Cape Town Crisis

Water Scarcity in a Warming World

by Shelley Brooks, Ph.D.

Californians know drought. It is an ever-present concern in this **arid** state, particularly as its population and economy – and therefore the demand on fresh water – continue to grow. A recent five-year drought prompted Governor Brown in 2015 to mandate a 25% reduction in urban water use, and state water officials set a goal of 55 gallons a day per resident for personal, indoor water use. After heavy rains last winter, the governor declared the drought over in April 2017 and lifted these targets. Nearly every month since, Californians have been conserving less water. Meanwhile, the bulk of California's water supply – approximately 60% - supports agricultural crops and livestock. When the inevitable happens and water supplies become low again, everyone and everything in California feels the impact – farmers make tough decisions about what and how much to grow, wildlife habitat declines, and certain jobs (in farming, food processing, winter recreation, and even semiconductors) can disappear.

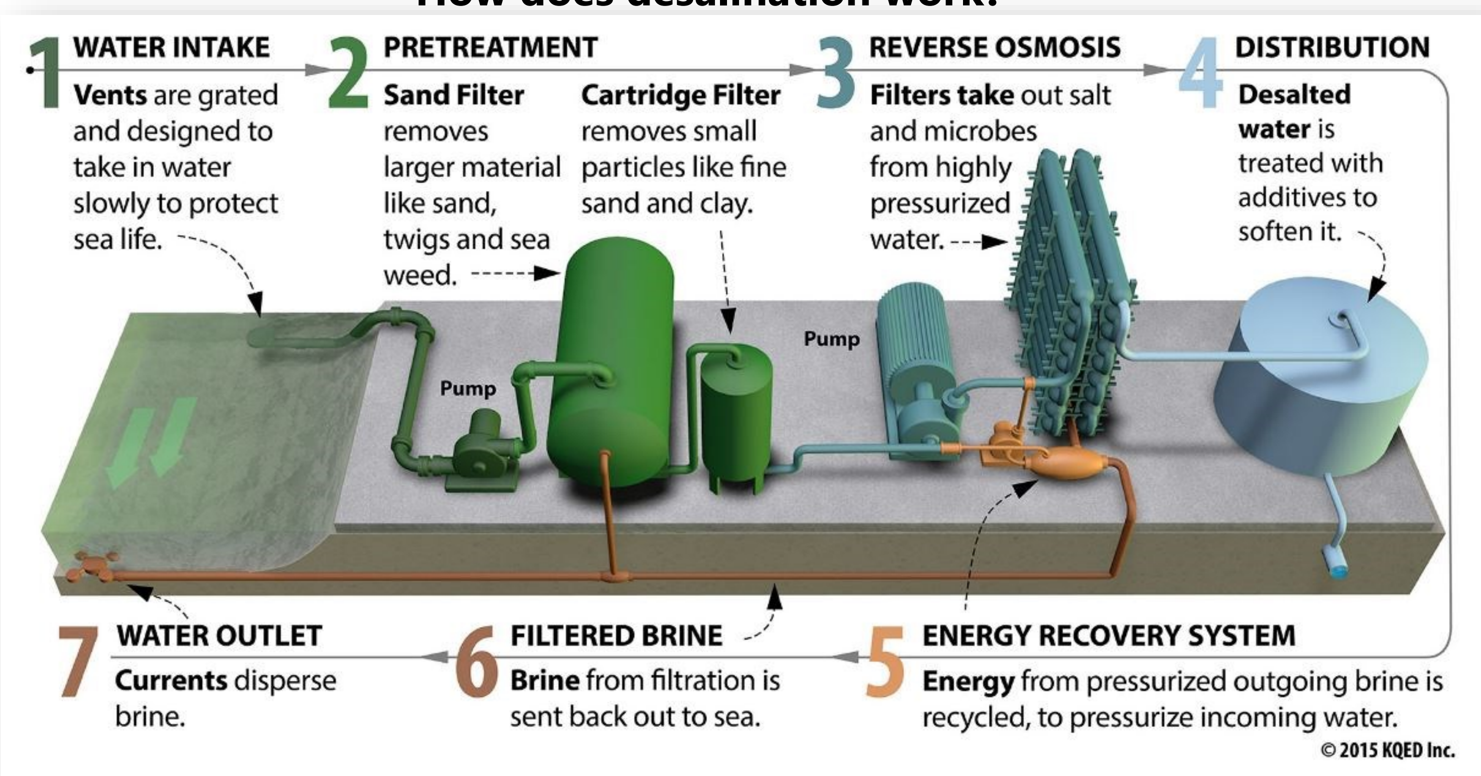
Californians are far from the only people on the globe struggling to maintain a sufficient water supply. The United Nation estimates that water scarcity affects more than 40% of the world's population. And, with climate change and a growing global population, this number is expected to rise. Right now, an unprecedented event is unfolding in South Africa due to a historic drought that may cause the city of Cape Town (population 3.75 million) to turn off tap water. 'Day Zero' – when the city's water supply runs dry – is expected to occur in early July. When Day Zero arrives, residents of Cape Town will have access to 25 liters (less than 7 gallons) a day per person, and they will need to stand in line at guarded water stations around the city to collect their water ration. In anticipation of harder times, residents of Cape Town have already dramatically reduced their water consumption; the national government has declared a state of emergency in order to focus additional resources on the crisis; and farmers in the region have given over water in their own reservoirs to add to the city's supply. These combined efforts have succeeded in padding the small supply of water and holding off, for now, the water cutoff.

Pros and Cons of Desalination

Cape Town's situation may be the most newsworthy, but it is likely that more and more places – especially in arid regions of the world – will face similar challenges. So, what can be done to continue to provide sufficient drinking water, as well as enough water for household and industrial use? Moreover, what level of water management is necessary to grow enough food to support an ever-larger global population? Not surprisingly, nations with very dry conditions have pioneered methods for increasing the water supply. No one can make the rain fall, but there is one method – called **desalination** – that can convert seawater into fresh water. Given that over 95% of the Earth's water is salt water, desalination is an appealing strategy. Israel – a country with a Mediterranean coastline and large desert regions – has developed productive desalination plants that today provide the country with approximately 60% of its **domestic water**. Saudi Arabia, the largest country on the Arabian Peninsula, also places greater reliance on desalinated water than on groundwater for its water supply. Cape Town, with its long coastline, has recently turned to desalination in order to alleviate its drought.

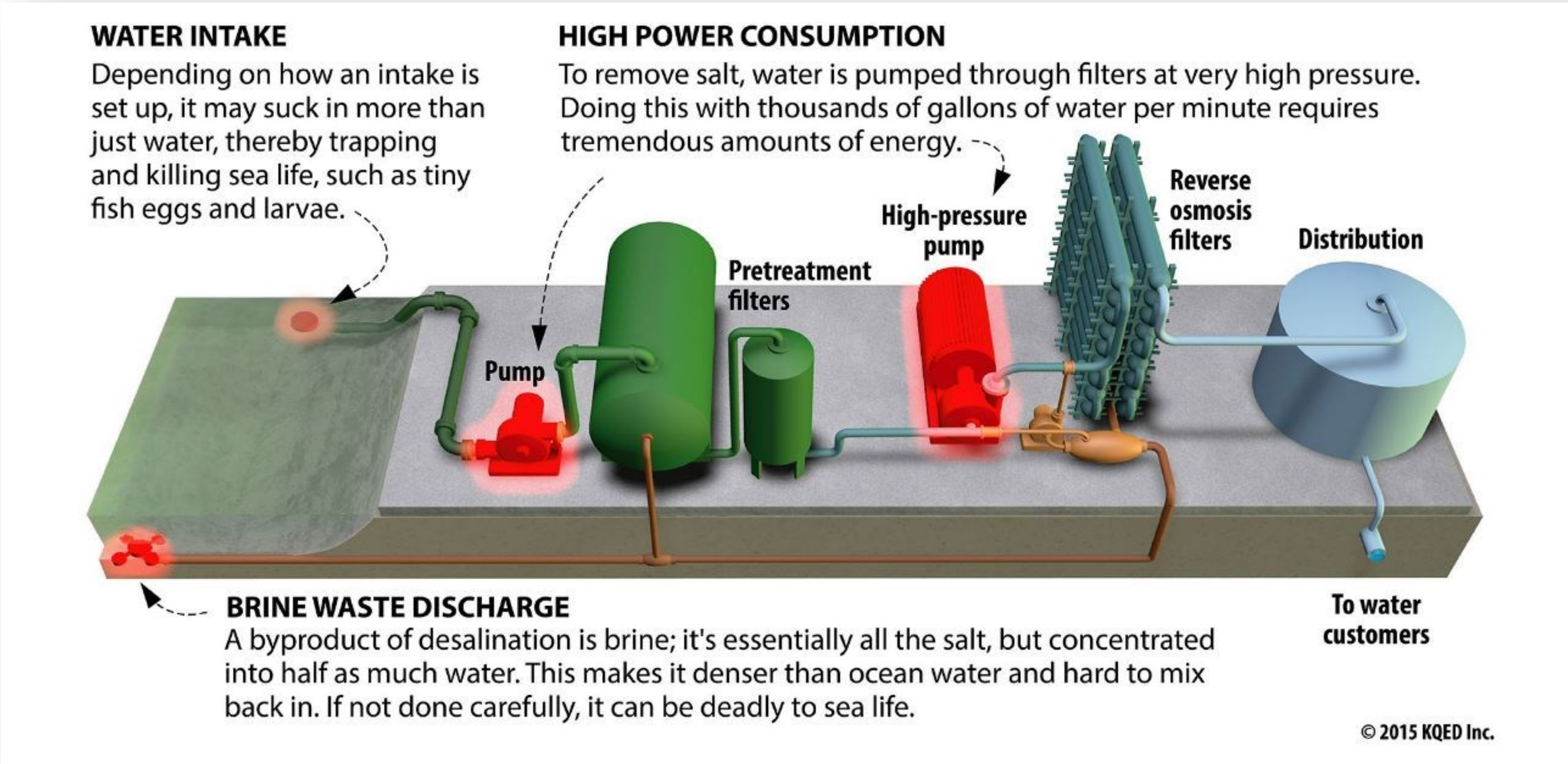
A careful desalination process (using the most effective technology) provides safe drinking water and causes only a minimal environmental footprint. But, scientists point out that desalination can pose certain health risks. For instance, a recent examination of seawater samples near Cape Town (water that could presumably be piped into desalination plants) found a number of chemicals from medicines and household cleaners as well as the dangerous bacteria E. coli in the water. In Israel, desalinated water is found to be lacking in the important naturally-occurring mineral, magnesium, which supports heart health. Desalination accounts for approximately 1% of the world's domestic water supply. This low number can be explained in part by the fact that it is primarily arid coastal regions that currently need such water. But beyond this factor and concerns about human health, desalinated water is small in quantity because of its high production costs. Desalination plants are very expensive to build (California's largest – in Carlsbad – cost $1 billion) and the cost of the purified water can be many times that of water that flows to consumers in the traditional fashion. Moreover, desalination raises certain environmental concerns. The process by which saltwater is converted to fresh water is extremely energy-intensive, and can negatively impact the ocean habitats from which the water is removed and the extracted salt is later returned.

How does desalination work?



Graphic courtesy of KQED

What are some of the concerns associated with the desalination process?



Graphic courtesy of KQED

Desalination alone cannot solve the problems of water scarcity, but it can be an effective part of a water management system for coastal areas that also prioritizes education about water conservation, efficient irrigation methods, recycling waste water and capturing storm water, and a water pricing structure that encourages wise use.

Desalination and Wise Water Management

Concerns about expensive production and the impact on human and ecosystem health are real challenges, but countries in the Middle East, parts of Asia and Africa, and a few other coastal areas have considered the costs to be worthwhile. In 2014, California voters passed a water bond that led to $30 million worth of grants to eight desalination projects throughout the state. Two of them are for seawater conversion, while six extract **brackish** water from a river, bay, or underground aquifer to convert to fresh water. Desalination alone cannot solve the problems of water scarcity, but it can be an effective part of a water management system for coastal areas that also prioritizes education about water conservation, efficient irrigation methods, recycling waste water and capturing storm water, and a water pricing structure that encourages wise use. To be clear, technology alone is not the answer to maintaining sufficient water for a country – individuals, companies, and governments all need to adopt habits and practices that treat water as a valuable and sometimes scarce resource.

Carlsbad Desalination Plant, 2017. Source: https://flic.kr/p/RZcjwW. Creative Commons License.

What Water Scarcity Could Mean in the Future

What happens if we don't address our water scarcity worldwide? Given our growing demands on fresh water, and the expected droughts associated with climate change, water scarcity will likely be an increasing source of political conflict among and within arid countries. Water is, after all, a required resource for all life on Earth. Beginning in the 1980s, a non-profit organization began to track and record worldwide conflicts related to water. The list (https://www.worldwater.org/water-conflict/) includes hundreds of historical events, many of which were caused at least in part by a lack of water. A recent example includes the civil war in Syria (http://chssp.ucdavis.edu/current-context/syrian-war.pdf). Some scholars point to the prolonged drought in helping to create the conditions for the devastating war. When a million Syrian farmers felt compelled to abandon their dry fields in 2008, they moved to urban areas where they were unsuccessful in finding alternative work. The overcrowded, temporary housing, and lack of government services and **infrastructure** became the "heart of the developing unrest" against President Bashar al-Assad. The fighting that ensued between Assad's government forces and rebels has yet to subside. Historically, wars have been fought over oil, gemstones, access to seaports and other environmental goods; drought conditions, and the lack of food that can follow, can also lead to volatile political conditions.

Cape Town's predicament is a good reminder for all communities that water conservation is everyone's responsibility, not just during times of drought but as a permanent response to changing climate conditions.

Word Bank

Arid - California, like most states west of the 100th meridian, is arid, with annual rainfall around 20 inches or below. But the term "average" is misleading, as rainfall varies dramatically not only from the temperate rainforest in the northwest corner of the state to the desert in the southeast portion of the state, but varies also from one year to the next.

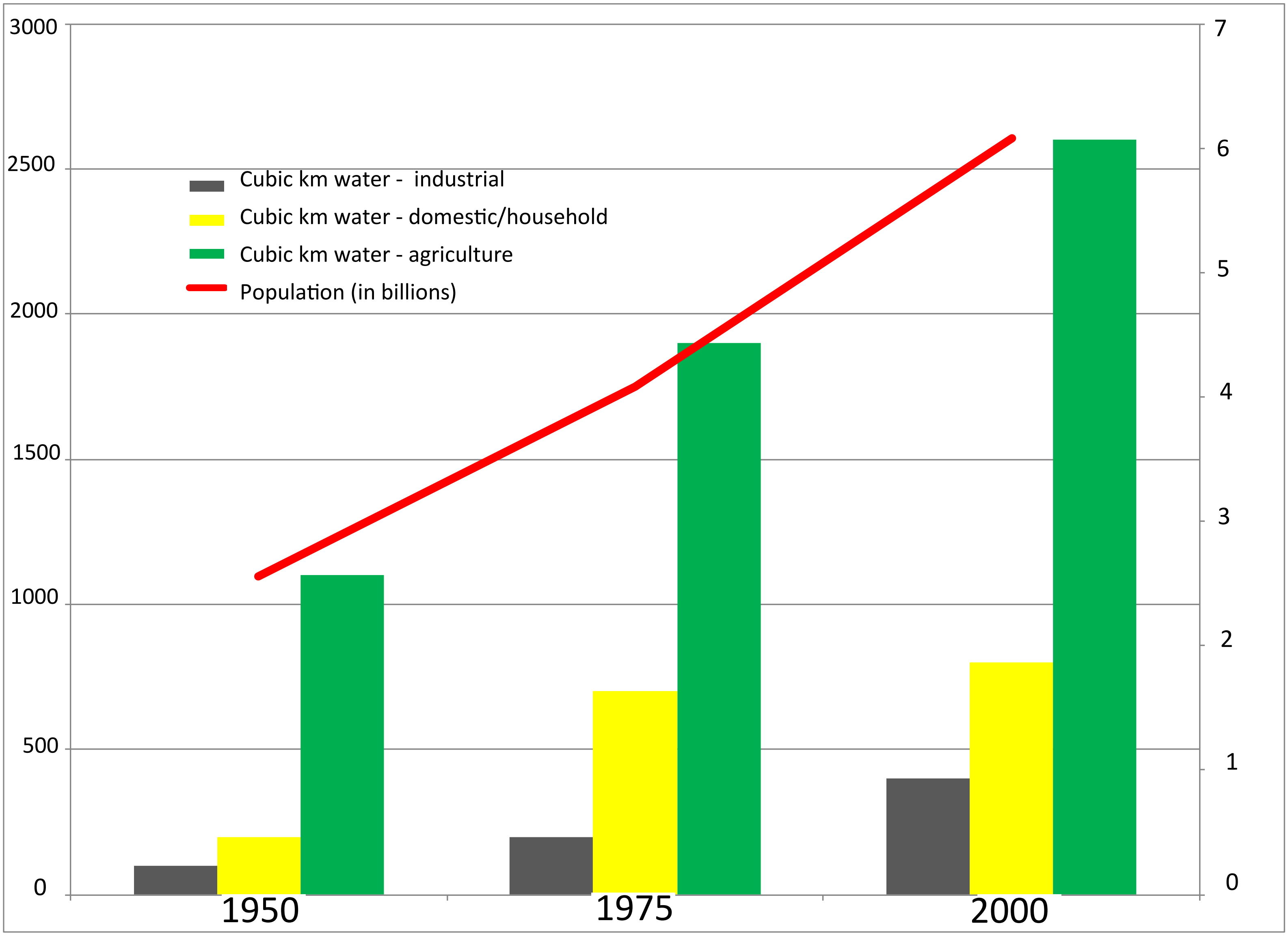
Brackish – slightly salty, as in the water in coastal estuaries. The six desalination plants being developed in California to treat brackish water have an advantage over traditional desalination plants because brackish water is less salty than ocean water and are therefore less expensive/energy-intensive to convert to drinking water.

Desalination - Water desalination is the removal of salts and dissolved solids from saline water (brackish or seawater), also known as desalting or desalinization. In addition to removing minerals, the process removes most biological or organic chemical compounds. (from water.ca.gov)

Domestic water – The water that is used in and around the house, including everything from the shower to watering outdoor lawns and trees.

Infrastructure – the roads, plumbing, sewage, communication network, energy supply, and other facilities and structures that support a society.

World Water Usage by Sector & Global Population



1) Examine this chart and think about what it tells you. What trend does this data show?
2) For what purpose/sector is the bulk of water used?
3) Why do you believe water usage is increasing for each of these sectors over time?
4) Given your analysis of this data, what do you predict will be the data points in 2025, or 2050?
5) What challenges do you foresee given your predictions?

How much water is required to make...?

1 liter of milk =
265 gallons of water

(to nourish the cow and process the milk)

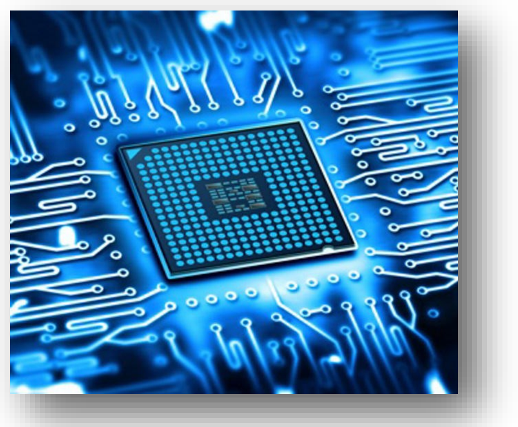
1 glass of orange juice =
55 gallons of water

(to grow the oranges and process the juice)

1 hamburger =

1,000 gallons of water

(to nourish the cow and process the meat)



1 microchip =

4,200 gallons of water

1 pair of jeans =

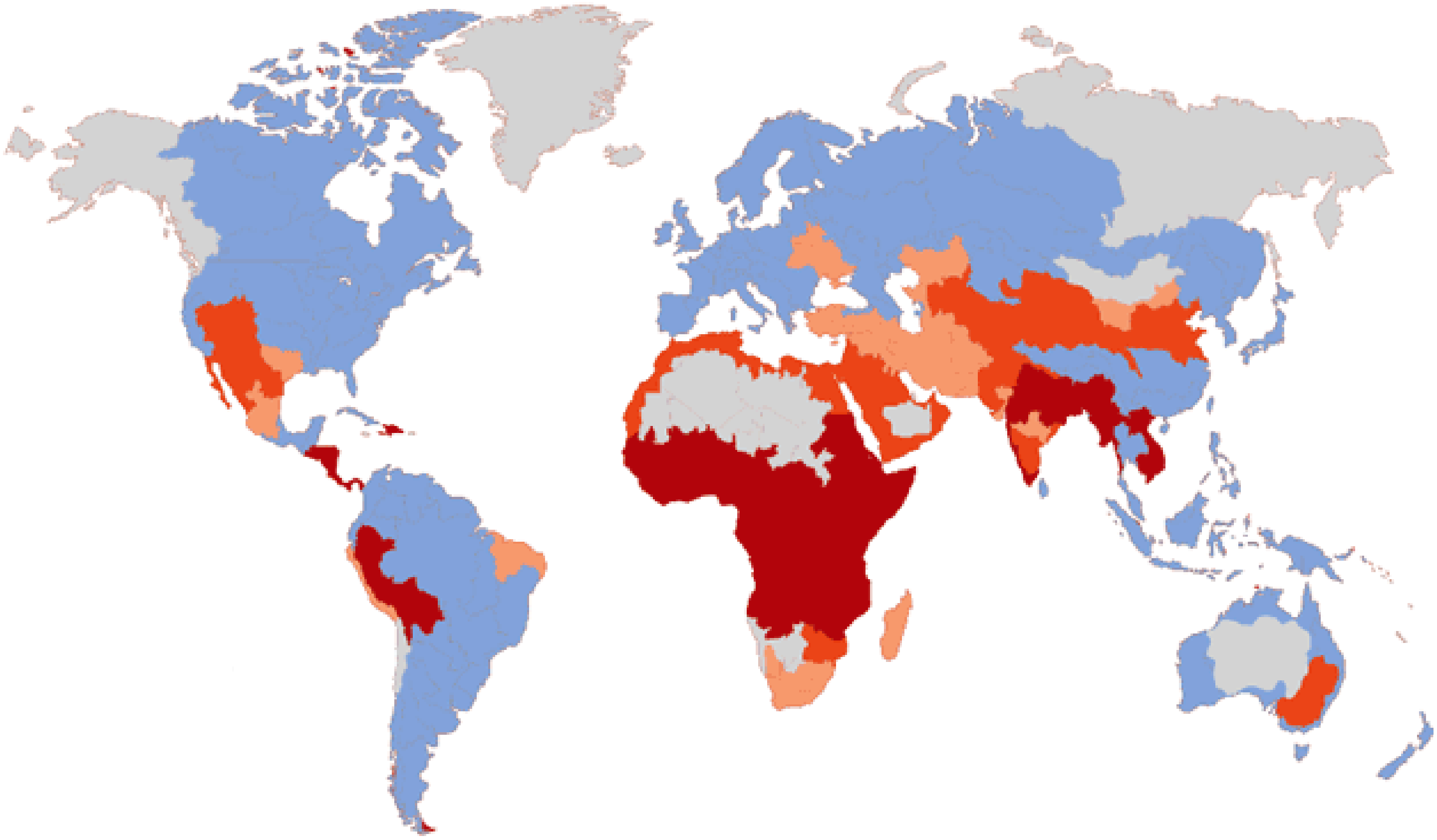
1,800 gallons of water

(to grow the cotton and process the jeans)

These are approximate amounts. To learn more, visit: http://worldwater.org/wp-content/uploads/2013/07/Table19.pdf

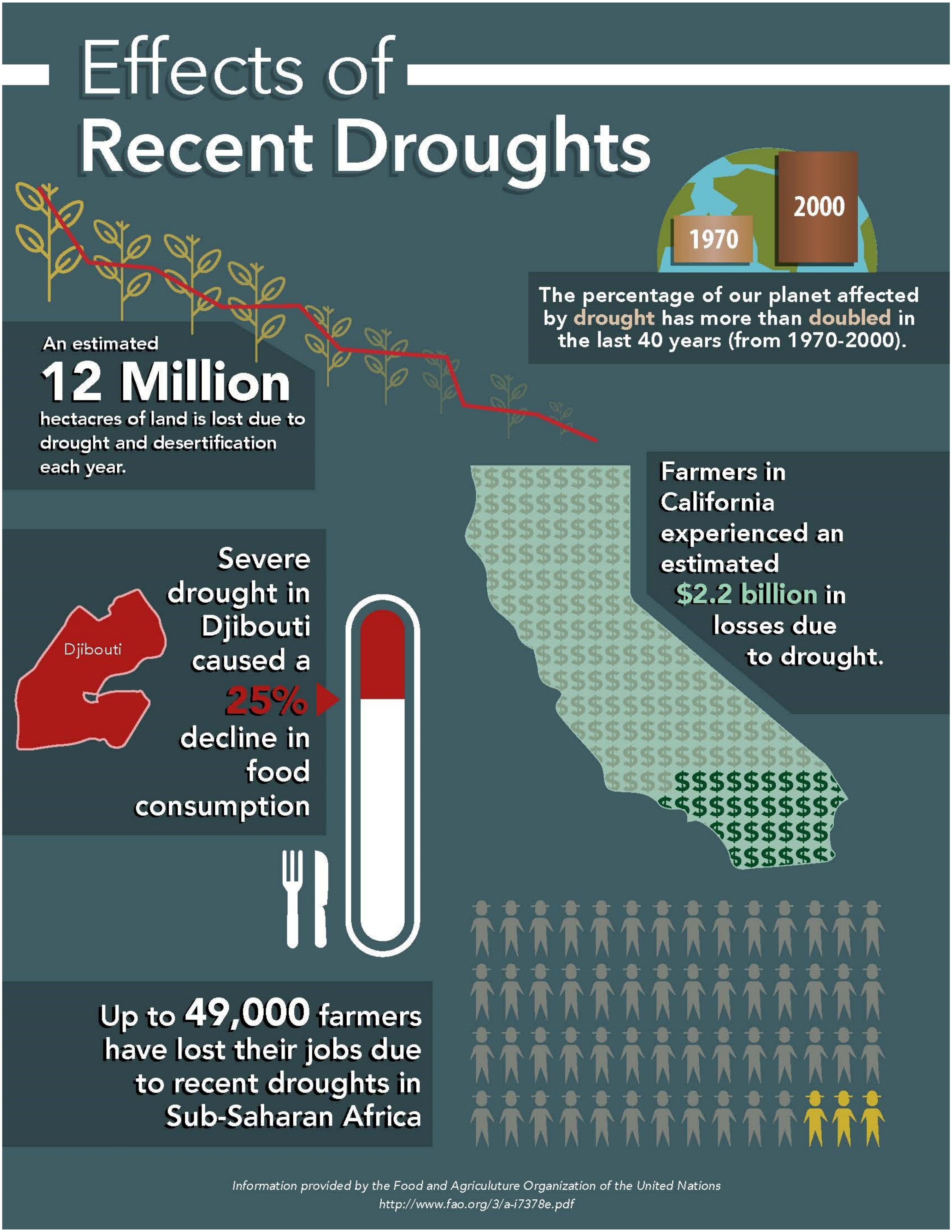
Areas of Physical and Economic Water Scarcity

As you examine this map and information, keep in mind that this map reflects 2007 data, when the global population was 6.6 billion. Estimates expect the global population to grow by 3.3 billion by 2050, while the total amount of fresh water is expected to remain roughly the same.



- Physical water scarcity—more than 75% of river flows are withdrawn for agriculture, industry, and domestic use.
- Approaching water scarcity—more than 60% of river flows are withdrawn for agriculture, industry, and domestic use.
- Economic water scarcity—less than 25% of river flows are withdrawn for human uses, but people in these regions cannot access adequate water due to a lack of money to invest in water infrastructure.
- Little or no water scarcity—there is more than enough water in rivers to meet human demands.
- No data created for these regions.

This map comes from the Food and Agriculture Organization of the United Nations: http://www.fao.org/land-water/outreach/graphs-and-maps/details/en/c/237285/


Effects of
Recent Droughts
2000
1970
The percentage of our planet affected by drought has more than doubled in the last 40 years (from 1970-2000).
An estimated
12 Million
hectacres of land is lost due to drought and desertification each year.
Farmers in California experienced an estimated $2.2 billion in losses due to drought.
Severe drought in Djibouti caused a 25% decline in food consumption
Djibouti
Up to 49,000 farmers have lost their jobs due to recent droughts in Sub-Saharan Africa
Information provided by the Food and Agriculuture Organization of the United Nations
http://www.fao.org/3/a-i7378e.pdf

Education and the Environment Initiative (EEI) Connections (http://www.californiaeei.org/)

A program of CalRecycle's Office of Education and the Environment, EEI lessons are designed to foster environmental literacy among California students. Below is a list of units and lessons to support student learning on the topic of water use and stakeholders, water infrastructure, and environmental considerations related to water management.

Kindergarten – K.4.5. & K.6.3. *Some Things Change and Some Things Stay the Same*, Lesson 3 "When a Community Grows"

1st Grade – 1.2.4. *People and Places*, Lesson 2 "Where People Live" and Lesson 3 "Change Related to Natural Events" and Lesson 5 "People and Places"

2nd Grade – 2.4.1. *From Field to Table*, Lesson 1 "How Does California Grow?"

3rd Grade – 3.1.1. and 3.1.2. *The Geography of Where We Live*, Lesson 4 "Changes in Our Local Region"

3.2.2. *California Indians People: Exploring Tribal Regions*, Lesson 2 "The Local Landscape Long Ago"

3.5.1/.2/.3 *California's Economy: Natural Choices*, Lesson 3 "The Resources Our Industries Need and Use"

4th Grade – 4.1.3/.5 *Reflections of Where We Live*, Lesson 3 "Land Uses and Natural Resources"

4.2.6. *Cultivating California*, Lesson 5 "Changing Natural Systems"

4.3.3. *Witnessing the Gold Rush*, Lesson 5 "Flattening Mountains, Filling Valleys"

5th Grade – 5.4.1. *Human Settlement and the Natural Regions of the Eastern Seaboard*, Lesson 1 "Coast to Coast Connections"

6th Grade – 6.2.1. *River Systems and Ancient Peoples*, Lesson 1 "The Importance of the Bay Delta to California";

6.2.2. *Agricultural Advances in Ancient Civilizations*, Lesson 1 "The Power of Agriculture" and Lesson 2 "Radical Revolution: Ancient Agricultural Advancements"

6.2.6. & 6.2.8. *Egypt and Kush: A Tale of Two Kingdoms*, Lesson 1 "Sharing a River"

6.5.1. & 6.6.1. *The Rivers and Ancient Empires of China and India*, Lesson 6 "Our Use of Rivers Today"

8th Grade – 8.8.4. *Struggles with Water*, Lesson 1 "California and the Colorado" and Lesson 5 "The Colorado River Revisited"

10th Grade – 10.3.3. *Growth of Population, Cities and Demands*, Lesson 4 "Laws and Policies to Manage Natural Resources" and Lesson 5 "Government Responds to Managed Growth"

11th Grade – 11.8.6. *Postwar Industries and Emerging Environmental Movement*, Lesson 1 "Postwar Changes in the Great Central Valley" and Lesson 3 "Tracking the Postwar Boom" and Lesson 4 "Effects of the Postwar Boom"

11.9.7. *The United States and Mexico Working Together*, Lesson 4 "From a Different Perspective"

12th Grade – 12.1.4. *Private Property and Resource Conservation*, Lesson 3 "Applying Utilitarianism to Water Resources"

Would you like to learn more about water management and desalination in California? The Water Education Foundation (http://www.watereducation.org/topic-desalination) provides a number of resources to better understand conditions in our state.

Image citations: Trees at Theewaterskloof Dam, South Africa, 2018. https://flic.kr/p/K82pv8. Creative Commons License; Desalination graphics from KQED: https://ww2.kqed.org/science/2015/12/18/why-isnt-desalination-the-answer-to-all-californias-water-problems/; *Carlsbad Desalination Plant. Source: https://flic.kr/p/RZcjwW. Creative Commons License;* Graphics on Page 8 by CHSSP Staff Martin Gaona

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