Quartet
Investment Managers

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Running Out of Freshwater

"Plans to protect air and water, wilderness and wildlife are in fact plans to protect man."

– Stewart Udall

As we enter autumn after the U.K.'s hottest and driest summer on record, we thought it would be timely to reflect on one of the core investment themes present in clients' portfolios – water. The challenges and opportunities relating to the provision and consumption of water have been the source of much debate at Quartet in recent months given the far-reaching implications of global water scarcity. Wildfires and droughts have been common features of the news during 2018, but the challenges run much deeper than that. While much of the grassland in the UK has now turned back to a reassuring shade of green we can no longer be complacent about the availability of freshwater, even in more temperate zones.

The following, written by Niels Jensen, Head of Investments at Quartet, highlights the issues surrounding water which we now view as a grossly undervalued commodity that will require significant investment in the years ahead. Niels' insights were the catalyst for us to invest in the Robeco Sustainable Water Fund, which is now present in almost all client portfolios as a part of our long-term, thematic, allocation. We hope you find this research thought-provoking, and please feel free to contact us, should you have any questions.

Introduction

Let me open this note with two striking indictments:

1. Between now and 2050, the world will need to produce more food than it has done in the last 10,000 years put together.
2. 2.4 billion people (one in three globally) have no access to proper sanitation; in fact, more people have a mobile phone now than have access to a toilet.

Those who tell you that access to freshwater won't be a problem are either lying, or they haven't done their homework, and here is why you should take this very seriously.

Water resources under stress

Going back to the first point above, water is critically important to the agricultural industry. The world is populated by approx. 7.5 billon people today. As the global population approaches 10 billion by the middle of the century, and as living standards

rise across emerging markets, demand for food and water will rise exponentially. Food production must rise 60% in the next 20 years to meet projected demand[1], and food production accounts for 70% of all water consumption globally, and as much as 90% in the fastest growing countries[2].

A huge amount of water is consumed every day; much of it wasted as the result of negligent attitudes. Take the US, for example, where the average person consumes 1,583 cubic metres per year (Exhibit 1). Compare that to the UK, where average annual consumption is 'only' 129 cubic metres.

That is a massive difference, which is certainly not due to differing living standards in the two countries, as they are quite similar. The US climate is much drier than the UK climate so, admittedly, more irrigation is required in the agricultural industry over there, but that is far from the whole story. The impact of different consumer habits and attitudes in the two countries is also a major factor and should not be underestimated.

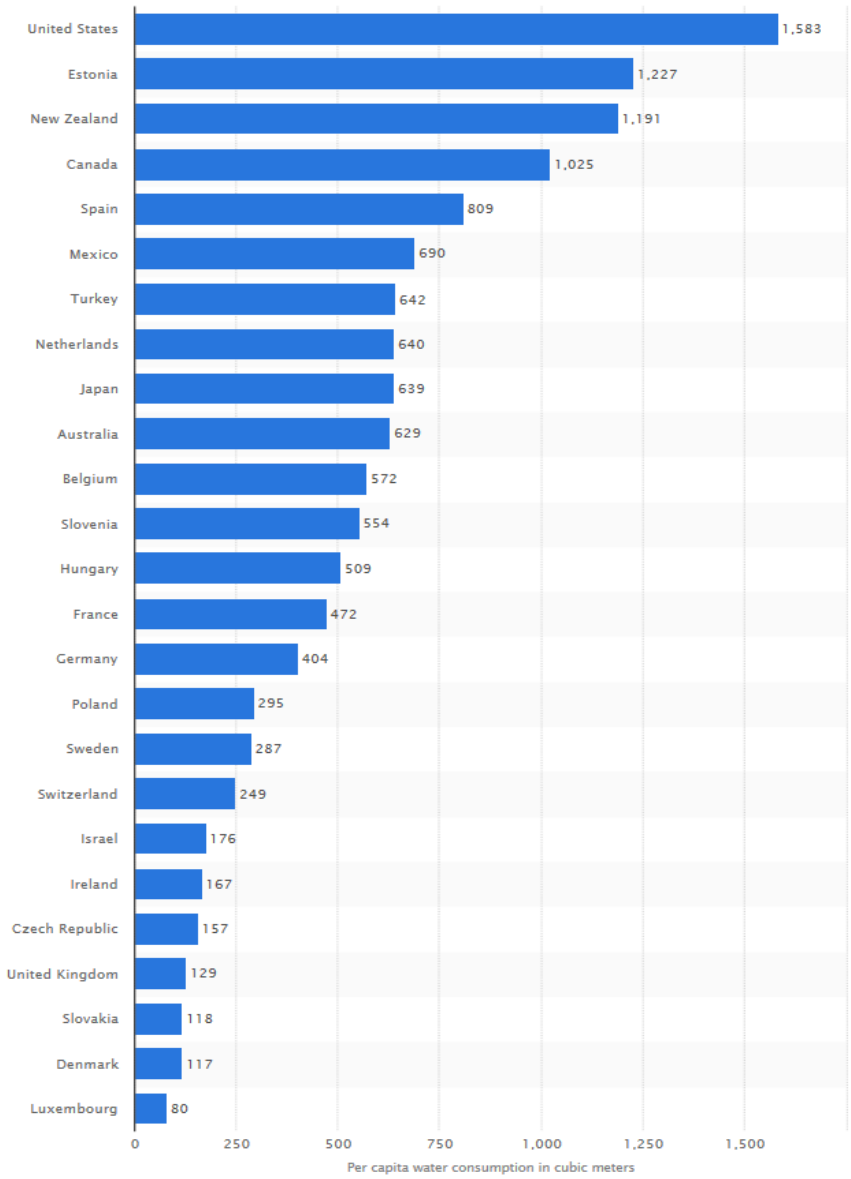

Exhibit 1: Water consumption per capita in various countries (m³)
Source: Statista

[1] *Source: The Economist.*

[2] *Source: Stratfor.*

As is evident when looking at Exhibit 1, per capita water consumption varies dramatically from country to country. What is not evident is that per capita consumption also varies a great deal within most countries, and is driven by factors such as:

- Living standards
- Microclimate
- Quality of agricultural irrigation systems
- Consumer attitudes

The world consumes over 9 billion cubic metres of freshwater every year with China, India and the US being the largest consumers[3] (in that order). With the global population continuing to grow, more water will be required, but many of the world's water systems are stressed. Aquifers, lakes and rivers are drying up or becoming too polluted to use, and over half the world's wetlands have now disappeared. Furthermore, climate change is altering patterns of weather and water systems around the world, causing scarcities and droughts in some areas and floods in others.

Water scarcity is a global issue

Water scarcity is widely perceived only to be a major problem in North Africa, the Middle East and Australia, but the reality is somewhat different. Yes, the areas just mentioned all suffer from scarcity problems, but so do parts of South America and the US, Southern Africa, India and many Asian countries. Spain is the main casualty in Europe (Exhibit 2).

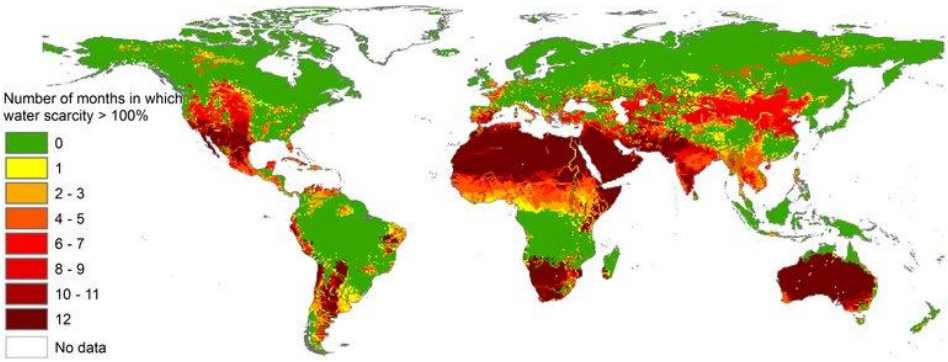

Exhibit 2: Water scarcity across the world
Source: New York Times

Water scarcity prevails in densely populated areas (even greater London is affected) and in areas with much irrigated agriculture[4]. Generally speaking, though, water scarcity is a much bigger issue in EM than it is in DM countries. Whereas the Americans, Australians or Saudis just build another desalination plant, should they need to boost water supplies, that option is not always open to a relatively poor country, the reason being cost.

The link between water scarcity and ISIS

Syria underwent severe drought conditions from 2006 to 2011. Allow me to quote from an article posted by the Center for Climate and Security in 2012[5]:

"Syria's current social unrest is, in the most direct sense, a reaction to a brutal and out-of-touch regime and a response to the political wave of change that began in Tunisia early last year [i.e. in 2011]. However, that's not the whole story. […]

"From 2006-2011, up to 60% of Syria's land experienced, in the terms of one expert, "the worst long-term drought and most severe set of crop failures since agricultural

[3] Source: Scientific American.
[4] Source: Science Advances.
[5] Source: The Center for Climate and Security.

civilizations began in the Fertile Crescent many millennia ago." According to a special case study from last year […], nearly 75 percent suffered total crop failure. Herders in the northeast lost around 85% of their livestock, affecting 1.3 million people.

"The human and economic costs are enormous. In 2009, the UN and IFRC reported that over 800,000 Syrians had lost their entire livelihood as a result of the droughts. By 2011, the aforementioned GAR report estimated that the number of Syrians who were left extremely "food insecure" by the droughts sat at about one million. The number of people driven into extreme poverty is even worse, with a UN report from last year estimating two to three million people affected."

My point is a simple one. You can blame Bashar Al-Assad for many things, but you cannot blame him for severe droughts. He is not a magician; hence he cannot make it rain, even if he wanted to.

The severe drought in Syria created difficulties of biblical proportions which, combined with an unresponsive Syrian regime under Al-Assad's leadership, resulted in social unrest of enormous proportions, in tribal wars and even in a catastrophic civil war. Out of all this came ISIS. It is therefore fair to say that severe water scarcity has been at least partly responsible for the rising of ISIS and hence for terrorism in our part of the world.

I bring this up because other Muslim countries are, in the years to come, likely to go through even more brutal conditions than Syria has experienced in recent years.

Take Egypt – a Muslim country in North Africa with a population of 96 million people or five times as many as Syria's. Egypt's freshwater resources stand at only 20 cubic metres per capita, and it is already facing an annual water deficit of about 7 billion cubic metres. By 2025, all freshwater resources will be empty!

I could write a virtually identical story on Iraq, Syria, Yemen and Libya (all Muslim countries), and the storyline on Nigeria (the 'host' of Boko Haram) isn't too good either. Even a relatively affluent Muslim country such as Morocco (where many ISIS recruits have originated from in recent years) have significant water scarcity problems.

Water is, as we all know, critical to survival. Water scarcity therefore leads to all sorts of problems, and I don't think it is any coincidence that ISIS appears to be particularly strong in the countries with the biggest freshwater problems.

One possible outcome is that countries will increasingly go to war over water. The Egyptians have long argued that the Ethiopians, who hold the source of the Blue Nile (Lake Tana), are trying to store water from the river, hence preventing it from reaching Egypt. Although the two parties recently came to a temporary agreement, which has substantially lowered the short-term risk, the long-term risk is higher than ever.

Both countries are just short of 100 million people today, and both are destined to grow fast in the years to come (Ethiopia even more so than Egypt). At some point in the not so distant future, access to freshwater will become a *massive* issue for both.

Another possible outcome is that, as water scarcity becomes a bigger and bigger issue, social unrest spreads to more and more countries, which will only make it easier for ISIS to recruit.

A third possible outcome is that the migration problems we have experienced in Europe in recent years is only the beginning of much worse to come. The pressure on Europe's borders could grow quite dramatically as water scarcity in Africa and the Middle East spreads.

It is estimated that, today, almost 7 million people live in temporary camps along the coast line of North Africa, waiting for an opportunity to slip into Europe. Should countries like Egypt and Ethiopia fail to guarantee sufficient freshwater supplies to their people, that number can only grow.

Is desalination the solution?

Desalination is widely perceived to offer the best solution to the world's freshwater problems, and it is indeed correct that desalination is a viable outcome for most affluent countries. Having said that, desalination is not an option open to all countries, either because they are landlocked[6], or because the cost is prohibitively high.

Before entering into a discussion about the pros and cons associated with desalination, let me explain the main principles behind it:

"Desalination is the treatment of saline waters. The treatment process aims at obtaining fresh drinking water from the salty ocean waters or groundwater with high salt concentrations that make them unsuitable for human consumption."[7]

There are more than 17,000 desalination plants in 150+ countries today. The prevailing technology behind desalination is called reverse osmosis. Seawater is injected into a high-pressure treatment system, which results in one litre of drinkable water and one litre of very salty water for every two litres of seawater going in. The salty water is discharged into the ocean again[8].

Desalination offers the most credible solution to freshwater scarcity available to mankind today. Having said that, there are a few problems associated with desalination:

(i) it is very expensive to build a desalination plant;

(ii) it is very power hungry to run; and

(iii) the overall environmental impact is far from perfect.

The cost of building a plant first. San Diego in Southern California, a city of approximately 1.3 million people, recently built a new desalination plant at the cost of about $1bn. The plant provides the water supply to 7% of the city's population (i.e. to under 100,000 people). Can an EM country with 100 million people, which is about to run out of freshwater, afford an investment of that magnitude? Most definitely not.

Secondly, as far as the electricity hunger is concerned, desalination plants around the world consume more than 200 million kWh *every day*. Although the reverse osmosis technology I referred to earlier has reduced the amount of kWh required to produce one cubic metre of drinkable water, it is still a power thirsty technology. The average used to be 7-9 kWh per cubic metre of water, but that has been reduced to about 3 kWh by adopting the reverse osmosis technology.

Economically, should more and more countries convert to desalination, the implications are quite severe. We live in world where the pool of capital at our disposal is finite and, with little or no workforce growth for many years to come, we need productivity to grow at a meaningful rate to generate a respectable amount of GDP growth (which we need in order to service all the debt we are saddled with).

Spending a significant proportion of the capital stock on desalination will further reduce productivity growth, as desalination, in economic terms, is an unproductive use of capital, provided water was previously available at a lower cost.

In that context, I should mention that the power used by desalination plants needs to be generated in a power plant, and power plants require *enormous* amounts of water. It is estimated that about 40% of all US freshwater is used to cool power stations.

An escalating water crisis could therefore have a meaningful impact, not only on the poorest countries, but on many developed countries as well. As power plants generate more and more power, more and more water shall be required to cool those power stations. This can only mean one thing. Productivity growth will decline further and, when that happens, GDP growth will decline as well.

[6] *Some landlocked countries have salty groundwater. This could also be desalinated.*

[7] *Source: EarthEclipse.*

[8] *Pri on desalination.*

The logic behind it all is that a rising share of the capital at our disposal is deployed unproductively, i.e. it is used to produce something we have had for free (and taken for granted) for centuries, namely water.

The impact on mother nature isn't too good either. As the growing presence of desalination plants raises the use of fossil fuels, the greenhouse gas problem escalates. Furthermore, the discharge of very salty water back into the oceans could potentially play havoc with marine life.

Are there any alternatives to desalination?

In the developed world, many things can be done to manage our water resources better without having to settle for desalination; however, fewer options are available to the poorest countries.

Given the extensive use of water in the agricultural industry, more targeted irrigation is an obvious way forward. Enormous amounts of water are wasted every year as a result of inefficient irrigation systems, and that goes for EM countries as well.

Consumer habits and attitudes must also change. A few examples:

Back in 2014, Peter Gleick of the Pacific Institute in Oakland[9] estimated that humans require about 60 litres of clean water each day to meet basic needs. Americans use about 450 litres a day[10].

Secondly, 30% of all US freshwater consumption goes towards rearing meat, and 15% towards producing sugar[11]. In other words, rearing meat and producing sugar account for ¾ of all freshwater usage in the US agricultural industry, which is the biggest user of freshwater.

Globally, 70% of all freshwater usage is accounted for by the agricultural industry. If one-third of the food that farmers produce never finds its way into our stomachs (which is true), substantial amounts of freshwater could be saved by changing our eating habits and attitudes.

Another way to cut back on total water consumptions is to be more pedantic as to what sort of water is used for what purpose. We all have a habit of referring to all non-salty water as freshwater, but not all freshwater is suitable for human consumption. That doesn't imply it cannot be used for other purposes. Industry insiders distinguish between so-called blue water, green water and grey water.

Blue water is freshwater suitable for human consumption once it has been appropriately treated - typically surface water from reservoirs. Green water is water stored in soil – typically groundwater – and may also be used for human consumption. Grey water is polluted water.

Two observations:

(i) we need to get (much) better at keeping grey water away from blue and green water, as water contamination is a big issue; and

(ii) we need to get better at using untreated blue and green water for things they are suitable for. You certainly won't want to drink untreated green water, but why do you need to treat it before it is used to irrigate or cool a power station?

Such changes could save huge amounts of both water and energy and will have a positive impact on productivity growth.

A final few words

The world will indeed run out of freshwater over the next few decades unless we change one or two things. Knowing mankind's desire to survive, the habits and attitudes that must change will indeed change.

[9] *Source: Pacific Institute.*

[10] *Source: Los Angeles Times.*

[11] *Source: Scientific American.*

Having said that, it could possibly turn into a rough ride, before we come out on the other side. Syria literally collapsed following their severe drought, and the same will almost certainly happen elsewhere in the not so distant future.

My number one favourite to turn into the next Syria is Egypt. With only 20 cubic metres of freshwater resources per capita, you only need a drought of modest proportions in that country before social unrest gets out of control and, drought conditions or not, by 2025, Egypt's freshwater resources will be gone anyway.

The ultimate solution to the world's water problems is energy at virtually no cost, which will dramatically reduce the cost of desalination. Energy at virtually no cost is not as far-fetched as you may think it is. A desalination plant powered by solar energy is currently under construction in UAE and, although solar is still quite expensive, the price is on a steep downward trajectory.

Further down the road (probably within the next 15 years), I expect fusion energy to become commercially available, but more about that later. I am currently researching the implications of the commercialisation of fusion energy. I should note, though, that the introduction of fusion energy will reduce the marginal cost of energy to $0 which is why coal and gas will eventually become obsolete. Some oil (but not a lot) will still be needed to produce plastic products.

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