Water conservation

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Water conservation includes all the policies, strategies and activities made to sustainably manage the natural resource fresh water, to protect the water environment, and to meet current and future human demand. Population, household size, and growth and affluence all affect how much water is used. Factors such as climate change have increased pressures on natural water resources especially in manufacturing and agricultural irrigation.[1] Many US cities have already implemented policies aimed at water conservation, with much success.[2]

United States postal stamp advocating water conservation.

The goals of water conservation efforts include:

- Ensuring availability of water for future generations where the withdrawal of freshwater from an ecosystem does not exceed its natural replacement rate.
- Energy conservation as water pumping, delivery and wastewater treatment facilities consume a significant amount of energy. In some regions of the world over 15% of total electricity consumption is devoted to water management.
- Habitat conservation where minimizing human water use helps to preserve freshwater habitats for local wildlife and migrating waterfowl, but also water quality.[3]

Contents

Strategies

The key activities that benefit water conservation are as follows :

1. Any beneficial reduction in water loss, use and waste of resources.
2. Avoiding any damage to water quality.
3. Improving water management practices that reduce the use or enhance the beneficial use of water.[4][5]

One strategy in water conservation is rain water harvesting.[6] Digging ponds, lakes, canals, expanding the water reservoir, and installing rain water catching ducts and filtration systems on homes are different methods of harvesting rain water.[6] Harvested and filtered rain water could be used for toilets, home gardening, lawn irrigation, and small scale agriculture.[6]

Another strategy in water conservation is protecting groundwater resources. When precipitation occurs, some infiltrates the soil and goes underground.[7] Water in this saturation zone is called groundwater.[7] Contamination of groundwater causes the groundwater water supply to not be able to be used as resource of fresh drinking water and the natural regeneration of contaminated groundwater can takes years to replenish.[8] Some examples of potential sources of groundwater contamination include storage tanks, septic systems, uncontrolled hazardous waste, landfills, atmospheric contaminants, chemicals, and road salts.[8] Contamination of groundwater decreases the replenishment of available freshwater so taking preventative measures by protecting groundwater resources form contamination is an important aspect of water conservation.[6]

An additional strategy to water conservation is practicing sustainable methods of utilizing groundwater resources.[6] Groundwater flows due to gravity and eventually discharges into streams.[7] Excess pumping of groundwater leads to a decrease in groundwater levels and if continued it can exhaust the resource.[6] Ground and surface waters are connected and overuse of groundwater can reduce and, in extreme examples, diminish the water supply of lakes, rivers, and streams.[8] In coastal regions, over pumping groundwater can increase saltwater intrusion which results in the contamination of groundwater water supply.[8] Sustainable use of groundwater is essential in water conservation.

A fundamental component to water conservation strategy is communication and education outreach of different water programs.[9] Developing communication that educates science to land managers, policy makers, farmers, and the general public is another important strategy utilized in water conservation.[9] Communication of the science of how water systems work is an important aspect when creating a management plan to conserve that system and is often used for ensuring the right management plan to be put into action.[9]

Social solutions

Water conservation programs involved in social solutions are typically initiated at the local level, by either municipal water utilities or regional governments. Common strategies include public outreach campaigns,[10][11][12] tiered water rates (charging progressively higher prices as water use increases), or restrictions on outdoor water use such as lawn watering and car washing.[13] Cities in dry climates often require or encourage the installation of xeriscaping or natural landscaping in new homes to reduce outdoor water usage.[14] Most urban outdoor water use in California is residential,[15] illustrating a reason for outreach to households as well as businesses.

One fundamental conservation goal is universal metering. The prevalence of residential water metering varies significantly worldwide. Recent studies have estimated that water supplies are metered in less than 30% of UK households,[16] and about 61% of urban Canadian homes (as of 2001).[17] Although individual water meters have often been considered impractical in homes with private wells or in multifamily buildings,

the U.S. Environmental Protection Agency estimates that metering alone can reduce consumption by 20 to 40 percent.[18] In addition to raising consumer awareness of their water use, metering is also an important way to identify and localize water leakage. Water metering would benefit society in the long run it is proven that water metering increases the efficiency of the entire water system, as well as help unnecessary expenses for individuals for years to come. One would be unable to waste water unless they are willing to pay the extra charges, this way the water department would be able to monitor water usage by public, domestic and manufacturing services.

Drip irrigation system in New Mexico

Some researchers have suggested that water conservation efforts should be primarily directed at farmers, in light of the fact that crop irrigation accounts for 70% of the world's fresh water use.[19] The agricultural sector of most countries is important both economically and politically, and water subsidies are common. Conservation advocates have urged removal of all subsidies to force farmers to grow more water-efficient crops and adopt less wasteful irrigation techniques.

New technology poses a few new options for consumers, features such and full flush and half flush when using a toilet are trying to make a difference in water consumption and waste. Also available are modern shower heads that help reduce wasting water: Old shower heads are said to use 5-10 gallons per minute, while new fixtures available are said to use 2.5 gallons per minute and offer equal water coverage.

Household applications

The Home Water Works website contains useful information on household water conservation.[20] Contrary to popular view, experts suggest the most efficient way is replacing toilets and retrofitting washers.[21]

Water-saving technology for the home includes:

1. Low-flow shower heads sometimes called energy-efficient shower heads as they also use less energy
2. Low-flush toilets and composting toilets. These have a dramatic impact in the developed world, as conventional Western toilets use large volumes of water
3. Dual flush toilets created by Caroma includes two buttons or handles to flush different levels of water. Dual flush toilets use up to 67% less water than conventional toilets
4. Faucet aerators, which break water flow into fine droplets to maintain "wetting effectiveness" while using less water. An additional benefit is that they reduce splashing while washing hands and dishes
5. Raw water flushing where toilets use sea water or non-purified water
6. Waste water reuse or recycling systems, allowing:
    - Reuse of graywater for flushing toilets or watering gardens
    - Recycling of wastewater through purification at a water treatment plant. *See also Wastewater - Reuse*
7. Rainwater harvesting
8. High-efficiency clothes washers
9. Weather-based irrigation controllers
10. Garden hose nozzles that shut off water when it is not being used, instead of letting a hose run.
11. Low flow taps in wash basins

12. Swimming pool covers that reduce evaporation and can warm pool water to reduce water, energy and chemical costs.
13. Automatic faucet is a water conservation faucet that eliminates water waste at the faucet. It automates the use of faucets without the use of hands.

Commercial applications

Many water-saving devices (such as low-flush toilets) that are useful in homes can also be useful for business water saving. Other water-saving technology for businesses includes:

- Waterless urinals
- Waterless car washes
- Infrared or foot-operated taps, which can save water by using short bursts of water for rinsing in a kitchen or bathroom
- Pressurized waterbrooms, which can be used instead of a hose to clean sidewalks
- X-ray film processor re-circulation systems
- Cooling tower conductivity controllers
- Water-saving steam sterilizers, for use in hospitals and health care facilities
- Rain water harvesting
- Water to Water heat exchangers.

Agricultural applications


Overhead irrigation, center pivot design

For crop irrigation, optimal water efficiency means minimizing losses due to evaporation, runoff or subsurface drainage while maximizing production. An evaporation pan in combination with specific crop correction factors can be used to determine how much water is needed to satisfy plant requirements. Flood irrigation, the oldest and most common type, is often very uneven in distribution, as parts of a field may receive excess water in order to deliver sufficient quantities to other parts. Overhead irrigation, using center-pivot or lateral-moving sprinklers, has the potential for a much more equal and controlled distribution pattern. Drip irrigation is the most expensive and least-used type, but offers the ability to deliver water to plant roots with minimal losses. However, drip irrigation is increasingly affordable, especially for the home gardener and in light of rising water rates. Using drip irrigation methods can save up to 30,000 gallons of water per year when replacing irrigation systems that spray in all directions.[22] There are also cheap effective methods similar to drip irrigation such as the use of soaking hoses that can even be submerged in the growing medium to eliminate evaporation.

As changing irrigation systems can be a costly undertaking, conservation efforts often concentrate on maximizing the efficiency of the existing system. This may include chiseling compacted soils, creating furrow dikes to prevent runoff, and using soil moisture and rainfall sensors to optimize irrigation schedules.[18] Usually large gains in efficiency are possible through measurement and more effective management of the existing irrigation system. The 2011 UNEP Green Economy Report notes that "[i]mproved soil organic

matter from the use of green manures, mulching, and recycling of crop residues and animal manure increases the water holding capacity of soils and their ability to absorb water during torrential rains",[23] which is a way to optimize the use of rainfall and irrigation during dry periods in the season.

Water Reuse

Water shortage has become an increasingly difficult problem to manage. More than 40% of the world's population live in a region where the demand for water exceeds its supply. The imbalance between supply and demand, along with persisting issues such as climate change and exponential population growth, has made water reuse a necessary method for conserving water.[24] There are a variety of methods used in the treatment of waste water to ensure that it safe to use for irrigation of food crops and/or drinking water.

Seawater desalination requires more energy than the desalination of fresh water. Despite this, many seawater desalination plants have been built in response to water shortages around the world. This makes it necessary to evaluate the impacts of seawater desalination and to find ways to improve desalination technology. Current research involves the use of experiments to determine the most effective and least energy intensive methods of desalination.[25][26]

Sand filtration is another method used to treat water. Recent studies show that sand filtration needs further improvements, but it is approaching optimization with its effectiveness at removing pathogens from water.[27][28] Sand filtration is very effective at removing protozoa and bacteria, but struggles with removing viruses.[29] Large-scale sand filtration facilities also require large surface areas to accommodate them.

The removal of pathogens from recycled water is of high priority because wastewater always contains pathogens capable of infecting humans. The levels of pathogenic viruses have to be reduced to a certain level in order for recycled water to not pose a threat to human populations. Further research is necessary to determine more accurate methods of assessing the level of pathogenic viruses in treated wastewater.[30]

See also

- Al Baydha Project
- Berlin Rules on Water Resources
- Conservation biology
- Conservation ethic
- Conservation movement
- Deficit irrigation
- Ecology movement
- Environmental protection
- GreenPlumbers
- Micro-sustainability
- Pan evaporation
- Peak water
- Sustainable agriculture
- Utility submeter
- Water cascade analysis
- Water metering
- Water pinch
- WaterSense - EPA conservation program

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External links

- Water Efficiency Magazine (http://www.waterefficiency.net) — Journal for Water Conservation Professionals
- Water Conservation Community of Interest (http://apps.awwa.org/ebusmain/community/conservation.aspx) — American Water Works Association
- Water Conservation (http://wqic.nal.usda.gov/water-availability/water-conservation) — Water Quality Information Center, National Agricultural Library, U.S. Department of Agriculture
- Alliance for Water Efficiency (AWE) (http://www.allianceforwaterefficiency.org)
- Smart WaterMark (http://www.smartwatermark.org/) — Australian Water Conservation Label

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