

For want of a drink

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Finite, vital, much wanted, little understood, water looks unmanageable. But it needn't be, argues John Grimond (interviewed [here](#))

WHEN the word water appears in print these days, crisis is rarely far behind. Water, it is said, is the new oil: a resource long squandered, now growing expensive and soon to be overwhelmed by insatiable demand. Aquifers are falling, glaciers vanishing, reservoirs drying up and rivers no longer flowing to the sea. Climate change threatens to make the problems worse. Everyone must use less water if famine, pestilence and mass migration are not to sweep the globe. As it is, wars are about to break out between countries squabbling over dams and rivers. If the apocalypse is still a little way off, it is only because the four horsemen and their steeds have stopped to search for something to drink.

The language is often overblown, and the remedies sometimes ill conceived, but the basic message is not wrong. Water is indeed scarce in many places, and will grow scarcer. Bringing supply and demand into equilibrium will be painful, and political disputes may increase in number and intensify in their capacity to cause trouble. To carry on with present practices would indeed be to invite disaster.

Why? The difficulties start with the sheer number of people using the stuff. When, 60 years ago, the world's population was about 2.5 billion, worries about water supply affected relatively few people. Both drought and hunger existed, as they have throughout history, but most people could be fed without irrigated farming. Then the green revolution, in an inspired combination of new crop breeds, fertilisers and water, made possible a huge rise in the population. The number of people on Earth rose to 6 billion in 2000, nearly 7 billion today, and is heading for 9 billion in 2050. The area under irrigation has doubled and the amount of water drawn for farming has tripled. The proportion of people living in countries chronically short of water, which stood at 8% (500m) at the turn of the 21st century, is set to rise to 45% (4 billion) by 2050. And already 1 billion people go to bed hungry each night, partly for lack of water to grow food.

People in temperate climates where the rain falls moderately all the year round may not realise how much water is needed for farming. In Britain, for example, farming takes only 3% of all water withdrawals. In the United States, by contrast, 41% goes for agriculture, almost all of it for irrigation. In China farming takes nearly 70%, and in India nearer 90%. For the world as a whole, agriculture accounts for almost 70%.

Farmers' increasing demand for water is caused not only by the growing number of mouths to be fed but also by people's desire for better-tasting, more interesting food. Unfortunately, it takes nearly twice as much water to grow a kilo of peanuts as a kilo of soyabbeans, nearly four times as much to produce a kilo of beef as a kilo of chicken, and nearly five times as much to produce a glass of orange juice as a cup of tea. With 2 billion people around the world about to enter the middle class, the agricultural demands on water would increase even if the population stood still.

Industry, too, needs water. It takes about 22% of the world's withdrawals. Domestic activities take the other 8%. Together, the demands of these two categories quadrupled in the second half of the 20th century, growing twice as fast as those of farming, and forecasters see nothing but further increases in demand on all fronts.

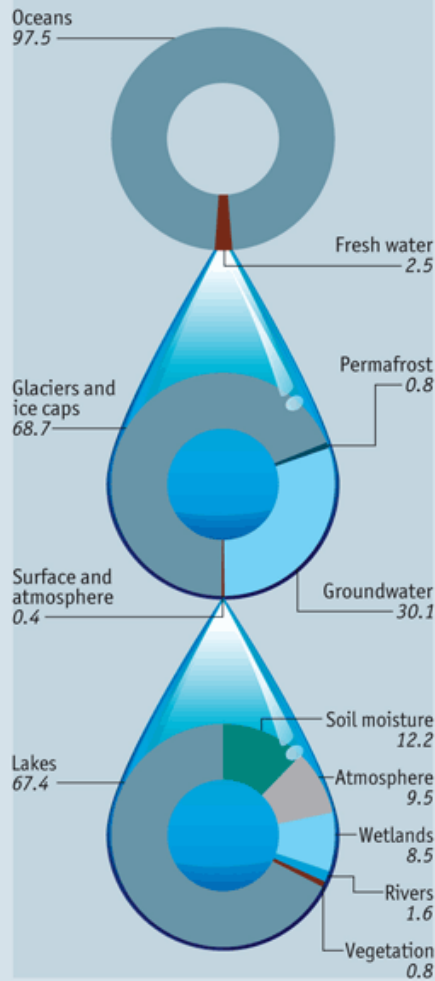
That's your lot

Meeting that demand is a different task from meeting the demand for almost any other commodity. One reason is that the supply of water is finite. The world will have no more of it in 2025, or 2050, or when the cows come home, than it has today, or when it lapped at the sides of Noah's ark. This is because the law of conservation of mass says, broadly, that however you use it, you cannot destroy the stuff. Neither can you readily make it. If some of it seems to come from the skies, that is because it has evaporated from the Earth's surface, condensed and returned.

Most of this surface is sea, and the water below it—over 97% of the total on Earth—is salty. In principle the salt can be removed to increase the supply of fresh water, but at present desalination is expensive and uses lots of energy. Although costs have come down, no one expects it to provide wide-scale irrigation soon.

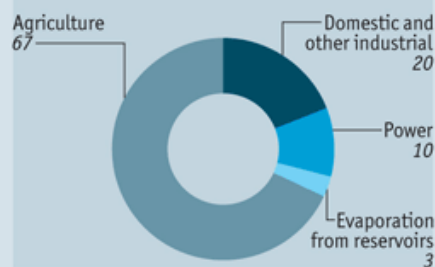
Where the water comes from...

Global water resources, %

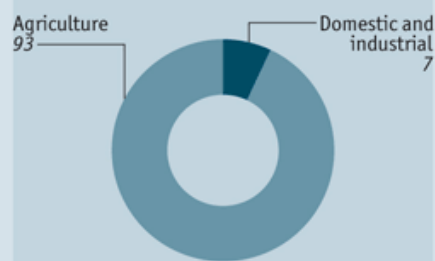


...and where it goes

Water abstraction from rivers, lakes and groundwater, %



Consumptive use* of abstracted water, %



Source: World Bank: *World Development Report 2010*

*Water unavailable for further use in the system

Of the 2½% of water that is not salty, about 70% is frozen, either at the poles, in glaciers or in permafrost. So all living things, except those in the sea, have about 0.75% of the total to survive on. Most of this available water is underground, in aquifers or similar formations. The rest is falling as rain, sitting in lakes and reservoirs or flowing in rivers where it is, with luck, replaced by rainfall and melting snow and ice. There is also, take note, water vapour in the atmosphere.

These geophysical facts affect the use of language in discussions about water, and the ways in which to think about the problems of scarcity. As Julia Bucknall, the World Bank's water supremo, points out, demand and supply are economic concepts, which the matchmakers of the dismal science are constantly trying to bring into balance. In the context of water, though, supply is also a physical concept and its maximum is fixed.

Use is another awkward word. If your car runs out of petrol, you have used a tankful. The petrol has been broken down and will not soon be reconstituted. But if you drain a tank of water for your shower, have you used it? Yes, in a sense. But could it not be collected to invigorate the plants in your garden? And will some of it not then seep into the ground to refill an aquifer, or perhaps run into a river, from either of which someone else may draw it? This water has been used, but not in the sense of rendered incapable of further use. Water is not the new oil.

However, there are some "uses" that leave it unusable for anyone else. That is either when it evaporates, from fields, swimming pools, reservoirs or cooling towers, or when it transpires, in the photosynthetic process whereby water vapour passes from the leaves of growing plants into the atmosphere. These two processes, known in combination as evapotranspiration (ET), tend to be overlooked by water policymakers. Yet over 60% of all the rain and snow that hits the ground cannot be captured because it evaporates from the soil or transpires through plants. Like water that cannot be recovered for a specific use because it has run into the sea or perhaps a saline aquifer, water lost through ET is, at least until nature recycles it, well and truly used—or, in the language of the water world, "consumed", ie, not returned to the system for possible reuse.

The problems caused by inexact terminology do not end here. Concepts like efficiency, productivity and saving attract woolly thinking. Chris Perry, an irrigation economist widely considered the high priest of water accounting, points out that "efficient" domestic systems involve virtually no escape of water through evaporation or irrecoverable seepage. "Efficient" irrigation, though, is often used to describe systems that result in 85% of the water disappearing in vapour. Similarly, water is not saved by merely using less of it for a purpose such as washing or irrigation; it is saved only if less is rendered irrecoverable.

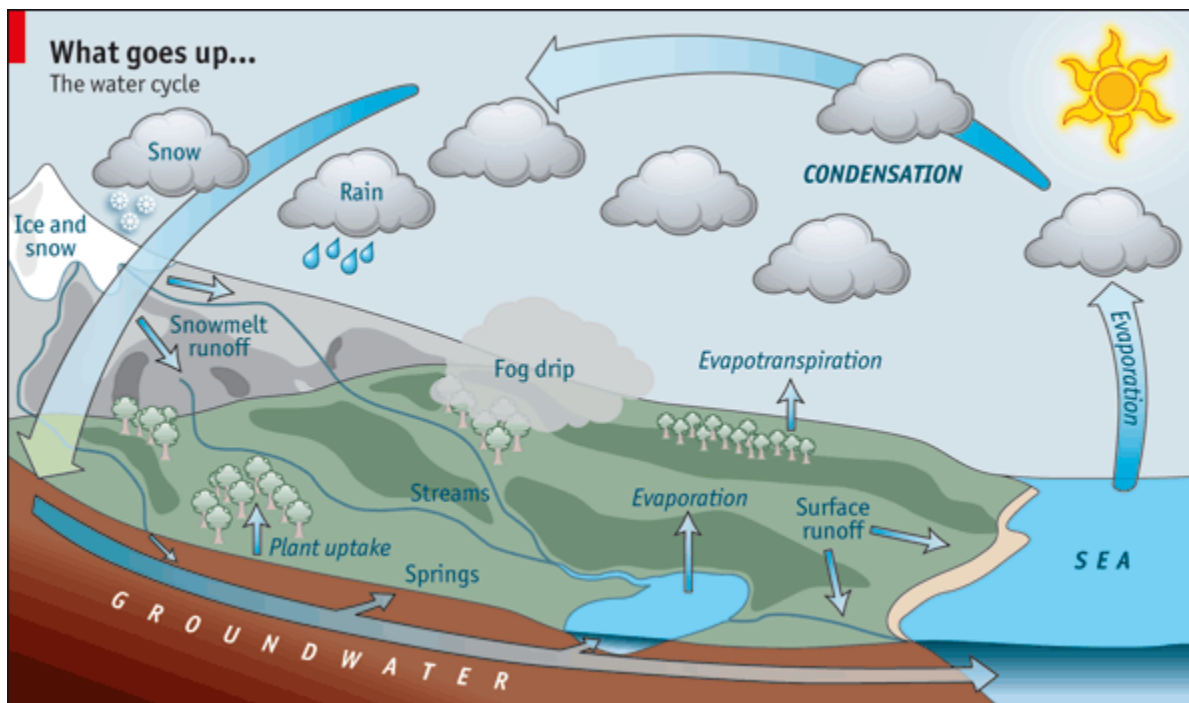
Soaked, parched, poached

Many of these conceptual difficulties arise from other unusual aspects of water. It is a commodity whose value varies according to locality, purpose and circumstance. Take locality first. Water is not evenly distributed—just nine countries account for 60% of all available fresh supplies—and among them only Brazil, Canada, Colombia, Congo, Indonesia and Russia have an abundance. America is relatively well off, but China and India, with over a third of the world's population between them, have less than 10% of its water.

Even within countries the variations may be huge. The average annual rainfall in India's north-east is 110 times that in its western desert. And many places have plenty of water, or

even far too much, at some times of year, but not nearly enough at others. Most of India's crucial rain is brought by the summer monsoon, which falls, with luck, in just a few weeks between June and September. Flooding is routine, and may become more frequent and damaging with climate change.

Scarce or plentiful, water is above all local. It is heavy—one cubic metre weighs a tonne—so expensive to move. If you are trying to manage it, you must first divide your area of concern into drainage basins. Surface water—mostly rivers, lakes and reservoirs—will not flow from one basin into another without artificial diversion, and usually only with pumping. Within a basin, the water upstream may be useful for irrigation, industrial or domestic use. As it nears the sea, though, the opportunities diminish to the point where it has no uses except to sustain deltas, wetlands and the estuarial ecology, and to carry silt out to sea.



These should not be overlooked. If rivers do not flow, nothing can live in them. Over a fifth of the world's freshwater fish species of a century ago are now endangered or extinct. Half the world's wetlands have also disappeared over the past 100 years. The point is, though, that even within a basin water is more valuable in some places than in others.

Almost anywhere arid, the water underground, once largely ignored, has come to be seen as especially valuable as the demands of farmers have outgrown their supplies of rain and surface water. Groundwater has come to the rescue, and for a while it seemed a miraculous solution: drill a borehole, pump the stuff up from below and in due course it will be replaced. In some places it is indeed replenished quite quickly if rain or surface water is available and the geological and soil conditions are favourable. In many places, however, from the United States to India and China, the quantities being withdrawn exceed the annual recharge. This is serious for millions of people not just in the country but also in many of the world's biggest cities, which often depend on aquifers for their drinking water.

The 20m inhabitants of Mexico City and its surrounding area, for example, draw over 70% of their water from an aquifer that will run dry, at current extraction rates, within 200 years, maybe much sooner. Already the city is sinking as a result. In Bangkok, Buenos Aires and

Jakarta, the aquifers are similarly overdrawn, polluted or contaminated by salt. Just as serious is the depletion of the aquifers on which farmers depend. In the Hai river basin in China, for example, deep-groundwater tables have dropped by up to 90 metres.

Part of the beauty of the borehole is that it requires no elaborate apparatus; a single farmer may be able to sink his own tubewell and start pumping. That is why India and China are now perforated with millions of irrigation wells, each drawing on a common resource. Sometimes this resource will be huge: the High Plains aquifer, for example, covers 450,000 square kilometres below eight American states and the Guaraní aquifer extends across 1.2m square kilometres below parts of Argentina, Brazil, Paraguay and Uruguay. But even big aquifers are not immune to the laws of physics. Parts of the High Plains are seriously overdrawn. In the United States, China and many other places, farmers probably have to pay something for the right to draw groundwater. But almost nowhere will the price reflect scarcity, and often there is no charge at all and no one measures how much water is being taken.

Liquid asset or human right?

Priced or not, water is certainly valued, and that value depends on the use to which it is harnessed. Water is used not just to grow food but to make every kind of product, from microchips to steel girders. The largest industrial purpose to which it is put is cooling in thermal power generation, but it is also used in drilling for and extracting oil, the making of petroleum products and ethanol, and the production of hydro-electricity. Some of the processes involved, such as hydro power generation, consume little water (after driving the turbines, most is returned to the river), but some, such as the techniques used to extract oil from sands, are big consumers.

Industrial use takes about 60% of water in rich countries and 10% in the rest. The difference in domestic use is much smaller, 11% and 8% respectively. Some of the variation is explained by capacious baths, power showers and flush lavatories in the rich world. All humans, however, need a basic minimum of two litres of water in food or drink each day, and for this there is no substitute. No one survived in the ruins of Port-au-Prince for more than a few days after January's earthquake unless they had access to some water-based food or drink. That is why many people in poor and arid countries—usually women or children—set off early each morning to trudge to the nearest well and return five or six hours later burdened with precious supplies. That is why many people believe water to be a human right, a necessity more basic than bread or a roof over the head.

From this much follows. One consequence is a widespread belief that no one should have to pay for water. The Byzantine emperor Justinian declared in the sixth century that "by natural law" air, running water, the sea and seashore were "common to all". Many Indians agree, seeing groundwater in particular as a "democratic resource". In Africa it is said that "even the jackal deserves to drink".

A second consequence is that water often has a sacred or mystical quality that is invested in deities like Gong Gong and Osiris and rivers like the Jordan and the Ganges. Throughout history, man's dependence on water has made him live near it or organise access to it. Water is in his body—it makes up about 60%—and in his soul. It has provided not just life and food but a means of transport, a way of keeping clean, a mechanism for removing sewage, a home for fish and other animals, a medium with which to cook, in which to swim, on which to skate and sail, a thing of beauty to provide inspiration, to gaze upon and to enjoy. No wonder a commodity with so many qualities, uses and associations has proved so difficult to organise.