The Effects of Groundwater Depletion

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Hello and welcome to the latest edition of Waterbytes! My name is Christina and today we're going to be talking about the issue of groundwater depletion. This has become an ever-increasing problem in today's world, especially with the threat of climate change. Aquifers, sources of groundwater worldwide, are beginning to suffer from a dramatic increase in human usage. This also seems to be leading towards increases in natural disasters, among problems.

So what is groundwater? Groundwater is basically water that lies beneath the ground surface. It is also found in water-filling pore space, also known as cracks and crevices in rocks. Some sources of groundwater are rain and snow, as the water fills pores and is absorbed by the Earth. This underground resource moves in response to differences in water pressure and elevation. Its velocity is also influenced by slope [1].

This is a resource that is being threatened nearly every day. The groundwater, or "fossil water" as it is also known, is limited. It was created eons ago and has been trapped in huge aquifers. In a similar fashion to oil, it is unknown when we will run out. There are also many worries related to this "fossil water" usage. In Jordan, the recently extracted groundwater was found to contain dangerous levels of radiation. It was contaminated naturally through sandstone over the eons. Similar issues were discovered in Israel, Saudi Arabia, and Libya. Though this problem can be fixed, it is rather expensive and creates another disposal issue [2].

Water quality problems are also arising. Depleted aquifers are subject to an influx of surrounding contaminants. One such contaminant is saltwater. Also, depleting these aquifers too quickly reduces underground pressure, rendering some quantities of water irretrievable [2].

Climate change also has a huge impact on groundwater depletion. Natural recharge, or replenishment if you will, is dependent on climate. This has a direct implication on precipitation and evapotranspiration. As the world becomes dryer, this process is slowed and aquifers are being drained too quickly as a result. Another impact of climate change on groundwater loss is global warming. As snow is a source of water for aquifer replenishment, these cycles are important. The warming has caused a change in these very same cycles, as snow is melting earlier and precipitation has become more common in the winter than snow. Discharge, another part of the groundwater cycle, may be affected by this climate change as well. It is projected that this process will be impacted by prolonged droughts and frequent and intense rainfalls. Research has shown that more than one part of the groundwater cycle is, or is going to be, impacted by impending climate change [3].

As I mentioned before, rising populations are causing these underground resources to suffer complications. One place this has been apparent is in India, specifically in Delhi, West Uttar-Pradesh, Haryana, and Rajasthan. According to CGWB Chairman S.C. Dhiman, overexploitation, due to population concentration, has led to depletion and the recharge process to slow due to the type of soil in this region [4].

This is also the case in the Tigris and Euphrates river basins. The Grace satellites from NASA have shown a substantial decline in the volume of these reserves. Jay Famiglietti, principle investigator, hydrologist, and professor at UC Irvine said that this region currently has the second fastest rate of groundwater storage loss on Earth, after India [5].

This issue affects and is affected by climate change as well as natural disasters. Groundwater depletion has been linked to sea level rise. All water pumped out of these aquifers, for whatever purpose, whether it be irrigation, industrial uses, or even just drinking, eventually reaches the ocean through the water cycle. Groundwater depletion is adding 0.6 millimeters per year to Earth's sea level. Basically, it adds about 25 percent to projected sea level rise [6].

This may also raise the possibility of global food crisis. Due to the increasing demand for food and drinking water, the rate at which underground resevoirs are being pumped has more than doubled between 1960 and 2000. Irrigation, accounting for 70 percent of world water use, is the main cause of groundwater depletion. These irrigated food sources are the cornerstone of global food security. The highest rate of depletion occurs in regions dependent on irrigated farming, including the north plain of China, northwestern India, and the central valley of California [7].

Natural disasters also impact this problem. In northwest Texas, a persistent drought is leading to increased pumping of the Ogallala Aquifer. About 77 percent of the Ogallala depletion occurred when the drought gripped the region. The Ogallala Aquifer spans some eight US states, 175,000 square miles, and waters 27 percent of the nation's irrigated cropland [8]. In California, the depletion of groundwater seems to be increasing the state's chance of earthquakes. This is being caused by the pressure that is being put on the San Andreas Fault. This increased tectonic activity has been clustered around where the groundwater was being lost, or in other words, depleted. Similar data was found in Spain, where a 5.1 magnitude earthquake occurred in 2011. There have also been other human activities linked to increased tectonic activity where there was previously little. These activities include draining large reseviors and fracking operations. In the case of California, the state is predicted to experience several changes in climate and

environment. Some of these changes are altered precipitation patterns, more frequent droughts, earlier snowmelt, larger floods, and increasing temperatures [9].

In addition to all these problems that I previously mentioned, some other issues are arising due to groundwater depletion. For example, groundwater depletion in the California Central Valley is slowly raising the Sierra Nevada Mountains. This gradual pumping of groundwater has risen the mountain range slightly every year, by an amount about equivalent to the thickness of a dime, resulting in a 15 centimeter, or 6 inch, rise over the last 150 years. This slight movement is associated with an increase in microquakes along the San Andreas Fault. When groundwater is pumped, the amount of mass or material in the Earth's crust lessens, disrupting the Earth's force balances. This not only raises mountains, but it also reduces the force that keeps the fault line from slipping [10].

Another issue arising is sinking ground. In Cedar Valley, the over-pumping of a deep aquifer is causing the ground to sink and crack. This aquifer has limited recharge and the aquifer is being overstressed. This damages would-be subdivision and puts future development at risk. The ground subsidence and fissures have also caused millions of dollars in damage in locations such as North Las Vegas, California, and Texas [11].

This is a problem that must be dealt with immediately. It may seem like groundwater depletion has little impact on a world mostly covered in water, but in reality, this "fossil water" loss could turn the world completely on its head. From increasing likelihood of earthquakes to a potential food crisis, our lives may cease to go on as we are accustomed to. So let's fix the problem today! For more information, please visit water.usgs.gov . This is Christina for Waterbytes, signing off! See you next time!

Resources:

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