The Future of Water

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Psalm 24 (KJV)

The earth is the LORD's, and the fullness thereof; the world, and they that dwell therein.

2 For He hath founded it upon the seas, and established it upon the floods.

3 Who shall ascend into the hill of the LORD? or who shall stand in his holy place?

4 He that hath clean hands, and a pure heart; who hath not lifted up his soul unto vanity, nor sworn deceitfully.
And God said, Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth.
Geological Time vs Human Time

Earth 4.6 billion years

Blue-green algae 3.6 billion years

Dinosaurs 135 million years

Humans 200 thousand years
Water, Plants and Carbon

**Majority** of Living Systems rely on Energy from the Sun.

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]

Energy from Sun

Process of Photosynthesis requires Energy from **The Sun**

To Convert Atmospheric **CO}_2 to Carbohydrates
Plants and the 1st Law of Thermodynamics

Plants Transform Energy from the Sun in Chemical Energy.

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \leftrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]

Energy from Sun   Chemical Energy of Bonds

Process of Photosynthesis *Transforms* Electromagnetic Energy
To Chemical Energy of *Carbohydrate C-O* bonds
All Animals rely on Plants to convert the sun's energy to Calories in the Form of Carbohydrates

\[ C_6H_{12}O_6 + 6O_2 \leftrightarrow 6CO_2 + 6H_2O \]

Carbohydrate – Glucose  Released Energy from calories in Plants

Processes of Cellular Respiration uses the energy stored in Chemical Bonds of Carbohydrates to fuel all living processes

Cellular Respiration is the Reverse of Photosynthesis

Same Amount of Water and Carbon cycles within the System
The Prince
by Niccolò Machiavelli

Has been called the first work of
Modern Political Philosophy
“The Prince ... does not explain what he thinks the best ethical or political goals are, except the control of one's own fortune, as opposed to waiting to see what chance brings.”
Politics

**Power** – Ambition, glory, honor, cunning and force, crush their opponents and earn great respect

**Control** – Injustice, immorality, deception

**Wealth** – control over something someone else wants.
Politics of Water

Water is often looked at as a “free” resource, responsible for man’s continued presence on earth, and consequently the inherent property of every living thing.
Water Wars

“Whisky is for drinking; water is for fighting over”,
Mark Twain
Water Wars - Power

**Does the Solution Lie Beneath Us?**

As lakes and rivers run dry and Earth’s surface water disappears, the solution might lie beneath us, in the vast and largely untapped network of underground aquifers. The United Nations cites over 33,400,000 km² of water in aquifers, 57% times more than all of Earth’s rivers combined. 98% of Earth’s accessible water is thought to reside in aquifers, much of it “locked” water more than a million years old. Until recently, deep aquifer pumping was out of the question (a cubic yard of water weighs one ton), but core-drilling technologies developed by the oil industry are changing the picture. Many of these aquifers span national borders, making access rights a huge matter of contention, and possibly a cause for future conflict.

**Water for the People**

Population and water distribution do not always correspond, often leaving highly populated regions with little access to water. This is most true in Asia, which has to support 60% of the world’s population with only 36% of the world’s water.

**Will There Be War?**

Of all the water on Earth, only 2.5% is fresh, and less than 0.007% is readily available to people through rivers, lakes, and streams. As worldwide populations surge, temperatures rise, climate changes, and diseases spread, clean water will become ever more essential and ever more rare. In 2009, United Nations Secretary-General Kofi Annan warned that national disputes over water could harbor “the seeds of violent conflict.” Opinions are split on the likelihood of “water wars.” In the past 50 years, there have been 1,851 water-related incidents between countries. Of these, the vast majority (1,229) ended peacefully. Only 21 involved actual military violence (18 between Israel and its neighbors). Furthermore, there are few places in the world where a water-poorest country is in a military position to attack a water-rich neighbor. Still, many experts believe that as water shortages become increasingly urgent, countries (or at least local communities) will resort to violence to quench their thirsts.

**Best Water**

1. Finland
2. Canada
3. New Zealand
4. United Kingdom
5. Japan

**Worst Water**

1. Belgium
2. Morocco
3. India
4. Iran
5. Sudan

**1970 Warning Signs**

In 1970, water consumption worldwide was half what it is today. With 80% of all sickness in the developing world linked to polluted water and with populations increasingly on the rise, the urgency of water management became apparent.

**2003 Dry and Dirty**

Over 1.3 billion people have no access to clean water. At least 2.7 million people die annually from diseases related to poor sanitation and contaminated drinking water—twice as many as die from bad water (or no water) each day.

**2025 Paradox Populace**

The United Nations estimates that the world’s per capita water supply will drop by 1/3 in the next 20 years: the worst strain will be in Africa and the Middle East, where populations are growing fast and rivers are running dry.

**Who Will Have the Water?**

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<th>Percentage of World Water Supply by Natural Economic Region</th>
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<td>&gt; 20</td>
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Water Wars - Control

The pump don't work 'cause the vandals took the handle. But look!

H2O Corp.
WATER
ONLY $1.00 PER CUP!
PAY HERE

PUBLIC WATER
Water Wars – Wealth

BLUE GOLD
THE WAR OVER YOUR WATER IS ABOUT TO BEGIN
As in the case with oil, the Middle East and North Africa is likely to see the most drastic conflicts in coming decades because of water.
Potential Water Wars

- Israel, Jordan and Palestine
- Turkey and Syria
- China and India
- Angola and Namibia
- Ethiopia and Egypt
- Bangladesh and India
Water Wars – Middle East

The Tigris Euphrates river basin has been a source of conflict between Syria, Iraq, and Turkey for decades. Ethnic Kurds in northern Iraq and southern Turkey, plan to divert water for irrigation reasons. This could reduce the amount of water to drier parts of Iraq. Kurds, lacking a nation state, may see repression of its people, the like of which could replicate Saddam Hussein’s attempt to eradicate the Kurds from Iraq post Persian Gulf war.
Water Wars - Control
Israel, Jordan and Palestine

- Five per cent of the world's population survives on 1 per cent of its water.
- In the Middle East this contributed to the 1967 Arab-Israeli war.
- Israel, the Palestinian Territories and Jordan rely on the River Jordan.
- Israel controls and cut supplies during times of scarcity.
- Palestinian consumption is severely restricted by Israel.
Environmental groups are making an early bid to try and stop a proposed water pipeline that would shunt water more than 500 miles from Wyoming to the Front Range of Colorado.
“Wyoming’s place as the water lawgiver of the arid region is due neither to geographical location or to superior natural resources; certainly it is not due to large population. It owes its commanding position solely to the character and ability of a few public men who happen to have found in this line of work their best opportunity for usefulness.”
The water laws ... dealt exclusively with the recognition of a need to direct water appropriators as to considerations in the construction of ditches for taking water out of the streams and rivers of the territory.
By 1899, it was known that the State of Wyoming’s water laws, as thoughtful and well-intentioned as they were, were not going to go unchallenged in the courts.
As successful crop production requires adequate water all through the growing season into late August and September, the need was great for a way to catch and hold water supplies.
Nebraska and Wyoming given more time to settle their fight over water from the North Platte River and end 100 + years of legal wrangling.
The California Water Wars were a series of conflicts between the city of Los Angeles farmers and ranchers in the Owens Valley of Eastern California.
Water Wars – California
Mulholland Drive?

As Los Angeles grew in the late 1800s, it started to outgrow its water supply. Fred Eaton, mayor of Los Angeles, realized that water could flow from Owens Valley to Los Angeles via an aqueduct.

The aqueduct construction was overseen by William Mulholland and was finished in 1913.
Eaton and Mulholland used underhanded methods to obtain water rights and block the Bureau of Reclamation.

The regional engineer of the Bureau, Joseph Lippincott, was a close associate of Eaton.

Eaton was a nominal agent for the Bureau through Lippincott, so Eaton had access to inside information about water rights and could recommend actions to the Bureau that would be beneficial to Los Angeles.

In return, while Lippincott was employed by the Bureau, he also served as a paid private consultant to Eaton, advising Los Angeles on how to best obtain water rights.
Mulholland also participated in misleading others. In Los Angeles, Mulholland influenced public opinion by dramatically understating the amount of water available for Los Angeles' growth. Mulholland also misled residents of the Owens Valley, by claiming that Los Angeles would take water only for domestic purposes, not for irrigation.
Water Wars - California

The water rights were acquired through political fighting and, as described by one author, "chicanery, subterfuge ... and a strategy of lies."
From 1908 through 1913, Mulholland directed the building of the aqueduct. The 223 miles (359 km) Los Angeles Aqueduct, completed in November 1913, required more than 2,000 workers and the digging of 164 tunnels. The project has been compared in complexity to building the Panama Canal. Water from the Owens River reached a reservoir in the San Fernando Valley on November 5, 1913. At a ceremony that day, Mulholland spoke his famous words about this engineering feat: "There it is. Take it."
After the aqueduct was completed in 1913, the San Fernando investors demanded so much water from the Owens Valley that it started to transform from "The Switzerland of California" into a desert. Mulholland was blocked from obtaining additional water from the Colorado River, so he decided to take all available water from the Owens Valley.
By the 1920s, so much water was diverted from the Owens Valley that agriculture became difficult. This led to the farmers trying to destroy the aqueduct.

Los Angeles prevailed and kept the water flowing. By 1926, Owens Lake at the bottom of Owens Valley was completely dry due to water diversion.
In the end, between acquiring key water rights and lobbying President, Theodore Roosevelt, Eaton and Mulholland were able to cancel the Bureau's irrigation project.
So much water was taken from the valley that the farmers and ranchers rebelled in 1924. A series of provocations by Mulholland were each followed by threats and Los Angeles property destruction by the local farmers. Finally, a group of armed ranchers seized the Alabama Gates and dynamited part of the system, letting water return to the Owens River.
Water Wars - California

The water needs of Los Angeles kept growing. In 1941, Los Angeles diverted water that previously fed Mono Lake into the aqueduct.
Water Wars - California

Because the creeks were diverted, the water level in Mono Lake started to fall, exposing tufa formations. The water became more saline and alkaline.
Water Wars – California
Did the “good” guys win?

The Mono Lake Committee and the National Audubon Society sued LADWP in 1979.

As of 2011, the water level in Mono Lake has risen 13 feet (4.0 m) of the required 20 feet (6.1 m). Los Angeles made up for the lost water through state-funded conservation and recycling projects.
Water Wars – Closer to Home

Diamond Valley Reservoir

“First and foremost, Diamond Valley Lake is a lifeline for Southern California in times of drought.

The lake holds enough water to meet the area’s emergency and drought needs for six months and is an important component in Metropolitan’s plan to provide a reliable supply of water to the 18 million people in Southern California who count on us.”

Metropolitan Water District
Where does The Water Come From?
The Law of the River

- Prior appropriation
  - Present Perfected Rights
- 1922 - The Colorado River Compact
  - Upper and Lower Basin allocations of 7.5 maf each
- 1928 - The Boulder Canyon Act
  - Hoover Dam and the All-American Canal
- 1944 - Treaty with Mexico
  - 1.5 maf to Mexico
Historical Flows of the Colorado River Below All Major Dams and Diversions, 1905-2000
The Hoover and Glen Canyon dams have reduced average annual flows from 13 million acre feet to practically zero and wetlands in the Delta from 2 million to 135,000 acres.
Population growth in the Colorado River Basin

- Colorado River supplies water to 30 million
- 8 of the 10 fastest growing cities are in AZ, NV and CA
- Top three are in Phoenix and Las Vegas areas
- An average of 175 new homes went up in the Phoenix area every day in 2005
- Enough water in AZ for at least another 60 years of growth
- Issue is not lack of water but environmental and social costs of unrestricted growth
Why Politics instead of Environmental Policy in the Colorado River Basin?

• Highly *engineered* system, physically controlled by an incredible system of dams and canals
• Highly *regulated* system, institutionally controlled by a system of rigid protocols, rules, laws and an international treaty
• Decision makers control management of the Colorado River by looking at trade-offs among policies
Ecosystem changes in last 50-75 years

* Construction of 2 major reservoirs
* Flows from Glen Canyon dam now determined by needs of water and power customers downstream rather than natural processes
* Tremendous growth of cultivated and urban areas in the Lower Basin
* River no longer regularly flows into the Sea of Cortez
* Negative impacts on beaches and native fish and plant species in Grand Canyon
* Salinization of soils in the Mexicali Valley
* Exacerbation of poverty for certain groups - Cucapa way of life and culture threatened with extinction
4 Scenarios to 2050

Dry Future

- 39% decrease in flows due to climate change
- Limited interstate water market
- Continued unrestricted urban growth
- No water for ecosystems beyond existing commitments
The Future of Water?