B"H

Canfei Nesharim

Sustainable Living Inspired by Torah ▪ www.canfeinesharim.org

Statement on Water Quality

Summary Statement

Without water life on Earth cannot exist. Yet, the amount, rate, and uses of water by human society have put a great strain on the quality and availability of this critical resource. This, in turn, has important implications for the health and well-being of people everywhere regardless of country or economic status. Among the main scientific concerns are: a) human-caused changes in the hydrologic (water) cycle due to aquifers being drawn down, diversion of water from lakes and rivers, and altered precipitation patterns due to climate change; b) the impact of agricultural, residential and industrial pollutants on water quality; c) balancing agricultural use, human drinking water needs, and the role of water conservation and alternative approaches to irrigation; and d) evaluation of alternate water supplies.

Statement of the Problem

Over 70% of the Earth's surface is covered by water. Although water is seemingly abundant, the amount of fresh water is not. 97.5% of all water on Earth is salt water, leaving only 2.5% as fresh water. Nearly 70% of that fresh water is frozen in the icecaps of Antarctica and Greenland; most of the remainder is present as soil moisture, or lies in deep underground aquifers as groundwater not accessible to human use. Less than 1% of the world's fresh water (~0.007% of all water on earth) is accessible for direct human uses. This is the water found in lakes, rivers, reservoirs and those underground sources that are shallow enough to be tapped at an affordable cost. Only this amount is regularly renewed by rain and snowfall and is therefore available on a sustainable basis[1]. Water, however, is not equally distributed. Of the very small amount of water that is usable by humans, approximately 20% is in the Great Lakes of North America (equal to 84% of all surface freshwater in the US)[2] with another 20% in the Russian Lake Baikal[3].

High quality drinking water is critical for the health of humans everywhere. Degradation of water quality erodes the availability of water for drinking, recreation, agriculture, industry and the ecosystems upon which our survival depends. Poor water quality also increases the financial costs for human users to purify existing water supplies or identify and build new infrastructure to transport cleaner water supplies[4]. Many effects on water quality are cumulative in nature in that multiple sectors of human society can affect water quality. These compounding effects on systems can lead to catastrophic changes.

Aquatic ecosystems and the human populations they serve are confronted both by old and continuing concerns and by multiple, new environmental problems. Climate change, the

---

[1] Gleick P. The World's Water. Island Press. Washing, DC, 2000, 432 pp.
[2] http://www.epa.gov/glnpo/basicinfo.html
[3] http://www.nsf.gov/news/news_summ.jsp?cntn_id=111511
[4] United Nations Environment Programme Global Environment Monitoring System/Water Programme. Water Quality for Ecosystem and Human Health, Burlington, Ontario, Canada, 2006.

discharge of chemicals into surface waters, the identification of new and emerging pathogens, greater rates of water usage from expanding requirements for industrial growth and agricultural production, and the introduction of non-native or invasive species to aquatic ecosystems all pose challenges to scientists, governments, and the general public interested in protecting the safety, health and economic viability of our water resources.

One billion people do not have access to safe drinking water; nearly 3 billion do not have adequate sanitation for this resource. While an estimated 5 million people die each year due to waterborne diseases found in water that is either poorly treated or not treated at all, billions more are at continual risk for exposure to waterborne pathogens[5]. Poor water quality is often associated with human activities such as industrial development, agricultural activities, and residential influences. Contributions of human-produced chemicals include pesticides, fertilizers, pharmaceuticals and personal care products, and industrial wastes. Human waste is also an important source for increased bacterial and other pathogenic contamination of aquatic systems and the human diseases associated with them. While disinfection is critical to avoid the spread of disease, there is a balance between the benefits and the biological and chemical risks of such procedures, e.g., toxic disinfection by-products of chlorination include chloroform.

Alterations in the natural cycling of water through the environment have important ramifications on water availability and quality. Potential disruptions in the hydrological cycle due to human-induced climate change will affect agricultural productivity, integrity of aquatic systems and the economies they support, availability of a resource critical for survival and the spread of water-borne pathogens[6]. Human activity has increased the rates of nutrient flow to lakes and rivers (eutrophication) often inducing algal blooms that may produce chemicals harmful to human health[7]. Increasing urban and suburban growth leads to greater development of impervious surfaces such as roads, parking lots, and roof tops. Such surfaces not only prevent water from seeping into the soil to purify and recharge aquifers, but alter water quality by enhancing runoff from surfaces contaminated with a range of toxic chemicals[8].

Scientific Evidence

A. Changes in the Hydrological Cycle

The water cycle, also known as the hydrologic cycle, describes the continuous movement of water on, above, and below the surface of the Earth[9]. The water in the etrog you used during Succot may have fallen as rain half-way around the world last year or could have been used in the time of Avraham Aveinu—or both.

---

[5] United Nations Educational, Scientific, and Cultural Organization, Hydrology for the Environment, Life and Policy, http://portal.unesco.org. 2004.

[6] Refer to Canfei Nesharim's Statement on Global Climate Change

[7] Brian J-F, Jaquet S, Bernard C, Humbert J-F. Health hazards for terrestrial vertebrates from toxic cyanobacteria in surface water ecosystems. Veterinary Research 2003; 34:361-377.

[8] Ritter L, Solomon K, Sibley P, Hall K, Keen P, Mattu G, Linden B. Sources, pathways, and relative risks of contaminants in surface water and groundwater: a perspective prepared for the Walkerton Inquiry. Journal of Toxicology and Environmental Health 2002;65:1-142.

[9] You can download a Hebrew version of a water cycle diagram at the US Geological Survey's web page: http://ga.water.usgs.gov/edu/watercyclehebrewhi.html.

Due to alterations in the distribution of precipitation as a result of climate change and the increase in water consumption in world with expanding human populations[10], immense stresses are being placed on water resources. Changes in these hydrological features affect availability of potable water supplies[11]. In areas with more frequent and intense precipitation, more contaminants and sediments will be flushed into lakes and rivers, degrading water quality and increasing pollution from agricultural and urban sources[12]. Precipitation is expected to increase at higher latitudes and decrease at lower latitudes over the next few decades[13]. Alterations in the frequency and duration of precipitation are expected to change the intensity, frequency and duration of flood and drought events. Inland waters will be influenced by these changes through altered water flow regimes and levels[14]. Increased flooding associated with more frequent and intense precipitation events often overwhelms municipal treatment facilities, thereby increasing the risk of contamination as untreated sewage is dumped into local waterways during heavy storm events[15]. Expanding areas of standing water could provide breeding grounds for insect and microbial pathogens, increasing the risk of disease. In regions that undergo periods of drought or receive lower than average annual rainfall, lower river flows will concentrate pollutants and increase salinity, as the dilution effects of watercourses will be reduced[16].

B. Chemical Contamination of our Water Systems

A wide range of chemicals enter our water systems through human activity, and adversely affect human health. (This document will focus on metals, pesticides, and pharmaceuticals and personal care products [PPCPs], examples of chemical classes for which the individual, through changes in lifestyle, can affect a positive change.) These chemicals are used in industry, agriculture, and medical treatments, as well as household and personal care products. They can enter the environment intentionally through measured releases, for instance with pesticide application in agriculture; in permitted and unregulated releases of the by-products of industrial processes; or directly as household waste, which can contain cleansers, personal care products, pharmaceuticals, and chemicals that mimic the activity of naturally occurring hormones (endocrine disruptors).

1. *Metals.* Elevated levels of trace metals in drinking water have resulted from a number of land use activities including agriculture, urbanization, impoundments, mining, and industrial activities.

---

[10] McIntyre O. Environmental Protection of of International Watercourses under International Law. Ashgate Publishing, Ltd., Aldershot, Hampshire, UK, 2007, 422 pp.

[11] http://www.epa.gov/climatechange/effects/water/availability.html

[12] McMichael, AJ, Campbell-Lendrum, DH, Corvalan, CF, Ebi, KL, Githeko, AK, Scheraga, JD, Woodward, A. Climate change and human health. World Health Organization, Geneva, 2003, 324 pp.

[13] Blenckner, T. A conceptual model of climate-related effects on lake ecosystems. Hydrobiologia 2005;.533:1-14.

[14] IPCC. Second Assessment: Climate Change 1995. Intergovernmental Panel on Climate Change. http://www.ipcc.ch/pub/sa(E).pdf

[15] Patz JA, Vavrus SJ, Uejio CK, McLellan SL. Climate Change and Waterborne Disease Risk in the Great Lakes Region of the U.S. American Journal of Preventative Medicine 2008;35(5):451–458

[16] Jacobs K., Adams DB, Gleick P. Potential consequences of climate variability and change for the water resources of the United States. In: National Assessment Synthesis Team, Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change. Report for the US Global Change Research Program. Cambridge University Press, Cambridge UK, 2001. http://www.usgcrp.gov/usgcrp/Library/nationalassessment/foundation.htm

a. Lead, which leaches into domestic water lines from lead-soldered water pipes, is often found in the drinking water of older neighborhoods. Lead is a potent neurotoxicant that is associated with learning deficits and behavioral disorders in children[17].
b. Mercury, also associated with learning and nerve function disorders, is used to separate the gold from its ore in areas in which artisanal gold mining is an important part of the local economy. It is often released into the streams where it accumulates in fish, a critical source of protein for the local population[18].
c. In developing countries that do not have adequate municipal treatment facilities, toxic metals, such as cadmium and chromium, enter the water from unregulated industrial practices[19,20].

2. Pesticides. Pesticides are frequently applied in agricultural, forestry, and urban settings. In regions of the world that do not have adequate treatment facilities, people can be exposed to pesticides directly by drinking contaminated water[21]. There are tens of thousands of pesticides in use, many of which have been linked to health problems in humans, such as cancer, neurological damage, immune system deficiencies, and problems with the endocrine system[22] caused by their mimicking natural hormones. Endocrine disruptors cause the body to over-react to stimuli or to respond at inappropriate times, block the effects of hormones, or directly stimulate or inhibit the production of hormones[23]. The effects of exposure of endocrine disruptors in humans are only beginning to be understood, but investigations using laboratory animals and wildlife populations suggest cause for concern, such as evidence of thinning of eggshells in birds, developmental abnormalities in embryos, inadequate parental behavior, cancerous growths in the reproductive system, and feminization of male offspring[24].

3. Pharmaceuticals and Personal Care Products (PPCPs). There is growing concern about the possible affects of PPCPs that enter surface and ground waters. These chemicals originate from industry, agriculture, medical and household activities and include commonly used products like cosmetics, detergents, toiletries and pharmaceuticals such as painkillers, tranquillizers, anti-depressants, antibiotics, birth control pills, estrogen replacement therapies, and chemotherapy agents[25]. Intensive agriculture makes use of feeds that contain veterinary pharmaceuticals. These additives are present in animal waste and are released into the

---

[17] Bellinger D. Neuropsychologic function in children exposed to environmental lead. Epidemiology 1995;6:101-3.
[18] Passos CJ, Mergler D. Human mercury exposure and adverse health effects in the Amazon: a review. Cad Saude Publica. 2008;24 Suppl 4:s503-20.
[19] Refer to Canfei Nesharim's newsletter article on the issues with electronic waste.
[20] Klaassen CD. Casarett and Doul's Toxicology: The Basic Science of Poisons. McGraw-Hill Co., Inc,, NY, NY, 1996, 1111 pp.
[21] http://pmep.cce.cornell.edu/facts-slides-self/facts/pes-heef-grw85.html
[22] Safe S. Endocrine disruptors and human health: is there a problem? Toxicology 2004;205:3-10.
[23] US EPA. What are Endocrine Disruptors? Endocrine Disruptor Screening Programme, Office of Science Coordination and Policy. 2006. http://www.epa.gov/scipoly/oscpendo/edspoverview/whatare.htm
[24] Markey CM, Rubin BS, Soto AM, Sonnenschein C. Endocrine disruptors: from wingspread to environmental development biology. Journal of Steroid Biochemistry and Molecular Biology 2002;83;235-244.
[25] http://www.teleosis.org/pdf/symbiosis/Intro_EcoTox4.2.pdf

environment accidentally through spills or damaged holding facilities, or intentionally as a soil treatment[26, 27].

Many PPCPs are not altered by municipal treatment facilities and enter our lakes and streams[28]. They have been detected in waste slurries, on potato fields, and even in groundwater, having arisen from landfill leachates or as contaminants in waters that recharge aquifers. Scientists are just beginning to identify potential human health effects of PPCPs but have already observed effects in laboratory animals and wildlife populations[29]. The potential concern from the environmental presence of these substances is the development of abnormal physiological processes and reproductive impairment in exposed humans, increased risk of cancer, the development of antibiotic-resistant bacteria and the potential for increased toxicity when these compounds interact[30].

C. Pathogens in our Water Systems

Water is an important environmental source and agent for transmission of pathogens. Although many cities have advanced wastewater treatment facilities that effectively reduce microbial contaminant loads to near-zero values, a very large proportion of the world's population, primarily in developing countries, remains without access to improved sanitation facilities and discharges wastewaters directly to the environment without treatment.

Waterborne pathogens in aquatic ecosystems and human water supplies emerge from the creation of new aquatic environments conducive to their growth and development, such as the building of dams and irrigation projects. Accidental releases (e.g., treatment plant overflows) or inadequate or non-existing water treatment facilities can introduce pathogens into drinking water supplies. Piped water systems, water-cooled air conditioning plants and water devices such as cooling towers, evaporative condensers, hot water tanks and whirlpools have also been implicated in the spread of disease[31,32].

Microbial pollution in inland waters originates primarily from agriculture and urban land uses. Communities downstream of intensively farmed areas or municipal sewage outfalls and people working or recreating in infected waters are at the highest risk of illness due to microbial pathogens. In addition to bacteria and viruses, many species of cyanobacteria (formerly called blue-green algae) release toxins into the water which can be potentially lethal to livestock and humans. These organisms can form dense blooms in waters that receive large amounts of fertilizers[33].

---

[26]Kolpin DW, Furlong ET, Meyer MT, Thurman EM, Zaugg SD, Barbe, LB, Buxton HT. Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999-2000: a national reconnaissance. Environmental Science and Technology 2002;36:1202-1211.

[27] Fox GA. Effects of endocrine disrupting chemicals on wildlife in Canada: past, present and future. Water Quality Research Journal of Canada 2001;36:233-251.

[28] Daughton CG, Ternes TA. Pharmaceuticals and personal care products in the environment: agents of subtle change? Environmental Health Perspectives 107 (Suppl. 6):907-938.

[29] Daughton CG. Environmental stewardship and drugs as pollutants. The Lancet 2002; 360:1035-1036.

[30]Kolpin DW, Furlong ET, Meyer MT, Thurman EM, Zaugg SD, Barbe, LB, Buxton HT. Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999-2000: a national reconnaissance. Environmental Science and Technology 2002;36:1202-1211.

[31] Rose JB. Emerging issues for the microbiology of drinking water. Water Engineering and Management 1990;137:23-29.

[32] WHO. Emerging Issues in Water and Infectious Disease. World Health Organization, Geneva, Switzerland. 2003. http://www.who.int/water_sanitation_health/emerging/emerging.pdf

[33] Brian J-F, Jaquet S, Bernard C, Humbert J-F. Health hazards for terrestrial vertebrates from toxic cyanobacteria in surface water ecosystems. Veterinary Research 2003; 34:361-377.

Water and Israel

The depletion of water resources along with the decrease in water quality is endangering Israel's water supply. Over-pumping of Israel's aquifers and a lack of coordinated, sustainable use policies have created much of the crisis Israel now faces with regard to its water supply. Increases in Israel's population and the resultant increases in total water usage (estimated to reach 1.68 billion cubic meters by 2010; the largest increase will be in the urban sector) along with extended drought conditions will challenge those in charge of Israel's water quality and quantity[34]. The need to identify additional sources of water will inevitably place a great strain on natural ecosystems that are dependent on the limited supply of water in this region of the world.

The quality of all of Israel's main water sources(Lake Kinneret and the various aquifers) is threatened. The Coastal Aquifer is seriously compromised by chemical and microbial pollutants, salination, nitrates, heavy metals, fuels and toxic organic compounds. About 15% of the total amount of water pumped from the Coastal Aquifer for domestic, agricultural and industrial uses does not comply with existing national drinking water standards for concentrations of chloride (due to seawater intrusions) and nitrate (due to fertilizers)[35]. Nitrate contamination of drinking water is of concern due to its role in causing "blue-baby syndrome", a potentially lethal condition in children[36]. 82% of the wells that supply water to the Tel Aviv area are contaminated with one or more widely produced and used chlorinated volatile organic compounds originating from multiple sources, including former industrial sites[37]. These human-made chemicals, leaching into the groundwater, are suspected carcinogens[38].

Water quality in Lake Kinneret is largely driven by agricultural inputs (pesticides and fertilizers) and lake level. As such, one of the sources of contamination, cyanobacteria blooms and the toxins they produce, is being watched carefully by Israeli scientists[39]. To date, it has not become a serious health issue but with increasing human impacts on Lake Kinneret, there remains cause for concern.

What You Can Do

Here are some sample web sites where you can find additional information on how to protect our water—and yourself.

Water Conservation:
http://epa.gov/p2/pubs/water.htm http://www.epa.gov/watersense/water/index.htm
http://www.ucsusa.org/publications/greentips/
http://www.epa.gov/nps/chap3.html

---

[34] Beyth M. http://www.gsi.gov.il/Eng/_Uploads/140Water-Crisis-Israel.pdf
[35] Israel Ministry of Environmental Protection, http://www.sviva.gov.il, 2005.
[36] Knoebeloch L., Salna B, Hogan A,, Postele J, Anderson H. Blue-babies and nitrate-contaminated wells. Environmental health Perspectives 2000; 108:675-678.
[37] Graber, E.R., Laor Y., Ronen D. Megasite Aquifer Contamination by Chlorinated-VOCs: A Case Study fro an Urban Metropolis Overlying the Coastal Plain Aquifer of Israel. Hydrogeology Journal 2008;16: 1615-1624.
[38] US Geological Survey, Volatile Organic Compounds in the Nation's Ground Water and Drinking-Water Supply Wells—A Summary, http://pubs.usgs.gov/fs/2006/3048/pdf/fs2006-3048.pdf, 2006.
[39] Sukenik A, Rosen C, Porat R, Teltsch B, Banker R, Carmeli S. Toxins from cyanobacteria and their potential impact on water quality of Lake Kinneret, Israel. Israel Journal of Plant Sciences 1998; 46:109-115.

Water Quality and Human Health:
Learn about the toxic chemicals we put into our water that put human health at risk:
http://www.epa.gov/pesticides/
http://www.epa.gov/oppt/lead/
http://www.epa.gov/OGWDW/lead/index.html
http://www.epa.gov/mercury/
http://www.epa.gov/ppcp/
http://www.state.nj.us/health/eoh/hhazweb/lead.pdf
http://pmep.cce.cornell.edu/facts-slides-self/facts/pes-heef-grw85.html
http://www.iptv.org/video/detail.cfm/3814/exm_20030702_clip_2_3_4_5_6_7_8_9_10_11_12_13_14_15

Protecting Our Water:
http://www.smarxtdisposal.net/
http://des.nh.gov/organization/commissioner/pip/factsheets/sw/documents/sw-33.pdf
http://ncsd.ca.gov/Library/water_conservation/Pharmaceuticals%20in%20Wastewater-Web.pdf
http://www.nsf.org/consumer/newsroom/fact_water_lead.asp
http://www.mda.state.mn.us/licensing/watertesting/pesticides.htm