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Comment Article Archive

Water Scarcity guide

Water scarcity is a headline favourite of the doom-mongers, in company with peak oil, overpopulation, climate chaos and war. It might be more constructive to regurgitate these existential fears into political resolve to protect the water cycle on which we all depend. If governments can observe principles of freshwater sustainability and equitable distribution, then there is more than sufficient knowledge, technology, and water itself, to meet our needs.

Precious water for desert herdsmen, Niger © Edward Parsons / IRIN News

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The Water-Food-Energy Nexus

Freshwater has been the constant and essential companion of *homo sapiens* throughout our history. In modern times, we have risked even greater dependence by adopting means of wealth creation characterised by gargantuan thirst.

Ancient water-food-energy nexus.../OliBac © Flickr

Industry accounts for 22% of freshwater use, the largest share of which is consumed by the energy sector. Water is used in great quantities for cooling in thermal and nuclear power generation, as well as in the extraction of coal and oil. Protests against new fossil fuel technologies such as gas fracking and oil sands are inspired in part by fears of wastage and pollution of water.

Although the relative needs of agriculture vary widely – from just 3% in the UK to 83% in India – this sector currently accounts for the largest global share of freshwater at about 70%. The dynamic expansion of food production in Asia over the last 40 years – often described as the "green revolution" - has been achieved through

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PeakWater.org

Water Security and Climate Change from SciDev

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Advocacy Reports
Global Water Security: an engineering perspective (pdf file) from The Royal Academy of Engineering

Finding the Blue Path for a Sustainable Economy (pdf file) a white paper by Veolia Water

Briefings
The Water Cycle from US Geological Survey

Water Scarcity and Desertification from UN Convention to Combat Desertification

Water Footprint Network

IWMI Briefings

Water Quality: why land management matters (pdf file)

Managing water for rainfed agriculture (pdf file)

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modern farming methods which require high input of water.

Households consume the remaining small share of 8% but demand the highest quality standards for safe drinking. Despite considerable humanitarian endeavour over the last three decades, almost 900 million people continue to lack access to safe water.

...and modern: Eggborough cooling towers, UK/fatedsnowfox © Flickr

The close dependence of industry and agriculture on freshwater ensures that any scarcity is likely to impose upward pressure on food and energy prices. This is the scenario that strikes fear into political leaders struggling to restore economic health. Prudent stewardship of the water cycle is nevertheless a virtue honoured more in the breach than in the observance.

News headlines provide constant reminders of this failing. The drought in the Horn of Africa demands emergency food aid for over 12 million people and has led to the first UN declaration of famine in over 20 years.

The Water-Food-Energy Nexus, from World Economic Forum

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Water Cycle

Our planet is a miserly distributor of freshwater. Most water is rendered useless to humanity by dilution with salt in the ocean. Only 2.5% is available as freshwater, of which two thirds is locked up in ice and snow.

The water cycle is driven by evaporation from land and sea, condensing into clouds which have the potential for precipitation as rain. Again, nature is unkind in depositing almost 80% of rain over the sea.

allocation (pdf file)

StraightTalk on Global Water Issues a series of video presentations by Dr Colin Chartres, Director General of IWMI

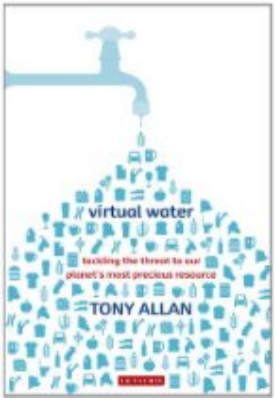
International Organisations
UN Water

World Bank and Water

International Water Management Institute

CGIAR Challenge Program on Water and Food

Nile Basin Initiative



Of the rain that falls over land, only 40% finds its way as “blue water” into aquifers, lakes and rivers which are accessible supply sources. The “green water” balance is absorbed by the land, of great potential value to agriculture but notoriously fickle for that purpose in volume, timing, intensity and location.

Kuang Xi Waterfall, Laos © Yip Seng Leong

Thanks to this natural cycle, water is a renewable source of energy and life. However, unlike other renewable resources such as sun, wind and tide, freshwater is not plentiful. It is a finite resource.

The current global per capita availability of freshwater from rivers, lakes, aquifers and rainfall averages a potentially healthy 6,000 cubic metres per annum. Availability of 1,000 cubic metres per annum within a country or region is regarded as sufficient to meet the needs of households, agriculture, industry - and to sustain local ecosystems.

A state of water scarcity exists below that threshold. Below 1,700 cubic metres, short term periods of "water stress" may be experienced.

Average annual consumption in the US is just under 3,000 cubic metres; in Syria and Jordan, availability is falling towards 500 cubic metres; in Yemen the figure is now below 200.

Freshwater is very unevenly distributed and scarcity is normally assessed within regions or individual river basins. “Water security”, the inverse of scarcity, implies consistent and affordable access to unpolluted freshwater for all categories of user.

The Forgotten Cycle, an animation by Sahana Singh reminding us how the water cycle has been abused by human intervention.

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Causes of Water Scarcity

Unsustainable extraction of freshwater and other human interference with the water cycle are the immediate causes of water scarcity within a river basin.

Sahito Banbhro tubewell, Pakistan © SAFWCO

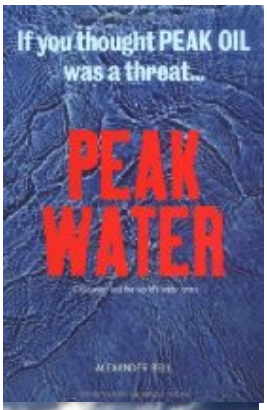
Over-extraction has its most straightforward manifestation in the level of aquifers, underground reserves charged by the passage of water through soil and rocks. If withdrawals exceed the natural rate of recharge, the level of an aquifer will fall, eventually drying up altogether. In parts of India, the water table is believed to have fallen more than 300 metres.

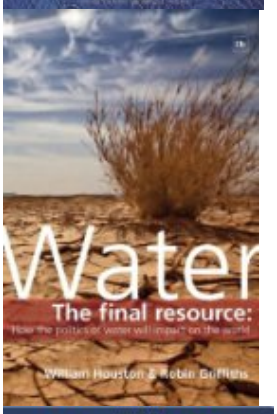
Human intervention which degrades the quantity and quality of the natural supply of freshwater occurs in three principal ways.

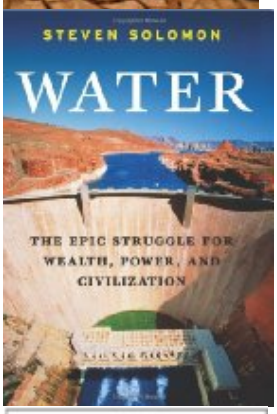
Firstly, there are 48,000 large dams in place around the world, with many more under construction. Dams alter the natural flow of a river, often improving water and energy security for some, at the expense of others.

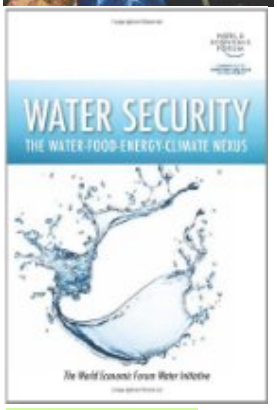
Secondly, soil moisture is lost in land degradation that results from poor farming practices and deforestation. And thirdly, surface waters are polluted by run-off of chemicals used in farming and by untreated industrial and household wastewater in cities. This is an acute problem in less developed countries where environmental and sanitation regulations remain inadequate.

In many countries of sub-Saharan Africa, there is an additional category of "economic" water scarcity which is caused by too little human intervention. This occurs when natural supplies are sufficient to meet demand but fail to reach users due to shortcomings in distribution or storage infrastructure.









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OneWorld Countries

Tracking the Crisis Issues **OneWorld Country Briefings** monitor how individual countries are

Upstream farmers extract and pollute water, causing water scarcity for downstream pastoralists in Kenya's Kimana Wetlands, from Wetlands International.

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Environmental Limits

Disruption of the water cycle has potentially serious environmental side effects. Cities are known to be sinking as aquifers become empty. This factor was one cause of the serious flooding in Bangkok towards the end of 2011. In coastal regions, depleted aquifers increase the risk of saline intrusion.

Agro-chemical pollution through run-off of nitrates and phosphates causes eutrophication, the excessive growth of algae whose eventual decomposition removes oxygen from the water, killing the aquatic ecosystem.

A combination of dams, drought and over-extraction can restrict the environmental flow of the river to the extent that it fails to complete its normal journey to the sea.

A quarter of the world's rivers suffer this fate. Important examples include the Yellow River in China and the Murray-Darling River in Australia. The rich ecosystem of the deltas are at risk.

Murray-Darling River, Australia/Neil Saunders © Flickr

"Global freshwater use" is listed as one of nine planetary boundaries in the influential 2009 study published by the Stockholm Resilience Centre. "These can trigger abrupt system state change when critical thresholds have been crossed," warns the report.

An example might be Lake Chad. Misguided governance of the natural cycle of the Lake led to its area of water collapsing by 90% in the space of 30 years, affecting 20 million people.

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Jonathan Foley, Director of the Institute on the Environment, University of Minnesota, explains why we should be more concerned about potential tipping points in the earth's ecosystem.

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Future Demand

The underlying drivers for continued strong demand for freshwater are population growth and rising incomes.

World population is projected to grow from 7.0 billion to 9.3 billion by 2050. Rising living standards will demand higher volume of household water use, together with richer diets and more consumer goods. All of these changes drive water consumption.

Precious water resource, Morocco © Curt Carnemark/World Bank / Flickr

Most of the population growth will occur in the cities of developing countries, many of which are already logistically overwhelmed by growth and unregulated slum development. Whilst cities were often founded in proximity to good freshwater supplies, the benevolence of nature rarely extends to megacity concentrations of over ten million people.

In addition to safe drinking water and sanitation, the rising pressure on freshwater will be felt most acutely in the energy and food sectors.

The latter is already in crisis, with almost a billion people experiencing hunger. The Food and Agriculture Organization estimates that global food production must rise by 70% by 2050.

World primary energy demand will increase by 36% between 2008 and 2035, according to the International Energy Agency. Despite the emergence of renewable energy sources, dependence on traditional water-intensive mining and power generation is

projected to rise in coming years.

The cumulative effect of these demand drivers will lift global demand for freshwater by 53% by 2030, according to the 2030 Water Resources Group, a consortium of private sector interests supported by the World Bank. One third of the global population, mostly in developing countries, will live in regions where demand for water exceeds supply by more than 50%.

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Climate Change

With projections of supply and demand for freshwater veering off in opposite directions, global warming represents the worst possible intervention. Rising planetary temperatures will accelerate the pump of the water cycle through faster evaporation from land and sea into a warmer atmosphere.

The implications for rainfall are of course the subject of intensive research. There is broad agreement that monsoon patterns will change in timing and intensity, that arid and semi-arid regions will become drier, and that extremes of drought and flooding will become more frequent. Rising sea levels will aggravate the problem of groundwater salinity.

House buried by sand in Mauritania © Phuong Tran / IRIN News

Much uncertainty remains, especially in focusing predictions on national or regional areas that match the scope of policy response. And the effect on the El Nino and La Nina climate phenomena remains unclear.

Even where predictions of rainfall trends are confident, there is insufficient understanding of the mechanics of run-off and groundwater recharge to fully grasp the implications. This same is true for the consequences of the melting of the world's glaciers which together account for 40% of global irrigation. The net impact on crop yields and soil conservation is also uncertain.

Water scarcity therefore presents policymakers with a perfect storm of known and "known unknown" threats. But hesitation wins no sympathy in nature. The 2011 emergency water relief for the Pacific island of Tuvalu delivered a preview of water scarcity in a warming world.

Water Storage: an answer to climate change with Dr Colin Chartres, Director General of the International Water Management Institute.

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Practical Solutions

Most of the world's poor are dependent on small farms in developing countries, inadequately equipped to respond to water problems. This is where sustainable solutions are most needed and are most challenging.

In Asia the tasks are to reduce demand for irrigation and to restore water tables. Most irrigation is currently performed by indiscriminate flooding of fields, highly inefficient and wasteful. Modern drip irrigation technology can reduce water use by around 50% and increase yields through its targeted application.

Drip irrigation in Niger/Pencils for Kids © Flickr

Underground aquifers are by nature ideal for adaptation to variable rainfall. Groundwater recharge can be revived by maintenance of neglected storage tanks and drainage, supported by simple rainwater harvesting technologies.

In sub-Saharan Africa the problems are very different. Nearly all of the farming is rainfed but only 4% of rainfall is captured for the purpose. Government and donors are under considerable pressure to reverse their long term neglect of this sector of agriculture.

Integrated programmes of land and water management would upgrade farmers' awareness of techniques to conserve soil moisture and structure. Selection of diversified and drought-tolerant crops represents basic risk management.

In view of the uncertain effects of climate change at local levels, most climate adaptation strategies will focus on steps that are

consistent anyway with establishing greater resilience to variable rainfall.

Water security in northern India: simple soil management techniques, from Deutsche Welle.

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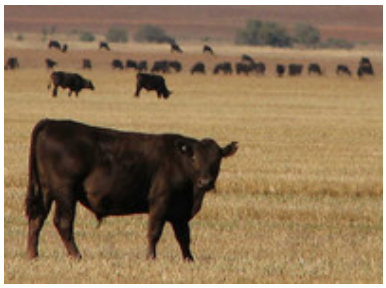
Theoretical Solutions

Richer countries can in theory contribute to management of water scarcity by leveraging the economic tools of modern consumer societies.

Measurement of water consumed throughout the manufacturing supply chain has provided an invaluable starting point for raising awareness amongst corporations and consumers alike. The figures are startling: 140 litres of freshwater are required for a single cup of coffee, 6,000 litres for a pair of denim jeans and more than 15,000 litres for a kilo of beef.



Virtual water ready for export, South Australia/Dave Clarke © Flickr

This invisible input has become known as "virtual water", a concept especially useful for illustrating the movement of water between countries in traded goods. The methodology can also be aggregated to quantify the water footprint of individuals and businesses.

These ideas have inspired economists to suggest replicating the familiar model for mitigating carbon dioxide emissions. This would involve a global system for countries and businesses to trade the right to consume water. Informed choices by individual consumers would be enabled by labelling retail goods with their water footprint.

These proposals remain on the drawing board. Unlike carbon

dioxide which has the same environmental consequences regardless of where it is emitted, the impact of water consumption varies widely according to its local availability.

Failure to price water as a scarce environmental resource is one of the fault lines of modern market economics. The consequences of the green revolution in Asia were exacerbated by allowing farmers unlimited free access to water. The world's largest exporters of beef and manufactured goods, Australia and China respectively, are countries which experience serious water scarcity.

Examples of the water footprint of everyday consumer goods, from Deutsche Welle.

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Governance Issues

Reconciling the demands of competing users of water is especially challenging where responsibilities are fragmented between different government departments.

Governments are encouraged to focus accountability for coordinating the water implications of goals for poverty reduction, food security and energy security. The demanding ideal of pulling together both human and environmental needs is often described as "integrated water resources management."

Poor governance standards in many developing countries can nevertheless enable powerful interests to gain disproportionate access to scarce water resources. An extreme example is the phenomenon known as "land-grabbing".

The acquisition of agricultural land in developing countries is being pursued by foreign investors and by wealthy governments seeking to overcome their own food and water insecurity. Displacement of the poor from land on which they have enjoyed customary use too often equates with the loss of water rights.

Governments are being reminded of their obligations to protect access to water for all citizens. A resolution passed by the UN

General Assembly in July 2010 recognises "the right to safe and clean drinking water and sanitation as a human right."

At international level, there is a governance vacuum on water scarcity. UN Water is not an implementing agency – its role is to strengthen coordination and coherence among other UN entities dealing with freshwater.

There is no UN Convention to tackle water scarcity in parallel with those for climate change, biodiversity and desertification. A 2011 meeting of the InterAction Council, the group of former world leaders, deplored that "international water leadership is virtually nonexistent."

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Conflict Prevention

History is replete with water conflict, from squabbles between neighbouring farms to wars decided by cutting off or poisoning a water supply.

Fear of water wars pervades the modern era, more so perhaps than is justified by events. The ingredients are certainly there – the mega-dam technology to deny supplies to downstream countries, the location of major rivers in regions already convulsed by water scarcity and military tension.

Deceptive calm on the Nile at Aswan © Jeff Black

The Middle East and North Africa region is the particular focus of concern. The River Jordan supplies water to Israel, the Occupied Palestinian Territories, Jordan and Syria – whose poor inter-relations in any event provoke a high state of military readiness.

Management of a transboundary river is a zero sum game; if one country gains in distribution rights, another loses. No fewer than nine countries share the resources of the River Nile and they are currently in dispute. The two major users, Egypt and Sudan, are refusing to sign the Entebbe Agreement, a set of new regulations which would reduce their current allocations.

There is nothing new about such disputes and water conflict resolution mechanisms are commonplace around the world.

In Southeast Asia, the Mekong River Commission is an inter-governmental agency formed by the governments of Cambodia, Laos, Thailand and Vietnam to further their interests of shared water resources of the Mekong River. The Commission maintains dialogue with China whose 21 dams on the upper Mekong are the cause of considerable anxiety.