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INDEPENDENT STRATEGIC ANALYSIS OF AUSTRALIA'S GLOBAL INTERESTS

Strategic Analysis Paper

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Global Water Supply and Demand Trends Point Towards Rising Water Insecurity

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Key Points

- Water demand is expected to increase over the next 30 years. It is unlikely that natural supplies will be sufficient to meet that demand in some parts of the world.
- While most of the world's water will continue to be used in agriculture, industrial and household demand is expected to rise at a faster rate as the agriculture sector becomes more water efficient.
- About 20 per cent of the world's groundwater, which supplies drinking water to more than half of the world's population, is already over-exploited. It is likely that more of the world's aquifers will be over-exploited by 2050.
- Water conservation is the best option to reduce rising water stress, but is not viable in many instances. Desalination, managed aquifer recharge and water recycling could reduce pressure on water sources, but are unlikely to prevent an increase in global water insecurity.

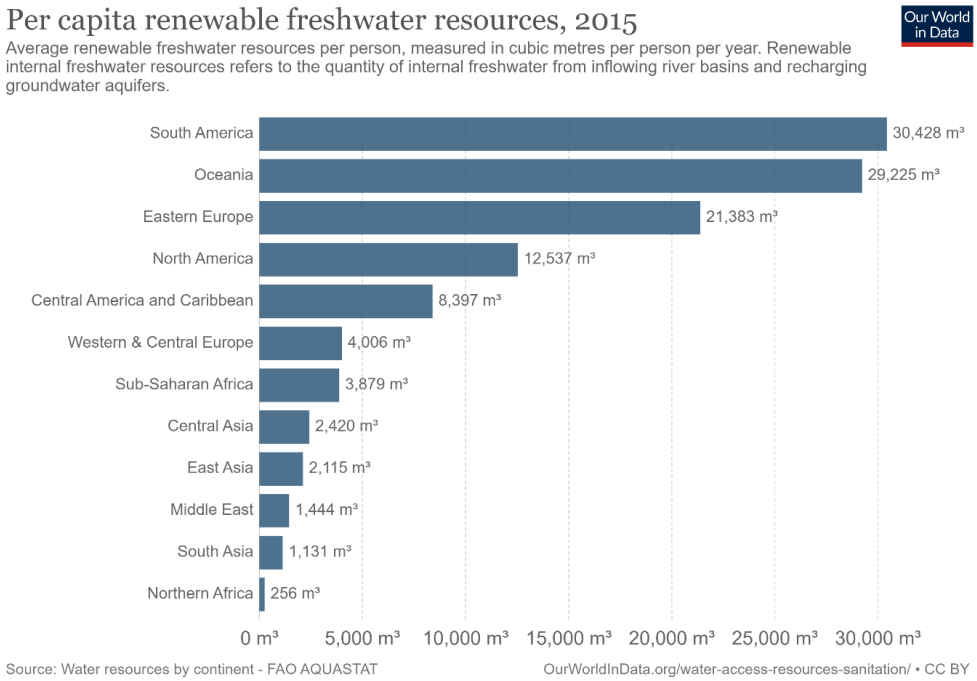
Summary

Global water supplies are expected to come under increased stress due to increased demand caused by population growth, rising wealth levels, dietary change, urbanisation, and rising industrial demand. Most of the world's water is currently used to produce food and that is likely to still be the case in 2050. Agricultural water use is expected to shrink over the next 30 years, however, as industrial and household demand continues to rise. Groundwater sources are likely to come under the greatest amount of pressure from rising water demand, but managed aquifer recharge could reduce some of that pressure. While reducing water consumption by repairing infrastructure and implementing water use efficiencies remain the

best options to reduce water stress, those are not always viable. Water recycling and desalination are other policy options that could alleviate, but probably not completely eradicate, global water insecurity.

Analysis

There is enough freshwater globally to meet current water demands. Water resources are not equally distributed, however, leading to water scarcity in some parts of the world. On a per capita basis and measured in terms of naturally renewable freshwater, Northern Africa, South Asia and the Middle East are at greatest risk of water insecurity.



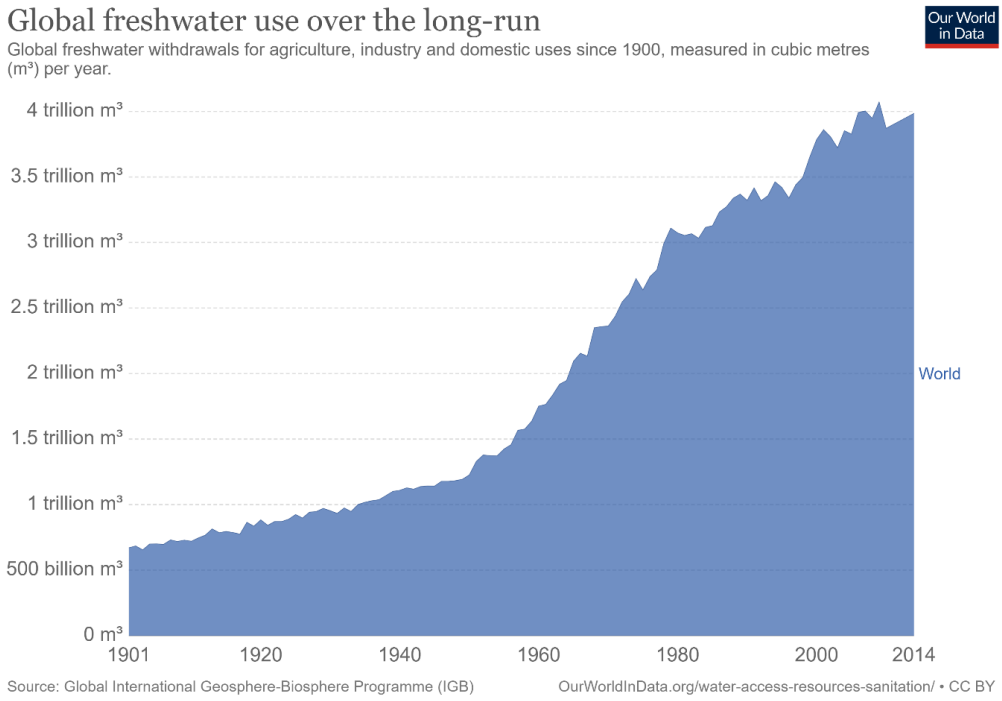
In 2018, an analysis of a 14-year satellite remote sensing mission identified 19 water depletion hotspots that were caused by drought, groundwater depletion, glacial retreat, ice-sheet loss, severe surface water loss (the drying of the Aral and Caspian Sea) and the filling of large reservoirs (the Three Gorges Dam). Water depletion is most pronounced in northern India, the Middle East and North Africa, and Central Asia. While other regions experienced an increase in water availability, that was probably mostly due to anthropogenic influences, natural variability and climate change.

Approximately 500 million people experience permanent severe water scarcity. Most of those people reside in India, Pakistan, Egypt, Mexico, Saudi Arabia and Yemen. About four billion people experience severe water scarcity for at least one month per year. There are 17 countries that currently experience high water stress, meaning that they are using more than 80 per cent of the surface and groundwater available to them.

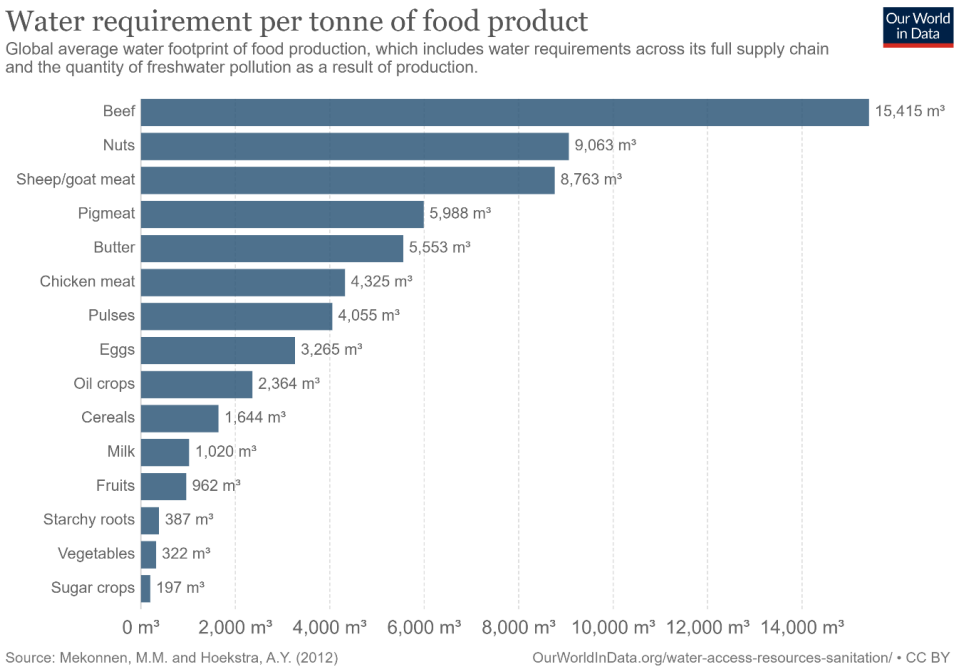
Projections for the next 30 years paint an equally bleak picture. By 2050, more than half of the world's population could experience severe water scarcity for at least some of the year. By 2030, high water stress is expected to become common in 45 cities and include almost 470 million people. Population growth, rising consumption, urbanisation, changing diets and

increased energy needs are expected to be the main factors leading to increased water demand. While demand is expected to continue to rise, water use efficiencies and the augmentation of water supplies through the use of desalination, managed aquifer recharge and water recycling could reduce pressure on water sources.

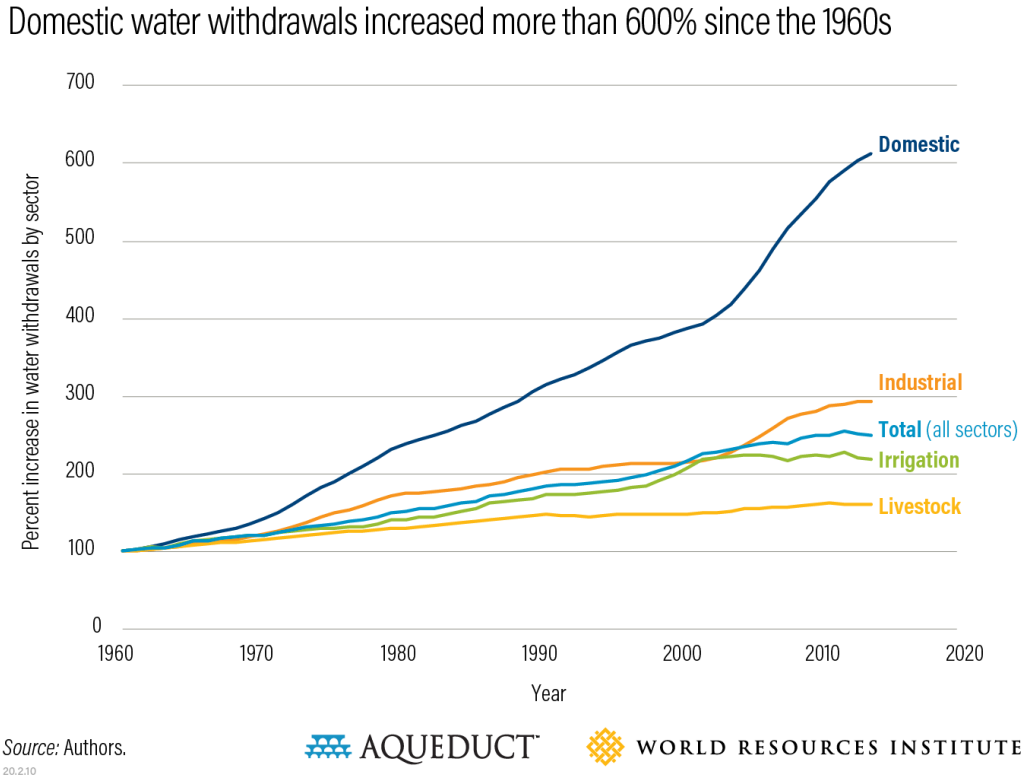
Water use has more than tripled since the 1950s, growing by more than twice the rate of population growth over that time. Annual water consumption increased from 1.22 trillion cubic metres in 1950, to four trillion cubic metres in 2014 (one cubic metre is equal to 1,000 litres). The OECD forecasts that if water demand continues to grow at a similar rate, it is likely that global water consumption will increase to almost six trillion cubic metres in 2050. Most of that increase in demand is expected to occur as a result of growing demand from industry, which includes energy generation.

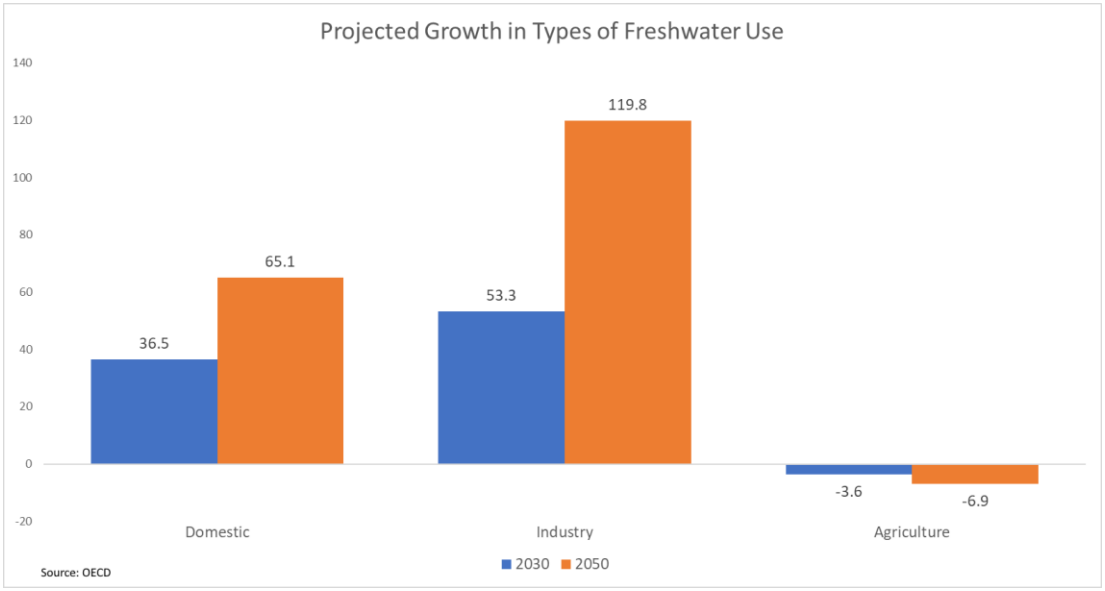


As the global population is expected to become more urbanised and wealthier over that time, however, those projections could underestimate the scale of future water demand. Urban areas generally have better access to water than rural ones and urbanisation could contribute to higher rates of water use than historical trends imply. Wealthier populations also undergo dietary shifts from grain-based diets to protein-based diets. Grains require less water to produce than most high protein foods and it is likely that such a dietary shift could lead to greater water demand than the historical trend suggests.



Agriculture is currently the main consumer of water; it accounts for about 69 per cent of the water used globally each year. In developing countries, where agriculture generally contributes more to the national economy than in developed countries, however, more than 90 per cent of the water used each year can be used in the agriculture sector. It is expected that global agricultural water use will decline over the next 30 years, as the sector becomes more water efficient. Industry is the second-largest water consumer, accounting for about 19 per cent of global water withdrawals. Water for domestic use accounts for the remaining 12 per cent of freshwater consumption and, while it is the smallest user of water globally, demand has increased at the greatest rate over the last 50 years. Household water demand increased by more than 600 per cent between 1960 and 2014. While it is expected that household demand will continue to increase, the majority of the increase in water demand is likely to come from industry.





Groundwater is an important water source, particularly at times when surface water sources are not readily available due to drought or pollution. It provides at least half of the world's population with drinking water and accounts for more than 40 per cent of the water used for irrigation. An estimated 20 per cent of the world's aquifers are over-exploited, calling into question the long-term stability of some of the world's groundwater reserves. The over-exploitation of groundwater resources is particularly evident in Jakarta, Bali, Mexico City, parts of the Middle East (although some countries in the region are attempting to reduce the unsustainable use of groundwater), parts of India (see also: here and here) and Vietnam.

Over-exploitation occurs when more groundwater is abstracted than is returned to the aquifer. Between 1900 and 2008, global groundwater reserves were depleted by an

estimated 4,500 cubic kilometres. The rate at which it is being depleted has also increased, reaching 145 cubic kilometres per year between 2000 and 2008. On a global scale, natural recharge rates exceed 12,000 cubic kilometres per year but, due to some aquifers being more heavily used than others, some groundwater sources have become increasingly depleted over time.

As groundwater accounts for half of the domestic water consumed in urban areas and is an important water source for about two-fifths of the world's irrigated cropland, it is likely that groundwater supplies will come under increased pressure over the next 30 years.

Increasing access to water is likely to support economic growth and development, particularly in urban areas where water is used for a wide range of economic activities. Urban areas are also expected to experience a 66 per cent reduction in water availability by 2050, compared to 2015 levels. It is estimated that providing universal drinking water coverage would cost US$203 billion ($310 billion), with urban areas accounting for US141 billion ($215 billion). The economic losses associated with inadequate water and sanitation services, however, are estimated to total US$260 billion ($400 billion) per year.

Maintaining existing water supply infrastructure is also an important part of water resources management. It is estimated that well-maintained urban water systems lose between 10-30 per cent of the water that they transport. In cities in developing countries, as much as 70 per cent of the water provided through piped water systems can be lost. That lost water is referred to as non-revenue water. Halving non-revenue water in the developing world would provide enough water for 90 million people. It is often more cost effective to reduce non-revenue water than increase the water supply and it has the added benefit of placing less strain on water resources.

Wastewater is also a growing global water security challenge. It is estimated that more than 80 per cent of the world's wastewater is released into the environment without being collected or treated – polluting the environment and wasting a renewable resource. Agricultural runoff often carries high levels of nitrogen, chemicals and other contaminants, which contributes to the creation of marine "dead zones". These zones are caused by the overgrowth of algae, promoted by nutrient-rich wastewater, which then decomposes and depletes oxygen. As there is less available oxygen dissolved in the water, marine life dies or migrates out of the area.

There are two broad policy options to deal with the expected increase in global water demand: increase the water supply or decrease demand for water. The construction of dams, water recycling and reuse, groundwater recharge, and desalination are all options to augment the water supply, but are not universally appropriate. Furthermore, as the World Bank notes:

> Supply side interventions, while essential, will not on their own resolve water management problems. History has consistently shown that when the amount of water supplied is increased and provided cheaply, this simply induces new demand ... Investments in increasing water supplies

must therefore be coupled with policies which promote efficiency and better allocate water resources.

In most instances simply tapping into groundwater supplies or building dams is not viable. About one-third of the world's aquifers are stressed and most viable dam sites have already been used. Other water sources will need to be developed, in conjunction with measures to reduce water use, if water insecurity is to decline.

Desalination is a climate-independent source of freshwater that provides about one per cent of the world's freshwater to 300 million people. It is an unsuitable option for most agricultural applications, due to its high cost. (Desalination can cost two to ten times more than traditional freshwater sources). More than 90 per cent of the world's desalinated water is used in industry and to augment municipal water supplies. Seawater desalination is widely used in the Middle East, where energy is cheap and freshwater is scarce. Brine production and energy consumption are the main barriers to the increased use of desalination. The expense of desalination technologies also makes it prohibitive for low income countries, where less than 0.1% of the global desalination capacity is located. Operating costs, which are mostly related to energy use, have declined significantly since the 1980s. Research and development in the desalination industry focusses on improving desalination materials and processes to reduce energy consumption and increase freshwater recovery. Over the last decade, the cost of desalination has declined by up to 20 per cent in some locations

Managed aquifer recharge (MAR) is another water management strategy that could augment stressed groundwater systems. It artificially recharges aquifers using treated water so that environmental and human health is protected. MAR has been implemented around the world at an accelerating rate since the 1960s, but has not kept pace with increasing groundwater extraction. On its own, MAR is unlikely to be a solution to the overexploitation of groundwater, but it could complement other measures that conserve water or encourage more efficient water use. In some parts of the world, MAR could be used to adapt to the adverse effects of climate change. As it stores water underground, it reduces the amount of water that is lost to evaporation (a major disadvantage of surface water storage).

Global water demand is expected to increase significantly over the next 30 years while the natural supply of water is expected to remain unchanged. Changes in the distribution of that water could occur, and result in some regions of the world becoming wetter or drier than they are currently, but the world will need to develop ways to use water more efficiently if supply is keep up with demand. Desalination, managed aquifer recharge and water recycling could alleviate some of the pressure on natural water supplies, but they are unlikely to be adopted at a large enough scale to prevent an increase in global water insecurity by 2050.

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