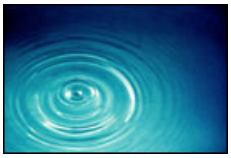
GreenFacts
Facts on Health and the Environment



Scientific Facts on

Water Resources

Source document:
UN-Water WWAP (2006)

Summary & Details:
GreenFacts

Context - Water is essential for human survival and well-being and important to many sectors of the economy. However, resources are irregularly distributed in space and time, and they are under pressure due to human activity.

How can water resources be managed sustainably while meeting an ever increasing demand?

This Digest is a faithful summary of the leading scientific consensus report produced in 2006 by the UN World Water Assessment Programme (UN-Water WWAP): *"The United Nations World Water Development Report"*

The full Digest is available at: https://www.greenfacts.org/en/water-resources/

This PDF Document is the Level 1 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

All GreenFacts Digests are available at: http://www.greenfacts.org/

1. Introduction: pressures on water resources

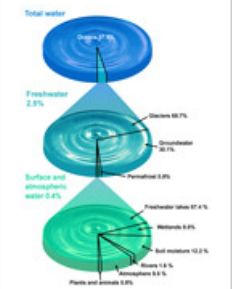
See also our Digest on Ecosystem Change [see https://www.greenfacts.org/en/ecosystems/index.htm]

Around the world, human activity and natural forces are reducing available water resources. Although public awareness of the need to better manage and protect water has grown over the last decade, economic criteria and political considerations still tend to drive water policy at all levels. Science and best practice are rarely given adequate consideration.

Pressures on water resources are increasing mainly as a result of human activity – namely urbanisation, population growth, increased living standards, growing competition for water, and pollution. These are aggravated by climate change and variations in natural conditions.

Still, some progress is being made. More and more, officials are evaluating water quantity and quality together, and coordinating management efforts across borders.

2. Where and in what forms is water available on Earth?



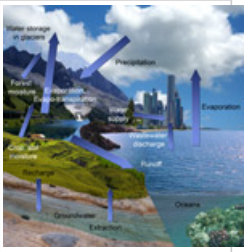
Global distribution of the world's water [see Annex 2, p. 7]

The world's water exists naturally in different forms and locations: in the air, on the surface, below the ground, and in the oceans.

Freshwater accounts for only 2.5% of the Earth's water, and most of it is frozen in glaciers and ice caps. The remaining unfrozen freshwater is mainly found as groundwater, with only a small fraction present above ground or in the air.

Looking at how water moves through the Earth's water cycle helps us understand how it interacts with the environment and how much is available for human use.

2.1 **Precipitation** – rain, snow, dew etc. – plays the key role in renewing water resources and in defining local climatic conditions and biodiversity. Depending on the local conditions, precipitation may feed rivers and lakes, replenish groundwater, or return to the air by evaporation.



Water cycle [see Annex 3, p. 8]

2.2 **Glaciers** store water as snow and ice, releasing varying amounts of water into local streams depending on the season. But many are shrinking as a result of climate change. **River basins** are a useful "natural unit" for the management of water resources and many of them are shared by more than one country. The largest river basins include the Amazon and Congo Zaire basins. River flows can vary greatly from one season to the next and from one climatic region to another. Because lakes store large amounts of water, they can reduce seasonal differences in how much water flows in rivers and streams.

Wetlands – including swamps, bogs, marshes, and lagoons – cover 6% of the worlds land surface and play a key role in local ecosystems and water resources. Many of them have been destroyed, but the remaining wetlands can still play an important role in preventing floods and promoting river flows.

2.3 Of the freshwater which is not frozen, almost all is found below the surface as **groundwater** . Generally of high quality, groundwater is being withdrawn mostly to supply

drinking water and support farming in dry climates. The resource is considered renewable as long as groundwater is not withdrawn faster than nature can replenish it, but in many dry regions the groundwater does not renew itself or only very slowly. Few countries measure the quality of groundwater or the rate at which it is being exploited. This makes it difficult to manage.

3. How much freshwater is available in different countries?

The quantity of freshwater that is available to a given country without exceeding the rate at which it is renewed, can be estimated taking into account the amount of precipitation, water flows entering and leaving the country, and water shared with other countries.

The average amount available per person varies from less than 50 m^3 per year in parts of the Middle East to over 100 000 m^3 per year in humid and sparsely populated areas.

The United Nations has kept a country by country database of such estimates for several decades.

Though the database has become a common reference tool, it has some drawbacks. Figures only indicate the maximum theoretical amount available for a country and may be an overestimation. Moreover, annual and national averages tend to mask local and seasonal differences.

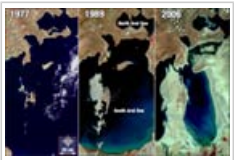
4. How can human actions seriously affect water resources?

Water resources face a host of serious threats, all caused primarily by human activity. They include pollution, climate change, urban growth, and landscape changes such as deforestation. Each of them has its own specific impact, usually directly on ecosystems and in turn on water resources.

4.1 If inadequately managed, activities like farming, forest-clearing, road-building, and mining can lead to too much soil and suspended particles ending up in rivers (sedimentation). This damages aquatic ecosystems, impairs water quality and hinders inland shipping.

4.2 Pollution can harm water resources and aquatic ecosystems. Major pollutants include for instance organic matter and disease causing organisms from waste water discharges, fertilisers and pesticides running off from agricultural lands, acid rain resulting from air pollution, and heavy metals released by mining and industrial activities.

4.3 The effects of extracting too much water, both from surface waters and groundwater, have been dramatic. A striking example is the drastic reduction in size of the Aral Sea and Lake Chad. Little is being done to address the causes, which include poor water management practices and deforestation.



Aral Sea evolution between 1977 and 2006 [see Annex 1, p. 6]

In recent decades, much more water has been extracted from underground sources. The benefits of withdrawing groundwater are often short-lived, while the negative consequences – lower water levels and depleted resources, for example – can last a long time.

4.4 Climate change appears to increase existing pressures, for example in areas already suffering from water shortages. Land and mountain glaciers are shrinking more rapidly in recent years. Extreme weather events stemming from global warming, such as storms and floods, are likely to become more frequent and severe. However, based on current knowledge, scientists can only make general predictions about the impact of climate change on water resources.

See also GreenFacts' digest on Climate Change [see https://www.greenfacts.org/en/climate-change-ar4/index.htm]

5. How can the growing demand for water be met?

Meeting a continuous and ever increasing demand for water requires efforts to compensate for natural variability, and to improve the quality and quantity available.

Demand for water is increasing

5.1 **Rainwater** has been collected for thousands of years in many parts of the world. Today, this technique is used in Asia to replenish underground supplies. It is relatively inexpensive and has the advantage of allowing local communities to develop and maintain the required structures themselves.

Diverting surface water into the ground can help reduce losses from evaporation, compensate for variations in flow, and improve quality. Middle East and Mediterranean regions are applying this strategy.

Dams and reservoirs have been built to store water for irrigation and drinking. Moreover dams can provide power and help control floods, but they can also bring about undesirable social and environmental impacts.

Transferring water between river basins can also help alleviate shortages. China, for instance, already has major interbasin links, and is planning more. The impact of these projects on people and the environment must be monitored closely.

5.2 Wastewater is now **reused** for different purposes in many countries, especially in the Middle East, and this practice is expected to grow. Worldwide, non-potable water is used for irrigation and industrial cooling. Cities are also turning to water re-use to supplement drinking water supplies, taking advantage of progress in water treatment.

5.3 **Desalinated water** – seawater and other salty water that has been turned into freshwater – is used by cities and by industries, especially in the Middle East. The cost of this technique has dropped sharply, but it relies heavily on energy from fossil fuels and hence raises waste management and climate change issues.

6. How could water resources be developed sustainably?

6.1 Using water resources sustainably is challenging because of the many factors involved, including changes in climate, the natural variability of the resource, as well as pressures due to human activity.

At present, most water policy is still driven by short-term economic and political concerns that do not take into account science and good stewardship. State-of-the-art solutions and more funding, along with more data on water resources, are needed especially in developing nations.

To assess the state of our water resources, we must fully appreciate the roles of different parts of the water cycle – such as rain, meltwater from glaciers, and so on. Otherwise, it remains difficult to develop adequate protection and mitigation strategies.

Poor water quality and unsustainable use of water resources can limit the economic development of a country, harm health and affect livelihoods. On a positive note, more sustainable practices are starting to be adopted.

6.2 When managing water resources, more attention should be paid to increasing existing natural resources and reducing demand and losses.

The traditional response to rising demand for water was to store surface water in reservoirs, divert flow to dry regions and withdraw groundwater. Now these methods are increasingly supplemented by water reuse, desalination and rainfall harvesting. Certain regions are even going to the extreme of exploiting non-renewable groundwater resources.

Some countries have programs to reduce demand and losses from urban water distribution systems but more efforts are necessary. However, this will involve changes in behaviour requiring education and political commitment. Such efforts to conserve water and reduce demand are not only useful in regions where water is in short supply, they can also bring economic benefits in wetter regions.

Decentralised approaches to water resource management that focus on river basins are increasingly pursued even across borders. Exchanging information between countries that share river basins will yield both economic and environmental benefits.

7. Conclusions on water resources

Our water resources are under pressure. More reliable information is still needed regarding the quality and quantity of available water, and how this availability varies in time and from place to place. Human activities affect the water cycle in many ways, which needs to be understood and quantified to manage water resources responsibly and sustainably.

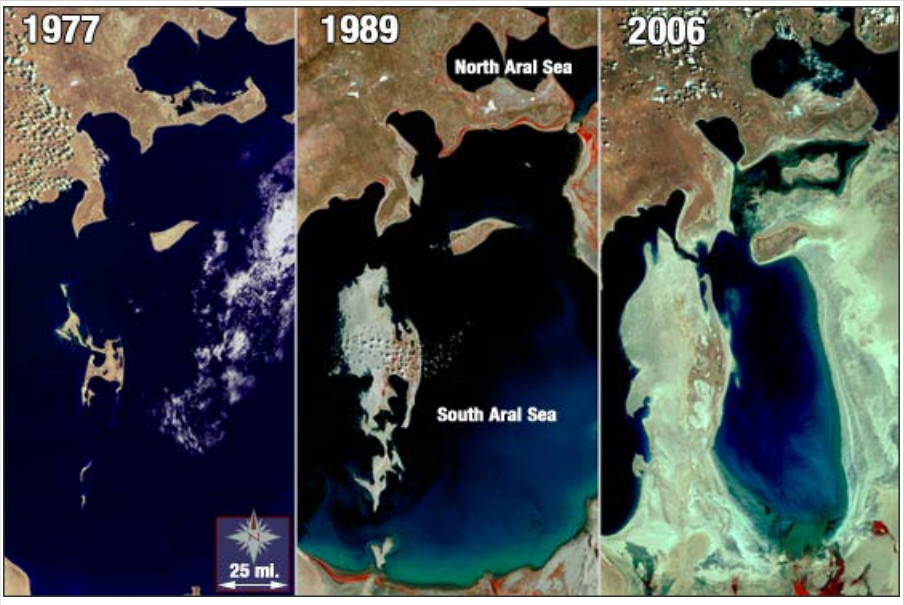
It has become evident that:

- Changes in climate are affecting water availability
- Pollution, water diversions and uncertainties about the abundance of water are threatening economic growth, environment, and health.
- Underground water is often being overexploited and polluted.
- To augment water supply, traditional techniques – such as rainwater collection – are now being supplemented by newer technologies like desalination and water reuse.
- Political support is needed to improve information collection that can in turn enable better decision making about the management and use of water.

Annex

Annex 1:
Aral Sea

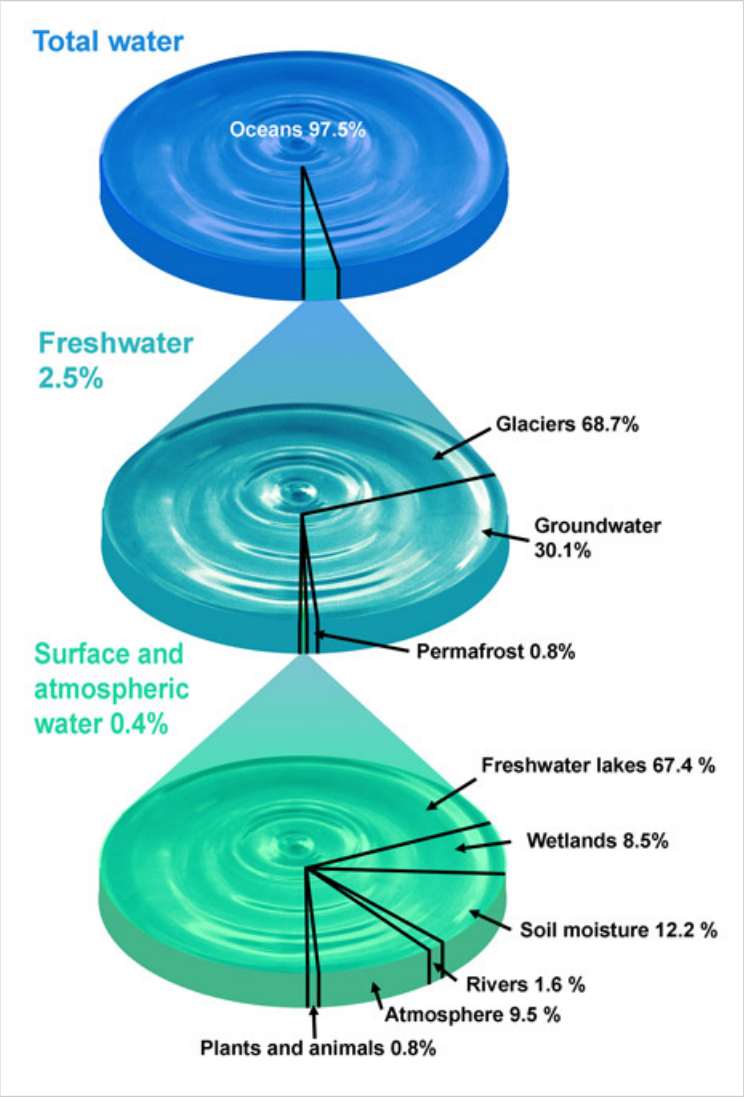
Over the last decades, diversion of rivers for irrigation has reduced its size by 60% and its volume by 80% , deeply affecting the local fishing industry and the livelihood of the population.



Source: © NASA/GSFC

Annex 2:

Figure 4.1: Global distribution of the world's water

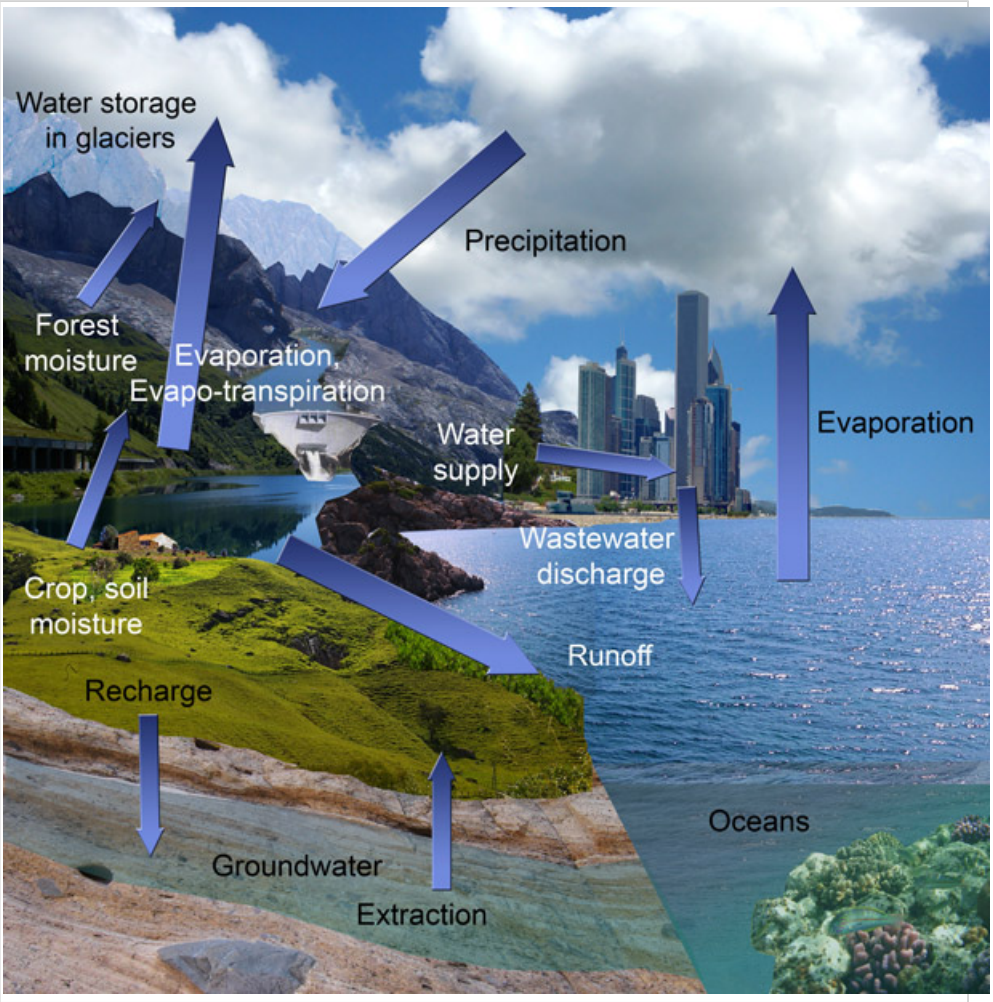


Data from Shiklomanov and Rodda, 2003. Freshwater has a global volume of 35.2 million cubic kilometres (km^3).

Source: UNESCO The United Nations World Water Development Report 2 [see http://www.unesco.org/water/wwap/wwdr2/pdf/wwdr2_ch_4.pdf]
Section 2: Changing Natural Systems,
Chapter 4, Part 1. Global Hydrology and Water Resources, p.121

Annex 3:

Figure 4.2: Schematic of the hydrologic cycle components in present-day setting



Source: UNESCO The United Nations World Water Development Report 2 [see http://www.unesco.org/water/wwap/wwdr2/pdf/wwdr2_ch_4.pdf]
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Partner for this publication

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