
Water Crisis: Towards a Way to Improve the Situation

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ABSTRACT: *There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people and the environment suffer badly. With the current state of affairs, correcting measures still can be taken to avoid the crisis to be worsening. There is an increasing awareness that our freshwater resources are limited and need to be protected both in terms of quantity and quality. This water challenge affects not only the water community, but also decision-makers and every human being. Water is everybody's business. Water should be recognized as a great priority.*

Keywords: *Water, Depleting Resources, Overuse, Pollution, Drought*

INTRODUCTION

Water is one of the world's most abundant resources, yet in many regions clean water is in critically short supply—endangering the economy, public health, energy production, and food supply. Water scarcity is the lack of sufficient available water resources to meet water needs within a region. It affects every continent and around 2.8 billion people around the world at least one month out of every year. More than 1.2 billion people lack access to clean drinking water. Climate changes and scarcity put pressure on water resources. To reverse this development requires collaboration across fields of expertise, behavioral changes and political reforms.

Water is one of the greatest current and future global challenges. We experience more frequent cloudbursts due to climate change, causing our sewers to overflow, yet at the same time, the scarcity of water elsewhere threatens public health and reduces food production. Freshwater makes up a very small fraction of all water on the planet. While nearly 70 percent of the world is covered by water, only 2.5 percent of it is fresh. The rest is saline and ocean-based. Even then, just 1 percent of our freshwater is easily accessible, with much of it trapped in glaciers and snowfields. By 2050, the world's population will have grown from 7 to 9 billion. This enormous upsurge means the need for water will increase by over 50 percent, if we continue our consumption at the current rate.

Many places in the world just don't have enough water. This is partly due to climate change, but especially due to increasing urbanization. Cities are growing at staggering rates, and to find water requires travelling further and further away from the densely populated areas. This is not a sustainable situation. With the growing urban demand, groundwater levels are sinking, and this not only means that water supplies are drying up, but that the water quality is deteriorating, due to chemical changes in the soil layers.

Agriculture is currently responsible for two-thirds of the world's water consumption, and projections show that in 2050, if we do not change our behavior – more than twice as much food will be required at that time. At the same time, the demand for energy will also grow, which will increase water usage in the energy sector. But there is not enough water to meet this need. In order to avoid a global energy and food crisis, political reforms and new technological solutions will be essential to balance the interplay between water, energy and food. These three sectors are inextricably linked; when the energy sector uses more water, then there is less left for food production.

Fresh Approach

New ways of generating access to fresh water—and sustainably ensuring its safety and quality are essential. According to the latest United Nations World Water Development Report, responsible water management is key to meeting the near 20-percent increase in global demand for fresh water by 2050. Less than one percent

of the world's water supply is safe for drinking, which leaves nearly 1 billion people without access to fresh drinking water.⁽¹⁾

The Institute for Molecular Engineering's Collaborative Water Research Initiative is investigating all aspects of water use, including novel purification methods, efficient use in agriculture, and optimal power usage in water treatment and distribution. IME is also developing innovative partnerships locally and globally—with universities, corporations, and government agencies—all with one goal: to transform new ideas into new tools that directly address problems of global importance. IME's novel approach brings together world-class scientists and engineers to advance the fundamental scientific understanding about water and water usage, as well as to accelerate the pace of new technology development for unmet market needs.⁽²⁾

GREAT POTENTIAL FOR EFFICIENCY – ALSO IN AGRICULTURE

It is not only possible to use sustainable solutions in the energy sector to reverse negative water projections, but water consumption can be also reduced in agriculture, by as much as 25 percent, using more effective methods of irrigation. In agriculture, there is a substantial water spillage when irrigating crops, and many countries still need to set clear eco-friendly goals for sustainable water usage," explains André Jol, Head of the Department of Vulnerability and Adaptation at the European Environment Agency.⁽³⁾

WATER – ONE OF THE 21ST CENTURY'S BIGGEST CHALLENGES

In April 2013, a group of 10 research scientists and supporting staff from the University of Chicago, Argonne National Laboratory, and Northwestern University joined another 20 research scientists from Ben-Gurion University (BGU) of the Negev in Beer-Sheva, Israel for a two-day workshop to develop research ideas and explore collaborations around the theme of "Science and Technology for Water and Its Utilization." The ideas generated and the collaboration network initiated at this workshop serves as the basis for collaborative water research projects among the institutions.⁽⁴⁾

The following June, Israeli President Shimon Peres, Chicago Mayor Rahm Emanuel, University of Chicago President Robert J. Zimmer, Ben-Gurion University President Rivka Carmi, and leading scientists in water research formally announced a major collaboration between the University of Chicago and Ben-Gurion University. These joint projects will explore innovative solutions at the water-energy nexus, developing more efficient ways of using water to produce energy and using energy to treat and deliver clean water.⁽⁵⁾

The Water Research Initiative will be led by IME fellow Steven Sibener, the Carl William Eisendrath, Distinguished Service Professor in Chemistry and the James Franck Institute. The team will also include scientists from Argonne National Laboratory, which the university manages for the U.S. Department of Energy, and the Marine Biological Laboratory in Woods Hole, MA, which has also recently signed an affiliation agreement with the school.⁽⁶⁾

UChicago, Ben-Gurion, and Argonne have jointly committed more than \$1 million over the next two years to support these inaugural projects, with the first set of projects scheduled to begin this fall. Proposals from nine cross-institutional research teams are currently being evaluated for funding.⁽⁷⁾

During the last three decades, efforts have been made in European countries to learn about the challenges related to water, as well as to develop strategies and regulations. These regulations are intended to support the governments of member states and to ensure that water reforms be implemented and maintained. A number of agreements have been established, requiring that EU member states live up to water sector standards.

One of the most significant regulations is the European Water Framework Directive (WFD) from 2000. This regulation is often seen to be the important driver in relation to building a sustainable water sector. Included in this directive is a requirement that member states, as well as England, conduct frequent measurements of water quality to avoid pollution of drinking water.⁽⁸⁾ The main goal of the EU directives is to advise member states about the best way to integrate water policies into other legislation, and how to fill the gaps existing

between water quantity and efficiency. The overall objective is to ensure that a necessary amount of water of good quality, available for all inhabitants throughout the EU. ⁽⁹⁾

Saving water resources

Whatever the use of freshwater (agriculture, industry, domestic use), huge saving of water and improving of water management is possible. Almost everywhere, water is wasted, and as long as people are not facing water scarcity, they believe access to water is an obvious and natural thing. With urbanization and changes in lifestyle, water consumption is bound to increase. However, changes in food habits, for example, may reduce the problem, knowing that growing 1kg of potatoes requires only 100 litres of water, whereas 1 kg of beef requires 13 000 liters. ⁽¹⁰⁾

An increase in tensions

As the resource is becoming scarce, tensions among different users may intensify, both at the national and international level. Over 260 river basins are shared by two or more countries. In the absence of strong institutions and agreements, changes within a basin can lead to transboundary tensions. When major projects proceed without regional collaboration, they can become a point of conflicts, heightening regional instability. The Parana La Plata, the Aral Sea, the Jordan and the Danube may serve as examples. (See Fig. 1). Due to the pressure on the Aral Sea, half of its superfcy has disappeared, representing 2/3 of its volume. 36 000 km² of marin grounds are now recovered by salt. ⁽¹¹⁾

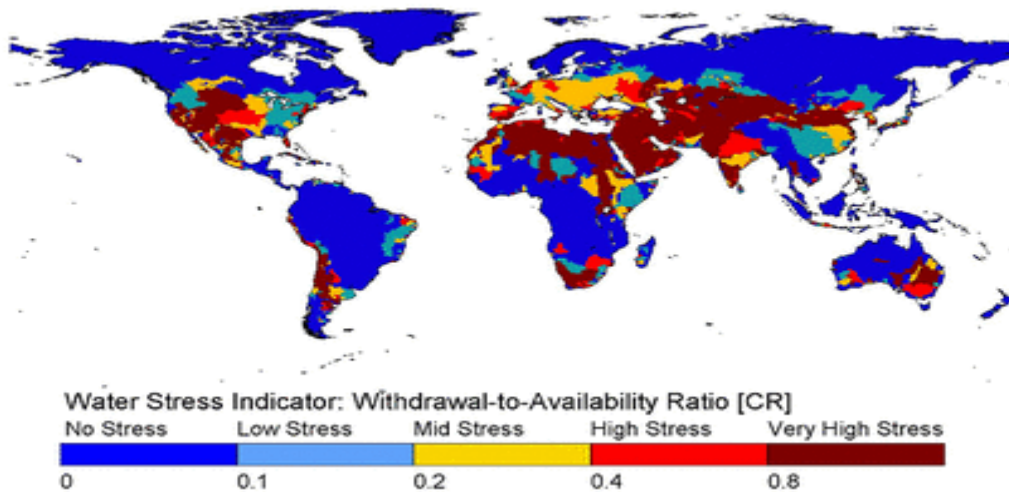


Fig. 1: Water Stress Indicator

Water Crisis

While the world's population tripled in the 20th century, the use of renewable water resources has grown six-fold. (See Fig. 2). Within the next fifty years, the world population will increase by another 40 to 50 %. This population growth - coupled with industrialization and urbanization - will result in an increasing demand for water and will have serious consequences on the environment. ⁽¹²⁾

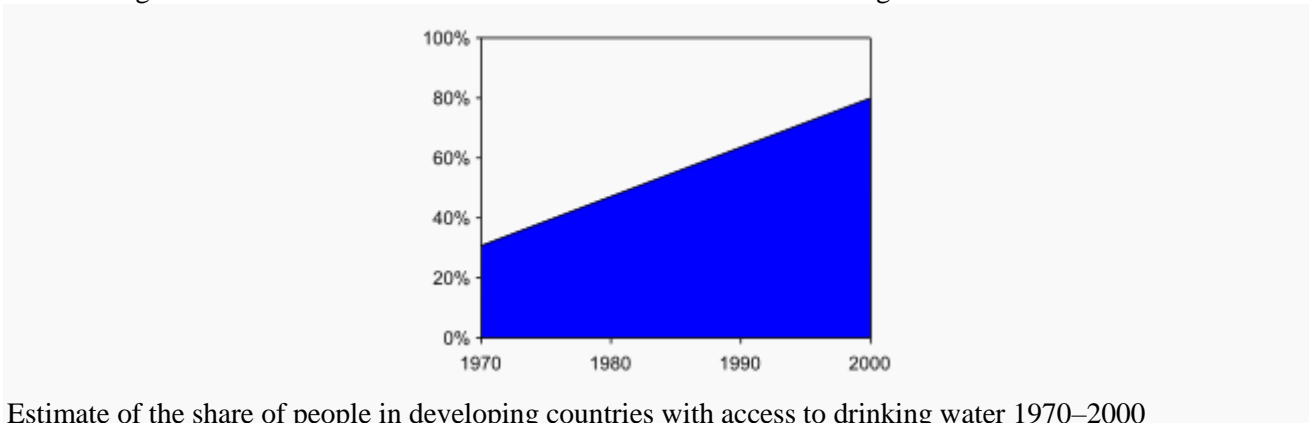
Facts and Figures

- 1 billion people live without clean drinking water.
- 6 1 billion people lack adequate sanitation.
- 8 billion people die every year from diarrheal diseases.
- 900 children die every day from water borne diseases.

Causes of water crisis

There are several principal manifestations of the water crisis. ⁽¹³⁾

- Inadequate access to safe drinking water for about 884 million people.
- Inadequate access to sanitation for 2.5 billion people, which often leads to water pollution.
- Groundwater over drafting (excessive use) leading to diminished agricultural yields
- Overuse and pollution of water resources harming biodiversity.
- Regional conflicts over scarce water resources sometimes resulting in warfare.



Estimate of the share of people in developing countries with access to drinking water 1970–2000

Fig. 2: Water Crisis

Depleting Fresh Water Resources

Apart from the conventional surface water sources of freshwater such as rivers and lakes, other resources of freshwater such as groundwater and glaciers have become more developed sources of freshwater, becoming the main source of clean water. Groundwater is water that has pooled below the surface of the Earth and can provide a usable quantity of water through springs or wells. These areas where groundwater is collected are also known as aquifers. Glaciers provide freshwater in the form meltwater, or freshwater melted from snow or ice, that supply streams or springs as temperatures rise. More and more of these sources are being drawn upon as conventional sources' usability decreases due to factors such as pollution or disappearance due to climate changes. The exponential growth rate of the human population is a main contributing factor in the increasing use of these types of water resources. ⁽¹⁴⁾

Causes of Water Scarcity

- **Overuse of Water:** Water overuse is a huge issue that a lot of people are dealing with. It may be overused on people, animals, land or any number of things. It may also be used for recreational activities without any care about the effects that it may have on the world around them.
- **Pollution of Water:** Water pollution is a huge problem, especially when you are looking at areas that don't necessarily have a good sewage system. Pollution can be anything from oil to carcasses, to chemicals and to faecal matter. No matter what it is, it makes a lot of issues for the people who may need to use it.
- **Conflict:** If there is conflict over an area of land, it may be difficult to access the water that is located there. In the worst case scenario, people could end up dying, If they try to access water in these areas (due to violence). This can result in a variety of other issues, including pollution.
- **Distance:** There are number of areas throughout the entire world that deal with water scarcity because they just aren't close to anywhere that has water. Areas that are considered to be desert, or areas that are secluded, may not have somewhere that the people can get water effectively.
- **Drought:** A drought, in short, an area which is not getting enough rainfall to be able to sustain the life that is residing there. Some areas are perpetual drought, whereas other areas may be dealing with a drought on occasion. Droughts are common all over the world, and there is little that can be done to prevent such things from happening.

- **Governmental Access:** In some countries, especially those with dictatorships, the use of water may be strictly controlled by those in power, causing a scarcity for those who may be located in those areas of the world. These governments use it as a source of control over those that are governing, which can be a huge problem.⁽¹⁵⁾

Effects of Water scarcity

- **Lack of Access to drinking water:** The biggest problem that happens when you have water scarcity is that people are not able to get fresh, clean drinking water. The human body can only go so long without water, and a lack of drinking water can result in a number of other problems.
- **Hunger:** If there is no water that can be used in order to help water the crops, then you are going to have people that are going hungry. **Animals will also die, which will result in lack of meat as well. Water scarcity, in short, causes starvation to occur en masse for both people and animals that are located in the area.**
- **Lack of Education:** Water scarcity makes difficult for people to get the education that they need or that they deserve. Mainly, because those children are either too sick to go to school, or they are working to help get water to the home and the family.
- **Diseases:** If you don't have clean water access, then you will be more likely to get diseases from the water that you do have. Whether you are drinking the water or using it for bathing, those diseases will get into the body and, in number of cases, the people carrying those diseases will pass away.
- **Sanitation issues:** Without access to clean water, there is no way to clean food, dishes or people. When people are not given access to proper sanitation, disease ends up becoming much more of an issue that it would have been otherwise. It also causes mental health issues, including depression and anxiety.
- **Poverty:** All in all, people who are dealing with water scarcity are often stuck in poverty as well. These people are not able to get the resources that they need in order to be able to thrive, and instead are just barely surviving through these difficult times.

Solutions for Water Scarcity

- **Education:** There are plenty of opportunities out there that people can use in order to learn more about the world around them. By educating those who are not dealing with water scarcity, they can be in a position to help. Those who are dealing with it can get educated on how they can prevent the problem from becoming even worse in the future.
- **Recycle Water:** There are plenty of technologies out there that allow you to recycle rain water and other water that you may be using in your home. Considering learning about how you can recycle water, not only does it help to prevent water scarcity, but it can save you some money as well.
- **Advance Technology Related to Water Conservation:** There has been lot of work in the world of water conservation, but there is a lot that needs to be done in order to ensure that the rest of the world is able to conserve water. Putting money and effort into conservation could be life saving.⁽¹⁶⁾
- **Improve Practices Related to Farming:** Farming and irrigation are often a huge culprit when it comes to water scarcity. Because of that, we need to improve practices so that we don't use as much water and those who are using water are using it to fullest potential. Technology also needs to advance in this manner.
- **Improve sewage System:** Clean drinking water starts with a good sewage system. Without proper sanitation, the water in an area becomes ridden with disease any number of other problems. By improving the sewage systems in these areas, we can prevent water scarcity. By improving the sewage systems in these areas, we can prevent water scarcity from becoming even worse.
- **Support Clean Water Initiatives:** There are organizations located all over the world that looking to bring clean water to areas that don't have it. Consider donating to these organizations, either with your time, your skills, or finances.

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“Water crisis? That’s like the California Drought, lead pipes in Flint Michigan or the dams breaking in New Orleans, right?” Few of us would think of the Great Recession as a water crisis. Further loss of revenue caused by mandatory conservation has only exacerbated the situation. This nexus of water and economics is what brought together a small group of large water consumers and management agencies in Nevada to accelerate the deployment of new technology solutions. We have quickly come to understand that technologies used to improve the operations of water systems also enables them to be more resilient in the face of larger environmental and economic forces. We created our own pilot fund to spread the risks out across our stakeholders.