while those that wait for a critical mass risk falling permanently behind. Being a first mover is high risk, but high return. The alternative – to hold back – is both high risk and high cost. It could ultimately result not only in much greater water impacts on the bottom line, but the widespread erosion of public trust in businesses and their leaders.

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17 See for example the 2030 Water Resources Group ([www.2030wrg.org](http://www.2030wrg.org)) and Toilet Board Coalition ([www.toiletboard.org](http://www.toiletboard.org)).

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# Conclusions

The changes we have identified will have important consequences not only for how we use and manage water and sanitation, but for the success, cohesion and resilience of our societies. Our list of ten is subjective. For those working on water and sanitation, the issues may also be familiar. Our contention is that they are still too often overlooked by the wider audience of politicians, business leaders and opinion shapers who will in fact determine our water future. They are therefore worth attention.

We have selected five trends that encapsulate the challenges we face to achieve SDG 6, to ensure availability and sustainable management of water and sanitation for all. Yet tackling these challenges will also be important for achieving other sustainable development goals. Ensuring water resources are developed and managed in a way that is resilient in the face of accelerating demand and variable supply as well as patchy quality will be critical for poverty reduction and growth. Managing the additional pressures on water from migration could help avoid increasing competition descending into conflict. Upping the ambition on drinking water and sanitation will contribute

to people's health, well-being and education, while putting poor and excluded people first will support wider social inclusion and reduced inequality.

As much as trends in water and sanitation will have big impacts on the wider world, shifts in the wider world will throw up important opportunities. Increasing pressure on governments and businesses to better share prosperity could lend water resources and WASH services renewed importance in ministries and boardrooms. The continued attraction of cities, small as well as large, offers a chance to rethink how water and sanitation services are provided. Innovations that, on the face of it, have little to do with water could help resolve some of the most intractable challenges in exploiting and managing common pool resources. And the increasing concentration of poverty in fragile states increases the imperative to use WASH to save the lives and support the livelihoods of the most vulnerable people. None of this is given, but whatever arises, specialists in water and sanitation will need to persuade others to meet the challenges and secure the opportunities, and work closely with them.

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