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www.research.hsbc.com

The Water Crisis

Clear risks, growing opportunities

Water scarcity is one of the biggest environmental challenges of our time...

...posing risks to countries, regions and cities across the planet

The challenges are immense – and have significant implications for investors



This is an abridged version of a report by the same title published on 21-Sep-21. Please contact your HSBC representative or email AskResearch@hsbc.com for more information.



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Lucy Acton

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Executive Summary

The Water Crisis

Water is essential to the development of all living things and key to the success of economies and businesses. We think it is more important than ever for investors, companies and governments to recognise the risks they face – as well as the opportunities that are open to them - as the quality and quantity of water supply increasingly comes under threat. The risks include reduced crop production, population displacement, and declining sanitation if action is not taken urgently.

Despite covering 70% of our planet, water is neither abundant nor evenly distributed around the world. At least, not the water that is suitable for drinking, sanitation and industry use. In fact, only 0.007% of the water on the surface of the planet is both useable and accessible. And it is not allocated evenly according to the needs of expanding populations, cities and industries.

The scale of this already monumental challenge is only increasing, with floods and droughts having regularly made headlines throughout this year so far. Climate change, demographics, and rapid rates of urbanisation that outpace infrastructure developments mean that demand and supply of freshwater is set to become “the challenge of the century” according to NASA. Water pollution is both a cause and effect of water scarcity, so it is also frequently mentioned in this report.

Moreover, water scarcity creates a full spectrum of spill-over effects, relating closely to a range of key ESG issues (page 5). These include biodiversity, pollution and climate change related developments. From a social perspective, this covers health risks, inequality, migration and conflict related risks.

“ Achieving a water secure future will require a complete transformation of our global economy and the business and financial models that sit at the heart of it. The time for business as usual is over.

Cate Lamb, Global Director of Water Security at CDP

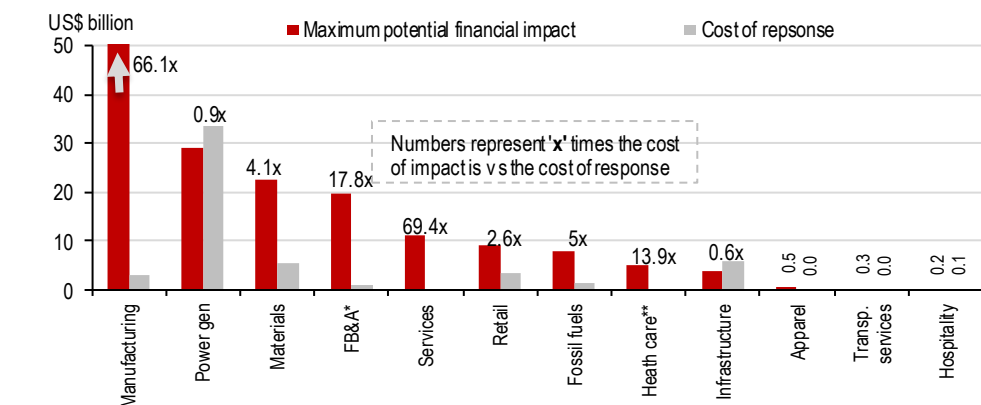
Naturally, these trends have significant implications for investors. Of note are data from the Climate Disclosure Project (CDP) which estimates that water related risks cost corporates USD301bn in 2020, and these risks were not isolated to specific sectors, either (Figure 1). Further, CDP estimates that USD55bn of investment would have been sufficient to mitigate those risks.

Sectors and regions face specific risks

One of the most common ways in which water risks develop at a company and sector level is via supply chain disruption. For example, the loss of supply of (clean) water to facilities in almost any sector can be catastrophic for operations (even just the basic supply of drinking water to employees on site), but particularly for those companies that rely on this water supply as a crucial part of the production process, such as the technology and agricultural sectors.

This presents two interesting areas of analysis: *where* supply chains are located, and *which* industry/sector a supply chain is operating in. We think understanding this allows investors to build a greater understanding of where water scarcity risk hotspots are. And so, in this report, we explore both the geographic risk areas, and the sector level risks – and sometimes how they relate to specific companies. Naturally, where there is downside risk, there is also opportunity.

Figure 1: Sectoral water risk impacts...vs the cost of action



Source: CDP Global Water Report 2020 *Food, beverage & agriculture, ** Biotech, healthcare & pharma

Cities will need to adapt

Investors should be acutely aware of water related risks, too. The UN estimates that regions affected by water scarcity could see growth rates decline by as much as 6% of GDP by 2050, as a result of lower income, agricultural output, as well as health and productivity declines. Cities in particular will be exposed to these risks as rapid rates of urbanisation continue across emerging markets, placing significant strain on water resources. Solutions will require improved water management, greater use of AI and other technologies to streamline information systems, reduce waste and improve infrastructure.

50%

Of global grain production could be at risk of water scarcity by 2050 (UN)

Critical for commodity markets

Finally, water is hugely important for commodity markets. It is needed for the production of many commodities, particularly agricultural products. We explore how it could become a widely-traded commodity. Treating water as such, and trading it within a well regulated market could help achieve more efficient outcomes in water allocation and usage.

Did you know?

- ◆ Only 0.007% of water on earth is suitable – and accessible – for our needs (e.g. drinking, sanitation, industry), (National Geographic, US Bureau of Reclamation)
- ◆ In 2020, 25% of the global population lacked access to safely managed drinking water, and almost 50% did not have access to safely managed sanitation services (WHO)
- ◆ 20% of global GDP is produced in areas that are suffering from water scarcity (World Water Development)
- ◆ Droughts have affected 1.5 billion individuals this century so far, at an estimated economic cost of c.USD124bn (UN)
- ◆ Global water demand is likely to increase by 20-30% by 2050 (UN)
- ◆ More than half of the global population will live in areas of water scarcity at least one month a year by 2050 (Nature), and one in five countries will be facing water shortages (UN)
- ◆ 50% of global grain production could be at risk of water scarcity by 2050 (UN)
- ◆ Even if warming is limited to 2°C, the Middle East will still face water scarcity issues (IPCC)
- ◆ Regions that suffer from water scarcity could see their growth rates decline by as much as 6% of GDP by 2050 (UN)
- ◆ Water managers from 40 different states across the US expect at least some form of water shortage within the next decade (Water Footprint Organisation)
- ◆ One-third of all river stretches across LatAm, Africa and Asia are affected by severe pathogen pollution (UN)
- ◆ 200m individuals could be displaced because of desertification, sea level rise and extreme weather events by 2050 (World Water Development)
- ◆ Water related risks cost corporates USD301bn in 2020...while investment to mitigate those risks would have cost USD55bn (CDP)
- ◆ USD21bn each year to 2030 (0.1% of global GDP) would bring water and hygiene benefits to all who need it globally, bringing potential economic benefits of c.USD60bn (World Bank).

Water stress: capital risks

25%

Global population without access to safely managed drinking water services in 2020

20%

Global GDP produced in areas of the world that suffer from water scarcity

50%

Global population at risk of water stress by 2050

80%

Share of wetlands lost since pre-industrial times

ESG themes: local issues with global implications



Climate change:

One of the clearest ways that we notice the impacts of climate change is via water; particularly via floods and droughts



Biodiversity:

Water and ecosystems are closely linked. Climate exacerbated droughts amplify challenges associated with biodiversity, and vice versa



Pollution:

Agri, algae blooms, saltwater intrusion, industrial, pathogen waste. 80% of global wastewater goes untreated, posing significant risks



Health:

Polluted water for drinking and sanitation can lead to pathogen related illness. 50% of the global population could not access safely managed sanitation



Gender equality:

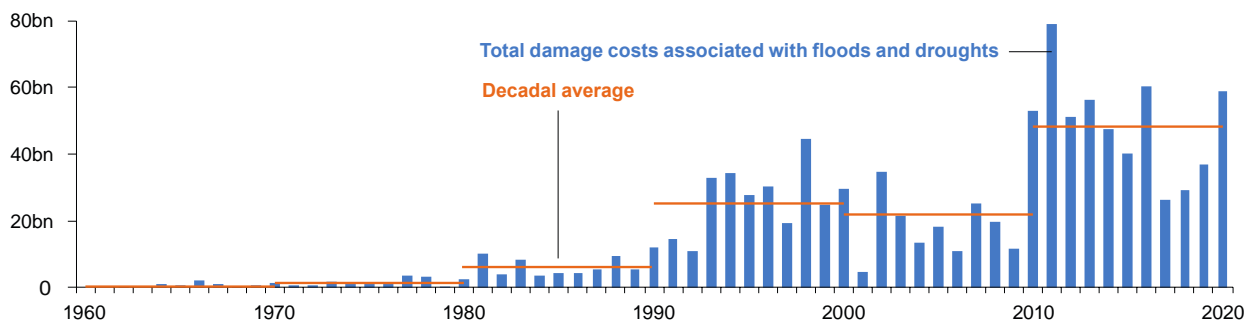
Women are particularly reliant on clean water supplies and sanitation for specific health and hygiene needs throughout their lives



Migration:

Conflict, water scarcity challenges, desertification, sea level rise and extreme weather events could lead to 200m people being displaced by 2050

Damage costs from water-related extreme events are on the rise (USDbn)

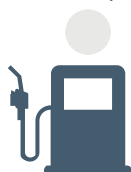


Virtual water: the invisible export trade affecting emerging and frontier nations

Virtual water is the amount of water 'embedded' in a product. As water-scarce countries trade goods and services, water in their local region is exported to another part of the world – ultimately reducing water levels available to the local community. Amount of water required for these everyday products:

Litre of petrol

13.5–27 (litres)



One avocado

273



One mobile phone

1,091



One cotton t-shirt

3,241

(= 18 bath tubs full of water)



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Water scarcity

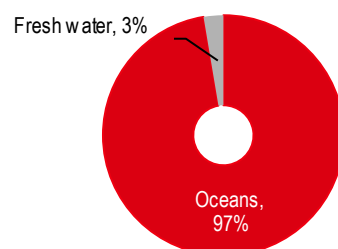
- ◆ Labelled the “challenge of the century” and “the next pandemic”...
- ◆ ...water scarcity poses a full spectrum of risks to equity, macro and commodity investors
- ◆ Better understanding “hotspot” regions, sectors and cities is critical for effective risk management, in our view

The water that we need for our very existence on this planet - for drinking, sanitation, and industry - must be freshwater. And, despite what one might assume on a planet which is 70% covered in water, supply of this is extremely challenged. Only 3% of all of the water on earth is freshwater, and not all of this is accessible; much of it is locked up in glaciers or parts of the world that are hard to access (over 75% of it, in fact). As a result, data suggest that only 0.007% of water on this planet is actually suitable and accessible for us by societies today (National Geographic).

While freshwater is renewable, there is a huge mismatch between the demand and supply of it around the world. Some countries and regions have freshwater in abundance. Other countries and regions see rapidly declining rates of freshwater availability per capita in the face of climate change, water infrastructure challenges, demographic changes, high levels of pollution and/or a combination of these factors. This mismatch is difficult to solve since transporting water over any significant distance is very difficult, and costly.

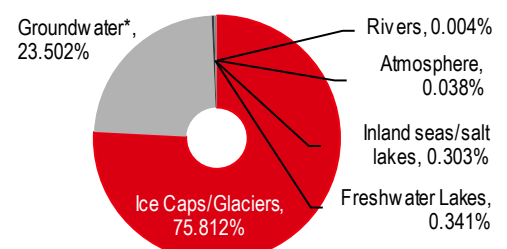
In this chapter, we explore why water scarcity is so relevant to investors. We then explain the root causes of water scarcity, and which areas of the world suffer most. Understanding this will, we believe, allow companies, equity and macro investors to better locate risk hotspots, where water related risks are likely to be more prevalent.

Figure 2: A planet full of water, but little to go around...



Source: United States Bureau of Reclamation

Figure 3: ...most of which is physically or economically inaccessible



Source: United States Bureau of Reclamation. *Note: Some groundwater lies too far under the earth's surface to be economically viable for extraction

The challenge of the century

A nexus of climate, demographic, industrial and urbanisation related developments points towards the world facing a large and growing threat from water scarcity, unless drastic action is taken now. A recent report by NASA described water scarcity as the world's environmental “**challenge of the century**”. NASA is not alone with this hypothesis; the United Nations has described droughts as “**the next pandemic**”, unless significant efforts around land and water management are made now.

The UN estimates that 50% of the population at risk of water stress by 2050

We think that water scarcity – and pollution – create threats at every level of societal and economic structures. At the most basic level, water is required for the very existence of humans – and other life forms – on this planet.

Water provides the basis of social, natural and financial capital across the world. And so, when water becomes scarce, ecosystems, societies and economies may begin to breakdown. This poses threats across the entire spectrum, from the smooth operating of companies and returns on investments, right through to economic growth and development, and even the existence of life forms.

Why investors should care

Companies and sectors

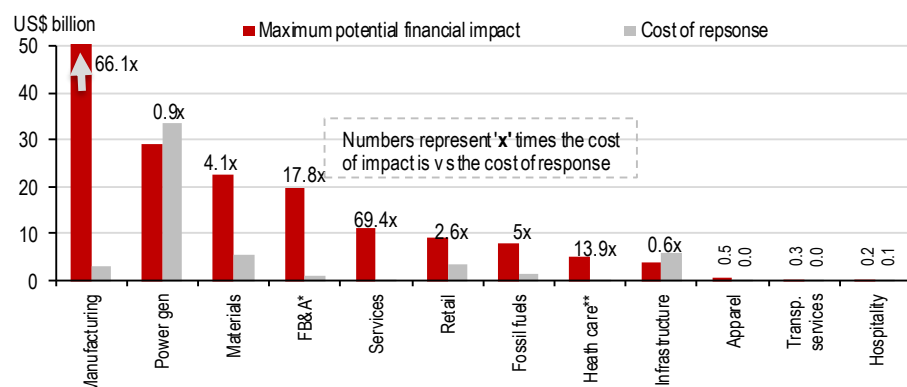
The Climate Disclosure Project (CDP) estimates that water related risks cost corporates USD301bn in 2020. Another CDP survey of 525 investors (covering USD96trn of assets) found that 45% of investors reported exposure to substantive risks from water insecurity. Further, this amounted to an estimated business value at risk of USD425bn, where 40% of these risks are expected to hit within the next 1-3 years. In our view, these are staggering statistics, in the face of how briefly these risks are discussed at a company and investor level.

Supply chain disruption from extreme weather events

One of the most common ways in which these water risks materialise for corporates is via supply chain disruption. Water scarcity and pollution pose a threat to clean water supplies in and of themselves. Added to this is the threat of other climate challenges, such as the growing probability of more frequent and severe extreme weather events including extreme temperatures, wildfires (which can occur following periods of drought) and flooding. These can lead to loss of physical infrastructure, disrupting operations and causing significant and costly damage.

And so, with these threats growing over time, not shrinking, we caution that companies and their investors should incorporate water related risk planning into their decision making. Investments to adapt to these risks are an important solution. We think this further highlights the urgency and importance for investors and companies to act now, and to better understand the risk sectors and regions around the world.

Figure 4: Sectoral water risk impacts...vs the cost of action



Source: CDP Global Water Report 2020 *Food, beverage & agriculture, ** Biotech, healthcare & pharma

Economics

Currently more than a quarter of the global population are living in countries that experience high levels of water stress. This has dramatic implications for the health, prosperity, development and economic successes of these societies. In fact, with the exception of one year between 2012 and 2020, “water crises” were ranked in the top five “global risks by impact” in the World Economic Forum’s annual Global Risks reports. And, the UN estimates that regions affected by water scarcity could see growth rates decline by as much as 6% of GDP by 2050, as a result of lower income, agricultural output, as well as health and productivity declines.

20% of global GDP produced in areas suffering from water scarcity

To put some numbers to this, an estimated 1.5 billion individuals have been affected by droughts alone in this century, with an economic cost over that same period of c.USD124bn (UN). Already, 20% of global GDP is estimated (by the UN) to be produced in areas of the world that suffer from water scarcity; that is a significant (and increasing as the challenges spread) share of capital at risk. We believe investors must be aware of the potential downside risks, and also to the fact that governments will increasingly be required to invest in land and infrastructure management, particularly across higher risk areas. Markets may react to water shortages directly, too, as a signal of poor economic management by authorities that lowers the trust in institutions.

Why investors should care: A case study

One good example of how a single water risk can pose threats to a range of different investors is a case study in the US. In July 2021, the US Bureau of Reclamation estimated that Lake Meade's water level will fall 31 feet by June 2023. The WSJ (14 August 2021) indicates that a 118 foot drop from current levels over this time frame would disable one of the most important hydroelectric turbines in the US, which is responsible for supplying power to businesses and 1.3 million citizens across Southern California, Nevada and Arizona. The Colorado River, which feeds the vulnerable Lake Meade, is also an important supplier to Mexico's industrial north.

This is a major investment risk that could be overlooked by institutional investors. Not only does the shortage of water for drinking and agriculture pose obvious social problems, but so too does the structural and long-term electricity shortages in an already power deficient region. Three years is certainly within the current investment time frame of many institutional investors.

Where in the world?

As with other natural resources, water resources are not evenly distributed around the world. Some areas suffer immensely from almost no freshwater supply, while others have it in abundance. These inconsistencies can dramatically worsen inequality around the world. Global averages point towards an overall steady decrease in renewable water resources across many countries, and particularly across the Middle East and Africa.

One basic way of exploring the regional disparities in freshwater availability, is by exploring the causes of scarcity first from a *demand* side, and second from a *supply* side.

Supply isn't simple

Supply of freshwater can be disrupted for a number of reasons, but climate change is a major one. Climate change disrupts the hydrological cycle, increasing the likelihood of heavy precipitation and flooding alongside extreme temperatures, droughts and wildfires. Floods can exacerbate water scarcity challenges is via devastation to infrastructure, loss of topsoil and water pollution.

Demand that's here to stay

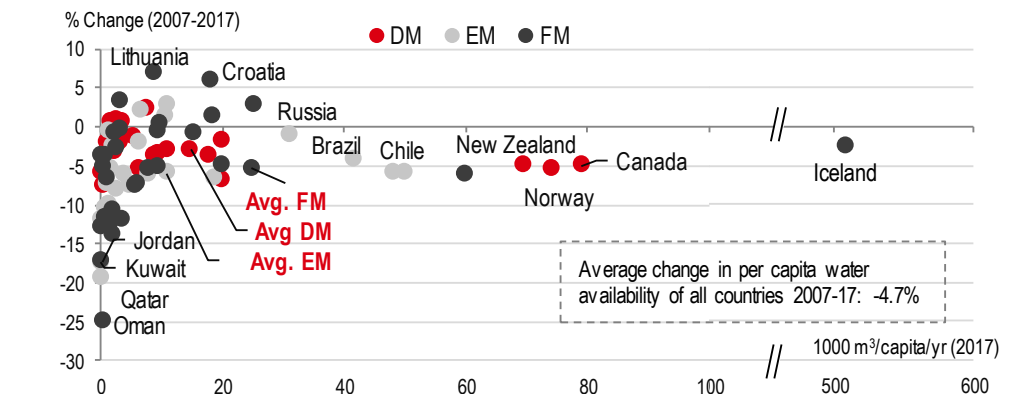
Coupled with disrupted supply is rapidly increasing demand for freshwater. Over the past century, water use has grown at a rate of two times the rate of population increase. Given population growth projections (amongst other things), the UN expects global water demand to increase by 20-30% by 2050 . Population growth and therefore demand for more water resources is particularly significant across emerging markets and areas that are undergoing rapid rates of urbanisation. Many emerging markets suffer more acutely from the physical impacts of climate change, as well as poorer quality infrastructure, thus constraining supply and compounding water scarcity and inequality challenges.

Regional and country perspectives

Global decline in freshwater availability in decade to 2017

Of the 77 EM, DM and FM nations classified by the FTSE (plus Argentina), we calculate there was a 4.7% decline in average per capita water availability in the decade to 2017. Even countries such as Iceland, Canada and Norway that have very high levels of water availability observed a decline availability during that timeframe. Oman and other Middle Eastern states observed both some of the lowest levels of water availability, and also the largest decline.

Figure 5: Water scarcity does not occur evenly



Source: Aquastat, United Nations, HSBC. Note this sample of countries is the 77 EM, DM and FM markets rankings according to FTSE listings (plus Argentina)

These findings tally with third party analysis of where freshwater scarcity challenges lie. A 2018 report by NASA found 19 global “hotspots” across the Middle East, Australia and California in the US. NASA’s study also identifies 30 hotspots where freshwater is likely to become a problem in future, across the Middle East, African nations and parts of China, for example. A separate report from the IPCC – the climate science division of the UN – poses a clear warning about climate exacerbated scarcity challenges in the Middle East.

Note: this forms part of a bigger modelling piece of research we have carried out that explores climate vulnerability at a country level. For more information, contact AskResearch@hsbc.com.

Virtual water: The invisible trade

To better understand the reasons why some countries suffer from water stress more than others, it is also important to understand the term “virtual water”. Many of the goods and services that we consume “contain” water, in that it has been used at some point along the production of those products. This includes products one might not usually expect (Figure 6).

Figure 6: Virtual water footprint of a selection of everyday products

Product	Water required for production (litres)
Litre of petrol	Between 13.5 and 27
One avocado	273
One mobile phone	1,091
Cotton t-shirt	3,241

Source: Water Footprint Organisation

Exporting water

And so, when countries manufacture and then export products, they are essentially “exporting” the water in their local region to another part of the globe. This reduces the level of water that is available to the local community for sanitation, drinking and other purposes.

With little value...agriculture uses 69% of global water but accounts for just 4% of GDP

This exacerbates the gap between water scarce, low income nations, and more water abundant, developed nations. Further, emerging and frontier markets can suffer much more from pollution and poor quality water infrastructure because of a lack of resources, planning and institutional quality to manage for these risks. Additional water wastage and pollution make the problems of water scarcity even greater.

Smart (and thirsty) cities

While water scarcity is often worse in rural areas than urban ones, the rapid growth of cities is not coming with the required infrastructure to meet water demand, meaning that shortages can become acute and there is greater uncertainty about the provision of water on a daily basis – something that could happen much more regularly in future.

Poor infrastructure can mean water shortages

Mexico City, for example, frequently experiences heavy rains and flooding, but a significant lack of infrastructure means that 40% of this water is lost. Elsewhere, Chennai, in India, has urbanised rapidly and now requires 800m litres of water each day to meet demand, but water infrastructure and management of the local area can only provide 675m litres each day. This gap has to be plugged via transporting in water from the surrounding area, an unstable situation that is a trigger for tensions across the city.

In 2018, South Africa's capital city, Cape Town, only narrowly avoided a “day zero” – a day where water demand would have completely outstripped supply – because of stringent regulation and public effort. For investors, this is worth noting. The water crisis caused social and economic damage, and such events can contribute to investor perceptions of how well run an economy is.

Other cities could be vulnerable. São Paulo, Bangalore, Beijing and Cairo have all been flagged by various reports¹ as possibly facing water stress in the coming years. But it may not just be emerging market cities – London, Miami and Tokyo are also flagged in reports. Cities that depend on surface water, from lakes and rivers, are vulnerable to pollution affecting the water supply, which needs to be treated to be useable.

Mexico City's Rain Harvest programme is a good policy example

As water becomes yet more scarce, and cities, particularly across emerging markets, continue to expand rapidly, we believe that such “day zero” near misses could become more frequent. And so, effective water management and infrastructure will be absolutely critical. This will need to encompass local level policies, planning, governance and investments across the entire value chain.

Further, the rapidly expanding development and application of AI technology can be used for solutions in cities – particularly in buildings – to limit environmental impacts. For example, with respect to water, combined with complementary technologies such as IoT devices and sensors, AI technologies can assist with ‘smart water systems’ and better data collection possibilities to minimise unnecessary wastage.

We expect these types of policies to be further integrated into “future cities” planning, alongside other equally important infrastructure needs such as green buildings, public transport and green spaces.

Desalination

A solution...or not?

Desalination still offers one of the most viable ways of supplementing the world's depleting freshwater availability. The process allows water-stressed states such as Kuwait to consume far water more than their natural freshwater supply. Given water scarcity challenges, we expect desalination related investments to continue to grow for a number of regions.

While these efforts are a commendable solution to an immense challenge, we caution sustainability investors to explore the true processes used at desalination plants first, because there are two critical environmental impacts from desalination: brine generation and high emissions intensities.

There are a number of different processes and technologies used for desalination, including reverse osmosis, which is the most common. The different processes have different environmental impacts. For emissions, efforts are underway to limit the emissions impact of desalination processes, by using renewable power – often solar power – in arid areas that are turning to desalination solutions.

However, we think investors who are concerned with minimising water related risks should pay particular attention to the brine generation risk of desalination. High levels of brine found in oceans, rivers and lakes can be toxic and damaging for ecosystems. Chlorine and copper are also found in brine water, which has an extremely high salt content (5% compared to saltwater at approximately 3.5%). And, on average, 1.5 litres of brine are released for every litre of freshwater produced (UN).

Water consumption 34x greater than supply in Kuwait

Pollution risk with desalination, worsening the problem of scarcity?

¹ The 11 cities most likely to run out of drinking water - like Cape Town, BBC, 11 February 2018

The high temperature discharge can also lower oxygen levels in oceans and waterways, disrupting animal and plant lifecycles. Ultimately, these issues contribute to water pollution, and can therefore exacerbate water scarcity risks. We therefore urge investor caution on these processes, and would suggest that companies turning to desalination solutions to water scarcity report on and monitor the pollution risks that may arise.

Water and commodities

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Despite a recognition of the value of water for humans, it has been largely absent from the commodities space. This largely stems from water's apparent abundance when compared to other commodities. For example, water can be collected by anyone for free, globally, by just attaching a tank to your drainpipe, and as a 'free good' any costs involved are usually related to recouping treatment, distribution, and pollution abatement costs.

This comes on top of water's low value-to-mass ratio, making transporting by air or freight cost-ineffective, compared to other commodities. For example, the cost of moving water from the north of Western Australia to the south of the state (a distance of over 2,000km) is far higher than just using desalination plants locally (Government of Western Australia). High transport costs mean that the trading of water as a commodity favours local markets, rather than global.

Pricing and trading water

As water becomes scarce, trading (and pricing) it makes more sense. There are already some nascent examples of water trading. In Australia, a water trading system has existed in the Murray-Darling system since the mid-1990s. This was formalised and nationalised with the Commonwealth Water Act of 2007. Access to shared water resources within the river systems is regulated by the states and territories through water access entitlements, which are a tradable asset.

In October 2020, the US's water trade market launched the first of its kind on the Chicago Mercantile Exchange. The move was triggered in response to growing uncertainty around availability of water in the future, particularly given the heat, wildfire and droughts that the US had been experiencing.

Of course, trading water like a commodity is only one aspect of commodity market interest, with another being the extent to which other commodities represent embodied water. In particular, this is the case with agricultural products. Meat is particularly water-intensive in its production with a kilogram of beef requiring over 15 kilolitres of water to produce, compared to less than two kilolitres per kilogram for cereals. The projected increase in the production and consumption of animal products is likely to put further pressure on the globe's freshwater resources, as the UN estimates half of the world's grain production could be at risk of water scarcity challenges by 2050.

To meet the challenges of managing the scarcity of water, appropriate pricing in markets, as is done with other commodities, could be a powerful tool. That would help to make sure water is allocated to the highest value uses. An efficient market could help improve equitable allocation of water among competing users, both between present and future generations.

These pricing systems could then be used to trade water rights and set policies such as taxes on water depletion and pollution. A well-functioning market that determines a reliable water price would help to make decisions about capital investment in pipelines and repair works that help to prevent wastage and large projects, such as desalination plants.

A well-functioning market for water would also help to support improved efficiency in the production of products that are embodied water, such as the agricultural products listed above.

From carbon markets to water markets

The emergence of Europe's carbon markets is evidence that once the institutional settings are put right, a price on low-value public resources can be powerful for encouraging less profligate use. A well-designed and enforced cap-and-trade system could be highly effective in ensuring environmental sustainability, for example, by restricting water drawing to levels consistent with flowing rivers and aquifers that maintain their levels over time. Systems such as these would help to build a constituency to ensure the water system's sustainability for the longer term.

ESG themes

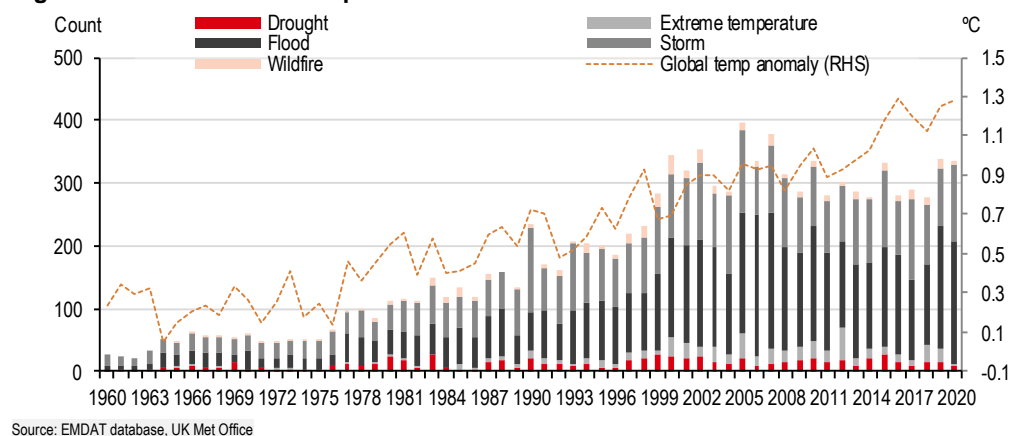
- ◆ Climate change and biodiversity risks are closely linked to water...
- ◆ ...meanwhile, pollution is both a result of water scarcity, and further exacerbates the issue
- ◆ Health, gender equality and migration are key social considerations

Climate change

In hot water

One of the clearest ways that we notice the impacts of climate change is via water. Climate change leads to a higher probability of more frequent and more severe weather events, including droughts, floods, wildfires, storms and extreme temperatures. As emissions climb and so too do temperatures, the rate at which we are seeing the impacts of climate change play out is rising rapidly; all five categories of climate exacerbated extreme weather events have become more frequent as temperatures have risen over the past 60 years (Figure 7).

Figure 7: Global extreme temperature increases....and extreme event occurrences

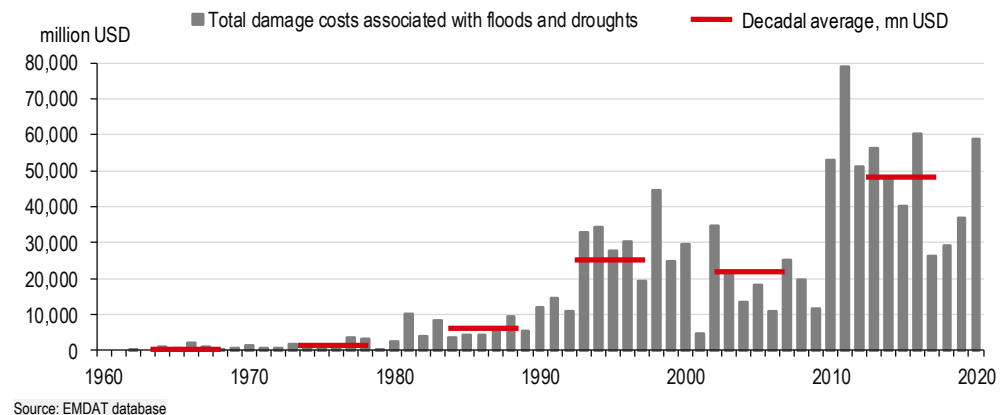


Of all extreme weather events, floods and droughts are most directly associated with changes in water availability around the world. Over the decade to 2018, an estimated 74% of all natural disasters were associated with water (UNICEF). Whilst the relationship between droughts and water scarcity is clear - groundwater is depleted leading to water stress - the relationship between floods and water scarcity may be less clear at first look; surely floods mean *more* water availability?

Floods worsening water stress

However, floods do play a role in causing more water stress. Erratic and uneven rainfall as a result of climate change can increase a region's flood risks. The most immediate impact of flooding on water scarcity comes from contamination of water used for drinking, cooking, sanitation and other key uses, as a result of sediment build up and damaged infrastructure. The ultimate impact is the reduction in availability of suitable water sources, contributing to water stress. As the frequency of these events increases, so too does the economic (amongst other) burdens of these events. Over time, this can weaken economies. Figure 8 demonstrates how damage costs associated with floods and droughts have risen dramatically over the years since 1960.

Figure 8: Damage costs from water related extreme events are on the rise



More to come

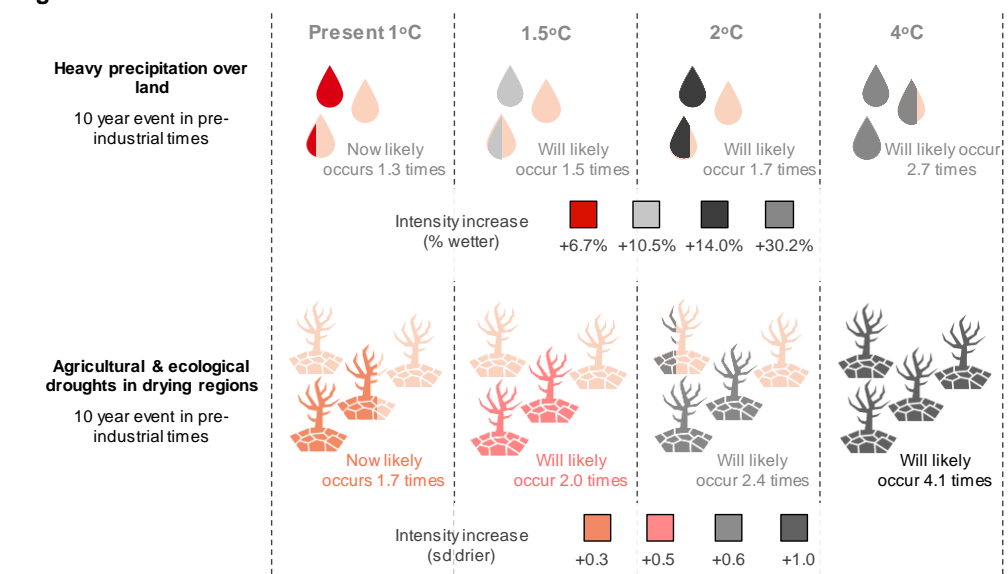
Looking forward, water stress caused by extreme weather events (such as droughts and floods) is likely to continue. In August, the UN's climate science body, the Intergovernmental Panel on Climate Change (IPCC), released its sixth assessment report, on the science of climate change. The report finds that *"it is unequivocal that human influence has warmed the atmosphere, ocean and land"* and, more concerning, provides a view as to how the future may look with regards to the physical impacts of climate change. More specifically, the report finds:

"There is strengthened evidence...that the global water cycle will continue to intensify as global temperatures rise (high confidence), with precipitation and surface water flows projected to become more variable over most land regions within seasons (high confidence) and from year to year." – IPCC – Sixth Assessment report

More often, and more severe

In fact, the IPCC alluded to events that were previously occurring once every ten years in pre-industrial times, now occurring with far greater frequency and intensity than before. The IPCC projects that under 4°C of warming, the frequency of heavy precipitation and agricultural and ecological droughts could be as much as 2.7x and 4.1x respectively every ten years (Figure 9). We think this opens the door for significant devastation, from which investors and companies are unlikely to escape unscathed.

Figure 9: "Once in a decade" events no more



Source: IPCC's Sixth Assessment report, August 2021

All extreme weather events pose a threat

Beyond just floods and droughts, other events such as extreme temperatures, altered amounts (and types) of precipitation, storms and wildfires all have indirect impacts on water scarcity. As temperatures rise, for example, polar ice caps and glaciers melt, posing a threat to low lying land and water sources, as sea levels begin to rise. The result can be compromised infrastructure, and even contamination of freshwater sources with saltwater.

Other risks such as altered types of precipitation pose a threat to water availability, too. For example, a study in the journal *Nature* found that in 2020, Japan saw a combination of high temperatures, and levels of rainfall, and the lowest levels of snowfall on record, resulting in low levels of “snow water equivalent” (SWE). Changes in the type of precipitation exacerbated water stress in some parts of Japan that rely heavily on SWE for supplies of freshwater. Higher temperatures contribute to more water and moisture lost from plants and soil, creating challenging environments for agricultural production.

Biodiversity

Water is a key part of the biodiversity and climate nexus. Climate exacerbated droughts amplify challenges associated with biodiversity, as some species struggle to survive with low water supply. This has a knock on effect on the entire local ecosystem. We have published recently on why addressing biodiversity loss is paramount to the future of society and economies - the UN described current rates of ecosystem decline as presenting a “*systemic risk*” to the global economy - and how investors and businesses will be affected by a broader movement to address ecosystem related risks.

80% of wetlands have been lost since pre industrial times

Floods are closely linked to biodiversity. Floods can leave destruction in their wake that challenge the survival of ecosystems. Alongside this, thriving ecosystems can allow for better flood protection; for example via mangroves, natural flood plains and water meadows. All of these are part of nature’s natural defence system, and protecting them is a vital part of the response to these issues; over 80% of wetlands have been lost since pre-industrial times (UN).

Water pollution

Water pollution arises when water sources become contaminated with pollutants that render it unsuitable for use. This exacerbates water scarcity. Contamination of groundwater supplies (such as aquifers) and other freshwater sources (such as rivers) can arise from a range of different polluters, including chemical pollution, plastic pollution, pathogens (from human or animal waste) and organic matter (including nitrogen and phosphorus from agriculture). Once a water source has become contaminated, it can be very difficult and/or expensive to resolve.

A result and a cause of scarcity

Water pollution not only worsens water scarcity, but also arises because of water scarcity. This is because contamination is more likely when one water source becomes over-exploited and used for a number of different uses; drinking, sanitation, industry, for example. Poor water management and infrastructure means wastewater and other pollutants can leak into the source. Further, contamination of one aquifer or water source can seep into other water sources too, further exacerbating the problem.

There are two main types of pollution:

1) *Point source pollution*, which originates from a single location, for example a wastewater or a chemical/oil spill. This contamination can spread miles, and into other waterways. A lack of supply chain visibility in some sectors (including fashion and food retail) means that addressing this pollution can more easily be overlooked. A lack of accountability for pollution means poor practices can slip in under the radar more easily.

2) *Nonpoint source pollution*, which is where plastic pollution, agricultural run-off and other pollutants find their way into waterways and the natural environment. In some ways this can be harder to tackle, and often, in our view, demands effective government regulation in order for the risks to be fully addressed. We believe that regulation to combat these risks is most likely to centre on the use of certain known polluting chemicals, pesticides and plastic types, where a build up over time presents either human or environmental concerns, or both.

Toxic and harmful to ecosystems
Algae blooms

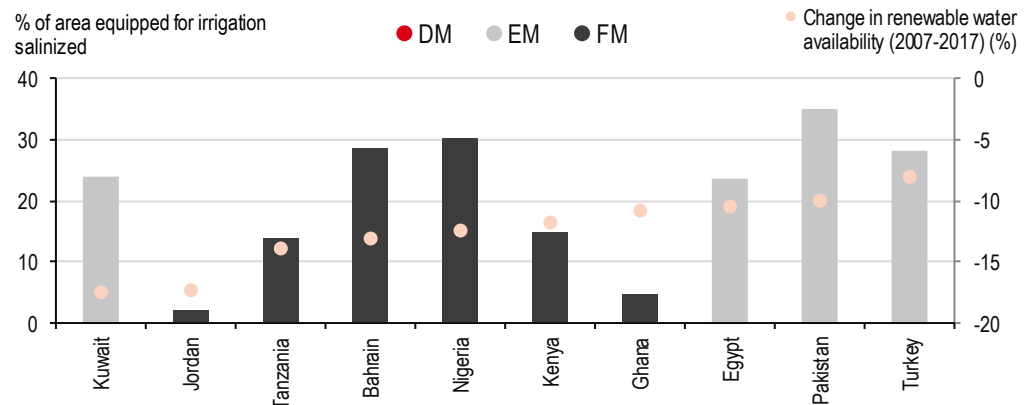
An algae bloom is the overpopulation of any member of the algae species in fresh or marine water. Whilst algae can be a vital carbon sink and producer of oxygen, overpopulation of certain types – sometimes visible and sometimes not – can be extremely toxic. And, as algae blooms die, bacteria build up in the water, starving the water of oxygen and harming ecosystems.

The frequency, duration and severity of algae blooms is increasing, due to both climate change and water pollution. The UN projects that lakes with harmful algae blooms are likely to increase 20% by 2050, threatening a vast number of species as well as posing threats to human health and sectors such as agriculture, fishing and tourism. Contaminates from agriculture, such as phosphorous and nitrogen are also thought to contribute to algae blooms. This is an important strand of consideration for both the agriculture and chemicals sectors, in our view. Later in this report we explore how this, alongside evolving government regulation, is an important consideration for investors in terms of upside and downside risks.

Saltwater intrusion

Saltwater intrusion means that the freshwater in these areas has become degraded and contaminated by becoming more saline. Of the 10 countries of the FTSE EM, DM and FM classified markets that have seen the largest change in water availability over the decade to 2017, six of them are now experiencing salinization in over 20% of their land areas that could otherwise be used for irrigation.

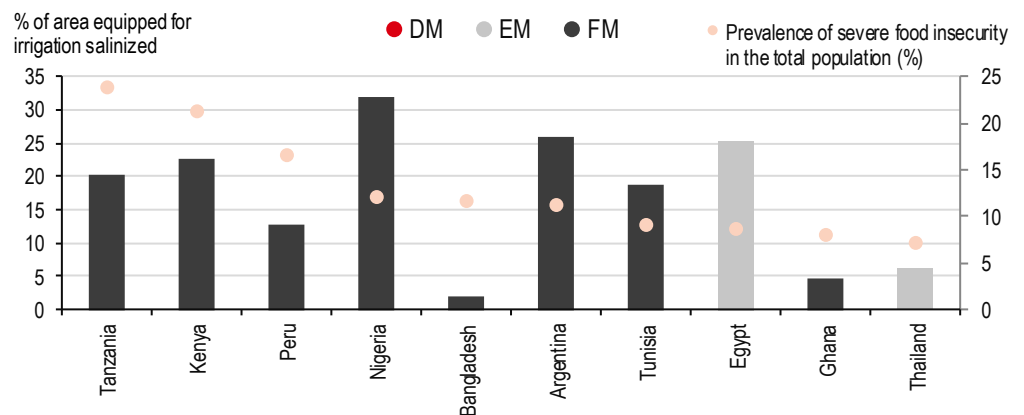
Figure 10: Large declines in freshwater availability....and highly salinized areas



Source: Aquastat

High rates of salinization in areas of food insecurity

Saltwater intrusion can be a particular challenge in areas that rely on the water supply for agriculture, as it can have a secondary impact on food supply (and livelihoods) in the local area. We find it concerning that many countries experiencing high prevalence of severe food insecurity are also seeing rates of salinization of 20% and over in areas that would otherwise be suitable for irrigation.

Figure 11: Salinization can present problems for water and food supplies


Source: FAO, Aquastat

A common cause of saltwater intrusion is when aquifers are overexploited in water stressed areas. The UN estimates that 20% of aquifers are being overexploited and thus risk saltwater intrusion. There are concerns that in some parts of the world, this could become a significant problem, including aquifers under the great plains of the US (the Ogallala aquifer), the north-west Sarahan aquifer system and aquifers across the north China plain and the Arabian peninsula. There are concerns that the Ogallala aquifer in the US may run out as early as 2050 (Nasa Grace).

In the Americas, we discussed earlier how severe water shortages in the Colorado River are already affecting power generation and potable water supplies in Northern Mexico and the Southwest of the US. This challenge is further complicated in some areas such as Mexicali, which sits below sea level. Here, there is an important aquifer for supply to the region, but salinization of this aquifer is of increasing concern, as it becomes overexploited, and media coverage suggests improper municipal and state water permits.

Overexploitation of aquifers also contributes to land subsidence. Land subsidence could actually affect an estimated 19% of the world's population by 2040 (UNESCO), which will present an additional flood risk in low lying areas.

A challenge multiplied

An added complication for assessing water pollution risks is the fact that water quality data are not collected in many parts of the world. The UN estimates that close to three billion people *could* be at risk of water pollution because the quality of their local freshwater ecosystems is unknown. We believe that governments will have a role to play here with encouraging better monitoring of water quality, for the sake of environmental and human health.

Health

Water is critical to support life on earth, and in some parts of the world, scarcity and pollution of supplies remains a critical challenge. It is for this reason that a core pillar of the UN Sustainable Development Goals, involves water. Specifically, Goal 6 of the 17 goals aims to “*ensure availability and sustainable management of water and sanitation for all*”. This covers a range of specific targets, including but not limited to, targets for safely managed drinking water, basic sanitation and handwashing services, participation of local communities in water and sanitation management.

Progress on these indicators has been made, but there remains a long journey ahead, and a recent WHO report cautions that the world is *not* on track to achieve basic targets for drinking water and sanitation services. In fact, the report finds that achieving universal coverage by 2030

3bn people potentially at risk of water pollution

Not on track for water and sanitation targets

will require a “*quadrupling of current rates of progress in safely managed sanitation series and basic hygiene services*”. In 2020:

- ◆ 25% of people in the world still lacked safely managed drinking water services
- ◆ Almost 50% of the population did not have access to safely managed sanitation services
- ◆ 30% of the population did not have access to basic hygiene services

Not enough safe water

Not only is there a lack of supply of water, there is a lack of supply of *safe* water. Using polluted water for drinking and sanitation can lead to illness, typically pathogen related illnesses. Water-borne pathogens are more likely in higher temperatures, something that is often synonymous with climate change (and increasing water scarcity). These pathogens can include cholera, cryptosporidiosis, campylobacter, leptospirosis, harmful algal blooms (as mentioned previously), and salmonellosis.

A common symptom of water-borne pathogenic illnesses is diarrhoea. Of the 250,000 additional deaths that are expected per year due to climate change between 2030 and 2050, 48,000 of them are linked to diarrhoea (WHO). Additional deaths for children aged under 15 years from diarrhoea caused by climate change are expected to be between 21,000 and 27,000 in 2030, according to the WHO, even accounting for assumed improved survival rates due to economic development. The WHO cites research showing a 3% to 11% increase in diarrhoeal disease risk per 1°C of temperature increase.

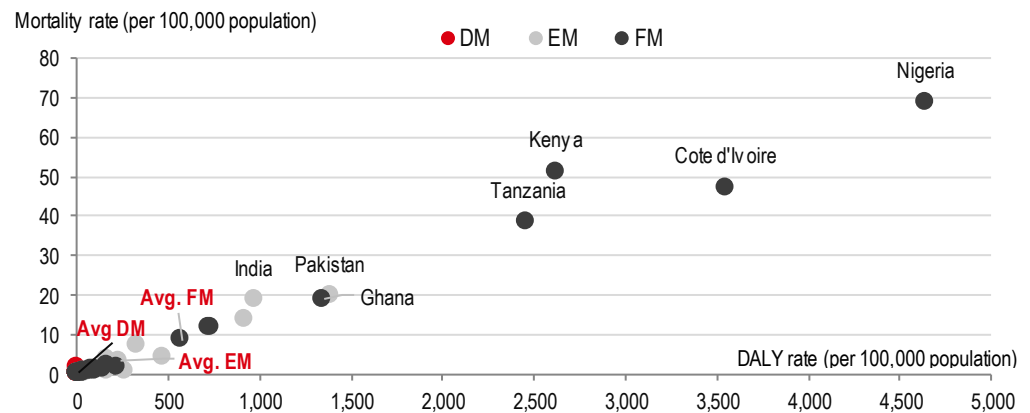
There are other health risks beyond water pathogens. Using polluted water during childbirth can present risks via infection. Unclean births contribute to an estimated 1m deaths each year (UN Water), with infections accounting for c.26% of neonatal deaths and 11% of maternal mortality.

COVID-19 and clean water

A clean water supply is required for basic hygiene; good sanitation is critical in the fight against pandemics, such as the ongoing COVID-19 pandemic. UNICEF estimates 3bn people did not have sufficient access to soap and clean water supplies at home during the pandemic, and that 40% of healthcare facilities were not properly equipped for good hygiene and sanitation in the face of COVID-19. Challenges such as these are increasingly likely as water scarcity presents an ever-greater threat around the world, and worsens inequality by exacerbating difficulties for vulnerable communities.

Water and health risks are an area of concern across the entire globe, but problems are typically most acute in emerging markets (Figure 12). The scale of the problem is dramatic, with the UN estimating that 21 million people around the world live within 5 kilometres of lakes with high turbidity (water cloudiness), which is typically associated with water pollution, and in many cases could well have an impact on local water sources used for drinking and sanitation.

These health risks pose a real threat to the productivity and health of the economies that suffer the most. They could also place a huge burden on governments and the health sector.

Figure 12: Water related health problems for EM and FM countries


Poor quality data

However, given poor quality data on water pollution there is much still unknown about the nexus between water and health risks. In the US, the Natural Resources Defence Council estimates that almost half of all rivers and streams, and almost one-third of lakes are likely to be unfit for drinking, swimming or fishing. 40% of Americans rely on groundwater for drinking water, suggesting that the remaining 60% of drinking water supply comes from freshwater surface water. This points to a worrying risk of contaminated water resources, although unconfirmed, in part due to a lack of data/research on the area.

Provision of clean safe water is the best means of preventing water-related illness. This can be achieved through use of filters and airtight water storage containers. Testing water for pathogens and parasitic organisms is another important feature in delivering safe water, which requires water testing equipment. There are a range of means for treating water borne illness, too. *In the following section of this report, we explore some of the diseases that are likely to become more prevalent in a more water scarce and polluted environment, against a backdrop of climate change threats. We explore some of the vaccines in development, and which companies are providing them.*

Gender equality

Lost education

Across many developing countries, women are primarily responsible for the collection and management of water supplies for the household and community. Where water collection sites are off premises, this responsibility takes time and effort that can have a significant impact on gender equality. For example, in some communities, girls miss out on education that boys receive because of these water related responsibilities. Across Africa, an estimated 17 million girls travel to collect water every day, spending time that often could otherwise be spent in education (George Washington University). This education level inequality can then persist through later life stages in life. Water is also closely intertwined with gender equality because women are particularly reliant on clean water supplies and sanitation for specific health and hygiene needs throughout their lives.

Conflict and migration

Water scarcity places a strain on economies and societies by limiting productivity and income levels, and lowering the quality of life of citizens living there. Many emerging markets, which typically suffer more acutely from water related risks, become even more strained and vulnerable under these circumstances. This can create a perfect storm for tensions and civil unrest, increasing the likelihood of conflict scenarios.

Water conflicts back to
3,000BC...

There is rarely just one cause of conflict situations, but a single factor may well act as a trigger for the conflict that follows. And there is significant evidence that water has acted as that trigger in conflict scenarios. In fact, the World Water Organisation has a water conflict database which finds that water has been the causality, trigger or weapon used in conflicts going back as far as 3,000BC.

But water has triggered
problems recently too

Water scarcity specifically has been a trigger for some of the more recent conflicts. For example, in 2019 alone water resource distribution issues triggered conflicts in Chad, twice in Mali, and in four different locations across India. Current tensions between Ethiopia, Sudan and Egypt are largely – but not entirely – attributable to water stress challenges. Ethiopia intends to build a dam to alleviate water stress within the country, while neighbouring countries are concerned about what that will do for their domestic water availability.

Mass migration is closely linked to this, too. The UN's 2016 World Water Development Report estimates that by 2050, 200 million people could be displaced because of growing water scarcity challenges, desertification, sea level rise and extreme weather events. This is happening already; over the past decade, subsistence farmers in both Central America and African Sahel have migrated to other countries because of droughts ruining harvests. The UN estimates that diversification alone could threaten the livelihoods of nearly 1bn people across 100 countries, by 2050.

200m

...individuals could be displaced because
of desertification, sea level rise and
extreme weather events by 2050 (World
Water Development, 2016)

Forced migration as a result
of water challenges

We expect that forced migration as a result of climate change impacts – particularly water scarcity – will become increasingly common in future. This presents challenges of course due to the potential conflict situations that may result, but also creates additional burden on the water infrastructure and management plans of any countries that see large influxes of people following mass migration. We believe that city and infrastructure planning in the face of rapid urbanisation and population growth will become a core pillar of many national and local government plans.

Next steps for investors

- ◆ Data and disclosure will play a vital role in better understanding risks
- ◆ While company engagement strategies will be specific to sectors
- ◆ Government policy has a role to play, but only goes so far

In the “Investing by sector” chapter, we touched on some of the key downside risks, and the possible opportunities and solutions, for different sectors and companies. The risk profiles vary widely by sector, but the message is clear: investors must factor in these considerations now.

In this section, we outline how three key areas relevant to investors are likely to develop. There is no silver bullet, and we think a collaborative action across all channels will be required.

Data

Measuring water risks, and particularly water pollution, can be complex, but is, in our view, a critical next step towards addressing the risks. Without measuring these risks, it is impossible to understand how to address them. We think that investors should play a role here in driving the thinking forward around water risk disclosure, reporting and methodologies by working with companies on calculating and delivering reliable data on risks and impacts.

More broadly, we do expect the market to begin to demand tighter reporting requirements on these risks too. The CDP has launched a 2021 Water Impact Index, which provides investors with granular information on 200 industrial activities and their potential impact on water resources (quality and quantity).

Water reporting aligned to the TCFD

Similarly, in August 2021 the Climate Disclosures Standards Board (CDSB) launched guidance and an online course about water related financial disclosure. This is a new framework that seeks to create a common way for companies to report on these risks, to allow investors to have better information for “effective capital allocation to drive the transition to a sustainable, resilient and water secure economy”. The aim is for companies to integrate this reporting information into their mainstream financial statements. The CDSB framework is closely aligned to the Taskforce for Climate Related Financial Disclosures (TCFD) framework, something we believe will give it extra clout,

Engagement

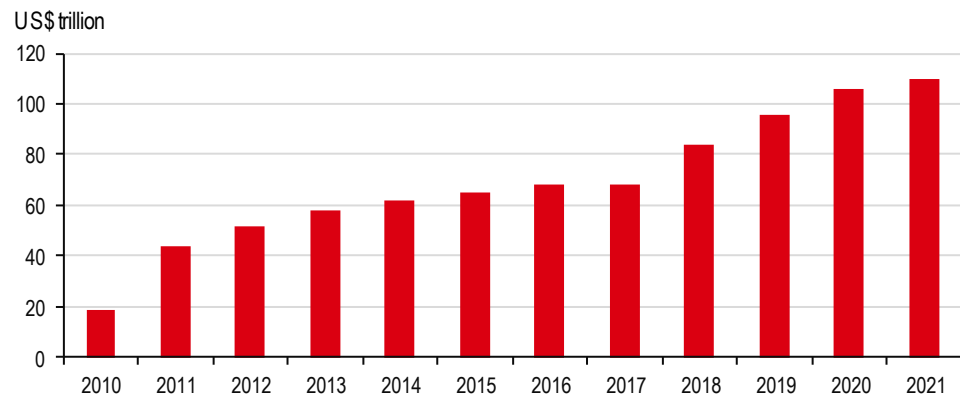
We think investors can return to the basic building blocks of responsible investment, in relation to integration and management of water risks embedded in their assets under management. This involves a three-part process of engaging with issuers, voting at general meetings to reflect biodiversity issues and disclosing on how biodiversity is integrated into the investment process.

On the engagement piece, we hope that investors can use our “investing by sector” chapter to start to build a framework of an engagement discussion. We have introduced some initial talking points for investors to have with their companies. This can encompass supply chain considerations, discussions about operations and processes, and the overall product or service offering at a company, based on examples of good and bad practice.

**Increasing share of AUM
flowing into corporate water
risk disclosure requests**

Another key part of the engagement piece will focus on disclosure of water risks, we believe, as alluded to above. Already, we have noticed that larger and larger investors are requesting better disclosure about water risks from their companies (Figure 13). Via the CDP, 1,868 large companies were requested to disclose their impacts on water security alone by their investors in 2021. CDP's disclosure requests have also been upgraded over time, becoming more detailed.

Figure 13: Corporate disclosure requests on water by investors (in terms of AUM)



Source: CDP Global Water Report 2020

Financing and regulation

According to the World Bank, it would cost USD21bn a year (0.1% of global GDP) until 2030 in order to provide water and hygiene benefits to all who need it around the world. The World Bank also estimates that this could bring with it economic benefits worth c.USD60bn.

**Big investment...but bigger
returns**

This highlights one of the key strands that runs through this report, we think. Financing for addressing the risks associated with water scarcity and pollution is significantly below where it should be. 80% of countries that have not achieved WHO's "WASH" (Water, sanitation and hygiene) targets for clean water and sanitation report having insufficient financing to meet these targets. But, if companies, investors and governments acted now and addressed these issues, we could well mitigate the risk or even bring around positive change.

Government regulation to limit pollution of waterways in order to address health and environmental risks will be useful to combat pollution from chemicals and the agriculture sectors in particular. But this can only go so far in that it may tackle the behaviours and end result of certain activities, but doesn't go straight to the root cause of the issue.

Some authorities and governments may explore the introduction of new markets for water, such as the commodification of water by putting a price on it and introducing water futures contracts. In any case, these projects are some way off, in our view. Water futures contracts are being trialled but to little success as the contracts are based on an index that tracks prices for water rights leases and sales in California, and settles in money, not water. This can mean that water users can't use the contract to solve real world shortages, and the market is illiquid.

Water is the foundation of success and growth in all living things, societies, economies and businesses. Investors, companies and governments must recognise the risks, and opportunities open to them as the quality and quantity of water supply increasingly falls into question.

This is an abridged version of a report by the same title published on 21-Sep-21, which contains implications of water scarcity and pollution across 11 sectors. Please contact your HSBC representative or email AskResearch@hsbc.com for more information.

Disclosure appendix

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