Blue Covenant

THE GLOBAL WATER CRISIS

AND THE COMING BATTLE

FOR THE RIGHT TO WATER

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Chapter 1

Where Has All the Water Gone?

The Laws of Ecology

All things are interconnected. Everything goes somewhere.
There is no such thing as a free lunch. Nature bats last.

– Ernest Callenbach

Three scenarios collude toward disaster.

Scenario one: The world is running out of freshwater. It is not just a question of finding the money to hook up the two billion people living in water-stressed regions of our world. Humanity is polluting, diverting and depleting the Earth's finite water resources at a dangerous and steadily increasing rate. The abuse and displacement of water is the ground-level equivalent of greenhouse gas emissions, and likely as great a cause of climate change.

Scenario two: Every day more and more people are living without access to clean water. As the ecological crisis deepens, so too does the human crisis. More children are killed by dirty water than by war, malaria, HIV/AIDS and traffic accidents combined. The global water crisis has become a most powerful symbol of the growing inequality in our world. While the wealthy enjoy boutique water at any time, millions of poor people have access only to contaminated water from local rivers and wells.

Scenario three: A powerful corporate water cartel has emerged to seize control of every aspect of water for its own profit. Corporations deliver drinking water and take away wastewater; corporations put massive amounts of water in plastic bottles and sell it to us as at exorbitant prices; corporations are building sophisticated new technologies to recycle our dirty water and sell it back to us; corporations extract and move water by huge pipelines from watersheds and aquifers to sell to big cities

and industries; corporations buy, store and trade water on the open market, like running shoes. Most importantly, corporations want governments to deregulate the water sector and allow the market to set water policy. Every day, they get closer to that goal. Scenario three deepens the crises now unfolding in scenarios one and two.

Imagine a world in twenty years in which no substantive progress has been made to provide basic water services in the Third World; or to create laws to protect source water and force industry and industrial agriculture to stop polluting water systems; or to curb the mass movement of water by pipeline, tanker and other diversions, which will have created huge new swaths of desert.

Desalination plants will ring the world's oceans, many of them run by nuclear power; corporate-controlled nanotechnology will clean up sewage water and sell it to private utilities, which will in turn sell it back to us at a huge profit; the rich will drink only bottled water found in the few remaining uncontaminated parts of the world, or sucked from the clouds by corporate-controlled machines, while the poor will die in increasing numbers from a lack of water.

This is not science fiction. This is where the world is headed unless we change course – a moral and ecological imperative.

But first we must come to terms with the dimension of the crisis.

We Are Running Out of Freshwater

In the first seven years of the new millennium, more studies, reports and books on the global water crisis have been published than in all of the preceding century. Almost every country has undertaken research to ascertain its water wealth and threats to its aquatic systems. Universities around the world are setting up departments or cross-departmental disciplines to study the effects

of water shortages. Dozens of books have been written on all aspects of the crisis. The WorldWatch Institute has declared: "Water scarcity may be the most underappreciated global environmental challenge of our time."

From these substantial and recent undertakings, the verdict is in and irrefutable: the world is facing a water crisis due to pollution, climate change and a surging population growth of such magnitude that close to two billion people now live in water-stressed regions of the planet. Further, unless we change our ways, by the year 2025, two-thirds of the world's population will face water scarcity. The global population tripled in the twentieth century, but water consumption went up sevenfold. By 2050, after we add another three billion to the population, humans will need an 80 percent increase in water supplies just to feed ourselves. No one knows where this water is going to come from.

Scientists call them "hot stains" – the parts of the Earth now running out of potable water. They include Northern China, large areas of Asia and Africa, the Middle East, Australia, the Midwestern United States and sections of South America and Mexico.

The worst examples in terms of the effect on people are, of course, those areas of the world with large populations and insufficient resources to provide sanitation. Two-fifths of the world's people lack access to proper sanitation, which has led to massive outbreaks of waterborne diseases. Half of the world's hospital beds are occupied by people with an easily preventable waterborne disease, and the World Health Organization reports that contaminated water is implicated in 80 percent of all sickness and disease worldwide. In the last decade, the number of children killed by diarrhea exceeded the number of people killed in all armed conflicts since the Second World War. Every eight seconds, a child dies from drinking dirty water.

Some wealthier countries are just beginning to understand the depth of their own crisis, having adopted a model of unlimited consumer growth based on industrial, trade and farming practices that are wasting precious and irreplaceable water resources. Australia, the driest continent on Earth, is facing a severe shortage

of water in all of its major cities, as well as widespread drought in its rural countryside. Annual rainfall is declining; salinity and desertification are spreading rapidly; rivers are being drained at an unsustainable rate; and more than one-quarter of all surface water management areas now exceed sustainable limits. Climate change is accelerating drought and causing freak storms and weather patterns just as the population is set to expand dramatically in the next twenty years. (Ironically, this is, in part, to take in the climate-change refugees such as the inhabitants of the Solomon Islands, who will lose their lands to the rising seas.)

Many parts of the United States are also experiencing severe water shortages. Pressure is mounting on the Great Lakes governors to open up access to the lakes to the burgeoning megacities around the basin. In 2007, Lake Superior, the world's largest freshwater lake, dropped to its lowest level in eighty years and the water has receded more than fifteen meters from the shoreline. Florida is in trouble. The state's burgeoning population, with a net influx of 1,060 people every day, relies almost entirely upon its dwindling groundwater sources for its water supplies. To keep its fast-spreading lawns and golf courses green, the Sunshine State is sucking up groundwater at such a rate that it has created thousands of sinkholes that devour anything – houses, cars and shopping malls – unfortunate enough to be built on them. California has a twenty-year supply of freshwater left. New Mexico has only a ten-year supply. Arizona is out: it now imports all of its drinking water. Lake Powell, the man-made backup for the western water supply, has lost 60 percent of its water. A major June 2004 study by the National Academy of Sciences and the U.S. Geological Survey found that the parched Interior West is probably the driest it has been in five hundred years. As in Australia, anxious American politicians talk about "drought" as if this is a cyclical situation that will right itself. But scientists and water managers throughout the American Midwest and Southwest are saying that it is more than a drought: major parts of the United States are running out of water. In fact, the Environmental Protection Agency warns that if current water use

continues unchecked, thirty-six states will suffer water shortages within the next five years.

Because of the wealth of these countries, most of their populations are still not suffering from water shortages. That is not so for those in the global South – hence the term *water apartheid*. The world's poor who are living without water are either in areas that do not have enough water to begin with (Africa), where surface water has become severely polluted (South America, India) or both (Northern China). Most of the world's megacities – those with ten million or more inhabitants – lie within regions experiencing water stress. These include Mexico City, Calcutta, Cairo, Jakarta, Karachi, Beijing, Lagos and Manila.

In 2006, the number of city dwellers surpassed the number of rural dwellers for the first time in history. The urban populations of the Third World are growing exponentially, creating enormous slums without water services. In the last decade, the number of city dwellers without reliable access to clean water increased by more than sixty million. By 2030, says the UN, more than half the population of these huge urban centers will be slum dwellers with no access to water or sanitation services whatsoever. One report cited a current example of an area in Mumbai, where one toilet serves 5,440 people.

Not surprisingly, there is a huge gulf between the First World and the Third World in water use. The average human needs fifty liters of water per day for drinking, cooking and sanitation. The average North American uses almost six hundred liters a day. The average inhabitant of Africa uses six liters per day. A newborn baby in the global North consumes between forty and seventy times more water than a baby in the global South.

These appalling disparities have rightly created a demand for more water equity and a commitment to providing water for the 1.4 billion people currently living without it. The UN Millennium Development Goals include reducing by half the proportion of people living without safe drinking water by the year 2015. While laudable, this initiative is failing not only because the UN has worked with the World Bank to promote a flawed model for water

development (see Chapter 2), but also because it assumes that there is enough water for everyone without seriously addressing the massive pollution of surface waters and the consequent massive overmining of groundwater supplies.

Our Surface Waters Are Polluted

We were all taught certain fundamentals about the Earth's hydrologic cycle in grade school. There is a finite amount of available freshwater on the planet, we learned, and it makes its way through a cycle that ensures its safe return to us for our perpetual use. In the hydrologic cycle, water vapor condenses to form clouds. Winds move the clouds across the globe, spreading the water vapor. When the clouds cannot hold the moisture, they release it in the form of rain or snow, which either seeps into the ground to replenish groundwater or runs off into lakes, streams and rivers. (This is the water – less than one-half of 1 percent of all the water on Earth – available for human use that does not deplete the stock.) As these processes are happening, the power of the sun is causing evaporation, changing liquid water into vapor to renew the cycle. About four hundred billion liters of water are cycled through this process every year. In this scenario, the planet could never "run out" of water.

But this cycle, true for so many millennia, did not take into account modern humans' collective capacity for destruction. In the last half-century, the human species has polluted surface waters at an alarming and accelerating rate. The world may not exactly be running out of water, but it is running out of clean water. Ninety percent of wastewater produced in the Third World is discharged, untreated, into local rivers, streams and coastal waters. As well, humans are now using more than half of accessible runoff water, leaving little for the ecosystem or other species.

In China, 80 percent of the major rivers are so degraded they no longer support aquatic life, and an astonishing 90 percent of all groundwater systems under the major cities are contaminated.

China is now home to seven of the ten most polluted cities in the world. The World Health Organization reports that 700 million of the 1.3 billion people of China drink water that doesn't even meet the most basic minimum safety standards set by that world body. In late 2006, the Chinese government reported in a rare admission of failure that, as a result of massive pollution, more than two-thirds of Chinese cities face water shortages, with at least one hundred of them facing immediate depletion. Forty-five billion tons (about forty-one trillion kilograms) of untreated wastewater are pumped directly into lakes and rivers every year, according to a recent article in the *China Daily*.

This scenario is repeated in many parts of Asia. A 2005 nationwide survey in Pakistan revealed that less than 25 percent of the population has access to clean drinking water due to massive pollution of the country's surface waters. The Indonesian Environment Monitor reports that Indonesia has one of the lowest sanitation rates in the world. Less than 3 percent of Jakarta's residents are connected to a sewer, leading to severe pollution of nearby rivers and lakes and the contamination of 90 percent of the city's shallow wells. Almost 65 percent of Bangladesh's groundwater is contaminated, with at least 1.2 million Bangladeshis exposed to arsenic poisoning.

Seventy-five percent of India's rivers and lakes are so polluted, they should not be used for drinking or bathing. More than 700 million Indians – two-thirds of the population – do not have adequate sanitation, and 2.1 million Indian children under the age of five die every year from dirty water. The fabled Yamuna River is clinically dead, killed as it makes its way through New Delhi's teaming slums. The coasts of Mumbai, Madras and Calcutta are putrid. The sacred Ganges, where millions come to worship, is an open sewer. Thousands of Hindu worshippers boycotted the 2007 religious festivals in which millions plunged into the Ganges to wash away their sins. One Indian government study called the situation in India "an unparalleled water crisis." Against this backdrop of pollution and scarcity, India's urban water demand is expected to double by 2025, and industrial water demand will triple.

The statistics for Russia are hauntingly similar. The U.S. Library of Congress reports on water pollution in Russia – a phenomenon little reported in Russia itself. Seventy-five percent of Russia's inland surface water is polluted and approximately 30 percent of the groundwater available for use is highly polluted. Many rivers are carriers of waterborne killers, and 60 percent of rural residents are drinking water from contaminated wells.

The underground reservoir of the Mountain Aquifer is the most important source of water for Israelis and Palestinians, supplying more good-quality water per year than any source between the Mediterranean Sea and the Jordan River. But, reports Friends of the Earth Middle East, the sewage of more than two million people who live above the aquifer is discharged untreated into streams and other natural water sources percolating into the groundwater. This amounts to almost sixty-one million cubic meters a year.

According to the European Commission, 20 percent of all surface water in Europe is "seriously threatened," and the UN adds that only five of the fifty-five major rivers in Europe can be considered "pristine" anymore. Belgium's water is singled out as particularly bad, due to heavy pollution by industry. The Rhine, the Sarno and the Danube rivers are all in peril. Recent and regular droughts have European leaders very worried about water availability. Southern Spain, southeastern England and western and southern France are all viewed as chronically vulnerable, while fears are growing in Portugal, Italy and Greece. In May 2007, a state of emergency was declared in the northern and central regions of Italy as the country's largest river, the Po, dried up, devastating the Po Valley, which grows a third of the country's food. In several of these countries, reservoirs are at their lowest levels in recorded history.

Forty percent of U.S. rivers and streams are too dangerous for fishing, swimming or drinking, as are 46 percent of lakes due to massive toxic runoff from industrial farms, intensive livestock operations and the more than one billion pounds of industrial weed killer used throughout the country every year. Two-thirds

of U.S. estuaries and bays are moderately or severely degraded. The Mississippi River carries an estimated 1.5 million metric tons of nitrogen pollution into the Gulf of Mexico every year. Every year, one-quarter of the U.S. beaches are under advisories or closed due to water pollution. The U.S. government refuses to ban the herbicide Atrazine, an endocrine disrupter banned in many countries around the world and widely linked to cancer. In Canada, more than one trillion liters of untreated sewage is dumped into waterways each year, a volume that would cover the entire 7,800-kilometer length of the Trans-Canada Highway, six stories high.

In Latin America and the Caribbean, more than 130 million people do not have safe drinking water, and only 86 million (of 550 million) are connected to adequate sanitation systems. Seventy-five percent of the population suffers from chronic dehydration because of poor water quality. Basic drinking water and sanitation are out of the reach of a third of Peru's urban dwellers and two-thirds of its rural populations. Major cities such as Mexico City and São Paulo are facing the twin threats of massive overconsumption of water and mass contamination. Less than 10 percent of Mexico City's waste is recycled in a city of more than twenty million people. And that is higher than the average: only about 2 percent of Latin America's wastewater receives any treatment at all.

More than one-third of Africa's population currently lacks access to safe drinking water, and within fifteen years, one in two Africans will be living in countries that are confronted with serious water stress. Of the twenty-five countries in the world whose people have the least access to safe, clean water, nineteen are in Africa. Lake Victoria, the source of the Nile, is being used as an open sewer. It and dozens of other African lakes and rivers are imperiled, according to the UN Environmental Program, whose October 2005 report, *The Atlas of African Lakes*, used satellite images to reveal the unprecedented deterioration of all of Africa's 677 major lakes. As well, the report reveals alarming drops in water levels in most of Africa's lakes. Lake Chad has shrunk by almost 90 percent.

Thousands of Angolans died in a 2006 cholera outbreak caused by filthy water. Only one in six Luandan households have basic sanitation services, and the city's 4.5 million residents live in the midst of mountains of garbage and open sewers in the streets. Eighty percent of South Africa's rivers are imperiled by pollution, and every year, residents (usually women) have to walk farther and farther to find clean water. The women of South Africa now collectively walk the equivalent of the distance to the moon and back sixteen times a day for water.

One inevitable result of the massive pollution of surface waters in poor countries is that sewage water is increasingly being used to fertilize crops. In 2004, the Sri Lankan bureau of the International Water Management Institute undertook the first global survey on the hidden practice of wastewater irrigation. It found that fully one-tenth of the world's irrigated crops – from lettuce and tomatoes to mangoes and coconuts – is watered by sewage, most of it completely untreated, "gushing direct from sewer pipes into fields at the fringes of the developing world's great megacities." The sewage is added to fields complete with disease-causing pathogens and toxic waste from industry. In some Third World metropolises, all food sold is grown in sewage.

Our Groundwater Sources Are Depleting

To deal with this vast pollution and the resulting effect of reduced clean water supplies, farms, cities and industries all over the world are turning to groundwater sources, using sophisticated technology to drill deep into the Earth and pull up ancient aquifer water for daily use. This is a second piece of the "running out" puzzle. We are taking water from where it is accessible – in aquifers and other groundwater sources – and putting it where it gets used and lost, such as in mass irrigation of deserts, to make cars and computers, or to produce oil from tar sands and coal methane beds where it becomes polluted or actually lost to the hydrologic cycle.

The current practice of "water mining" is different from the sustainable use of well water that has served farmers for generations. Today, groundwater is seen as a finite resource such as a mineral – a deposit to be mined until it is gone, allowing the searcher to move on to new sites – rather than a renewable resource that must be managed and replenished. The exponential mining of groundwater is largely unregulated, and no one knows when the limit will be hit and the supply depleted within a certain community or region.

We do know that the use of groundwater for daily living is growing very fast. About two billion people – one-third of the world's population – depend on groundwater supplies, withdrawing approximately 20 percent of global water annually. Groundwater aquifers are being overpumped almost everywhere in the world and are also being polluted with chemical runoff from industrial farming and mine tailings, as well as being invaded by saltwater from careless drilling practices. (In some cases, overextraction of a river exposes an aquifer to danger. The Dead Sea is disappearing, victim to widespread abuse of the waters of the Jordan River for irrigation. As the Dead Sea withdraws, aquifers surrounding it are left at a higher level than its surface. Underground water flows into the sea, drying out aquifers that have been untouched for millions of years.)

In the First World, much of the groundwater extraction is due to big industrial agribusiness taking massive amounts of water using huge industrial bores. In the Third World, the problem is caused by millions and millions of small farmers using personal pumps.

Groundwater mining can be traced in great part to the famous Green Revolution and the use of flood irrigation to mass-produce food. Since 1950, the global acreage of land under irrigation – the driving factor behind the Green Revolution – has tripled. Using vast amounts of water, scientists developed high-yield crop varieties to meet the needs of developing nations. While the "revolution" produced more food, it used way too much water and also depended on copious amounts of dangerous pesticides and fertilizers. Some countries abandoned past sustainable farming

practices and started "double cropping," whereby crops are grown during the dry season *and* the wet season, adding to the demands on water.

As British environmentalist Fred Pearce points out, irrigated farming gave us twice as much food but used three times as much water, and did more harm than good. He lists the world's major rivers that no longer reach the sea: the Colorado and the Rio Grande in the United States; the Nile in Egypt; the Yellow River in China; the Indus in Pakistan; the Murray in Australia; the Jordan in the Middle East; and the Oxus in Central Asia. They have been depleted from damming, overuse and the mining of the groundwaters that feed them.

In *Pillar of Sand*, about the growing desertification of the planet, Sandra Postel argues that the changes in food production over the last fifty years have put a profound strain on the world's groundwater supplies. The agricultural practices of many countries are sustained by the hydrological equivalent of deficit financing. At least 10 percent of the global grain harvest is grown with groundwater supplies that are not being replenished, an amount equal to the total flow of two Nile Rivers every year.

Groundwater extraction often turns oases into deserts, but it can also literally turn a desert into an oasis. The Ogallala Aquifer is a vast geologic formation that sprawls underneath eight states from South Dakota to Texas. Early settlers in the semi-arid High Plains were plagued by crop failure due to cycles of drought, culminating in the dust bowl of the 1930s. After the Second World War, the technology was developed to mine the Ogallala, and the High Plains was turned into one of the most agriculturally productive regions in the world. Its massive water reserves – larger than Lake Huron – are now used to grow water-intensive crops such as cotton and alfalfa in the desert. But the miracle will not last. Because it is so deep, the Ogallala gets very little replenishment from nature to offset the two hundred thousand borewells working 24-7 to remove its ancient treasure. In several short decades, it has lost – forever – a volume of water equivalent to the annual flow of eighteen Colorado rivers. It is

now producing half as many crops as it did in the 1970s, but demand continues to grow.

This story is repeated all over the United States, which is now dependent on nonrenewable groundwater for an astonishing 50 percent of its daily water. Groundwater supplies Europe with 65 percent of its drinking water, and the European Commission warns that 60 percent of European cities exploit their groundwater resources. Half of Europe's wetlands are endangered from groundwater mining, and the groundwater itself is becoming seriously polluted. Aquifers are way overpumped in Australia as well – groundwater extraction skyrocketed a whopping 90 percent in the 1990s – and is contaminated from the eighty thousand toxic dumpsites under Australia's major cities.

However, it is in Asia that the coming crisis can be seen most clearly. The London-based *New Scientist* reported scientists' findings on what it called a "little-heralded crisis" all over Asia with the unregulated and exponential drilling of groundwater. Farmers are drilling millions of pump-operated wells in an ever-deeper search for water and are threatening to suck the continent's underground reserves dry, setting the stage for "untold anarchy." Vietnam has quadrupled its number of tube wells in the past decade to one million, and water tables are plunging in the Pakistani state of Punjab, which produces 90 percent of the country's food.

In India, twenty-three million tube wells operate around the clock using technology borrowed from the oil industry, going so deep they are taking up water formed at the time of the dinosaurs. Every year another million wells are added. The pumps are taking two hundred cubic kilometers of water out of the Earth every year, with only a fraction of that replaced by monsoon rains. (A cubic kilometer is the volume of water equal to that of a cube of one kilometer each side.) The farmers are forced to drill deeper to keep pace with falling water tables, and thousands of farmers have committed suicide in the last decade when their farms ran out of water completely. Plunging water tables in Tamil Nadu and northern Gujarat have cut the land available for farming in half. This situation will be repeated all over India, say water experts there.

China has less water than Canada and forty times more people. In Northern China, groundwater depletion has reached catastrophic levels. Across the northern half of the country – China's breadbasket – groundwater pumping amounts to some thirty billion cubic meters a year. This is due to massive overpumping for agriculture but also because government planners divert large amounts of water from farming to industry every year, to fuel China's economic "miracle." The water table beneath Beijing has fallen nearly two hundred feet in the past twenty years, which has led some planners to warn that China may have to choose another city for its capital.

Drought-related sandstorms are already plaguing China. In the first half of 2006, thirteen major sandstorms had hit Northern China. In April 2006, one storm swept across an eighth of the country and even reached Korea and Japan. On its way, it dumped a mind-boggling 336,000 tons (about 305 million kilograms) of dust on Beijing, forcing people to walk around with facemasks for protection. Every year, a new desert the size of Rhode Island is created in China.

The Planet Is Drying Up

Melting Glaciers

China's crisis is exacerbated by the rapid melting of the Tibetan glaciers, which are vanishing so fast (due to climate change) they will be reduced by 50 percent every decade, according to the Chinese Academy of Sciences. Each year, enough water melts from the 46,298 glaciers of the plateau to fill the entire Yellow River. But rather than adding freshwater resources to a thirsty country, the furious pace of this melting is actually creating desertification. Instead of steadily feeding the great rivers of Asia – the Yangtze, the Indus, the Ganges, the Brahmaputra, the Mekong and the Yellow – as the Himalayan glaciers have done for millennia, the fast-melting water running off the plateau increases soil erosion, allowing the deserts to spread, and then evaporates before it reaches the thirsty rivers.

Says the Academy's Yao Tandong, "The full-scale glacier shrinkage in the plateau regions will eventually lead to an ecological catastrophe." The Indus, for example, provides water for 90 percent of Pakistan's crops.

The World Wildlife Fund (WWF) echoes the concern, reporting that billions of people worldwide face severe water shortage as the world's glaciers experience meltdown. The WWF singles out Ecuador, Peru and Bolivia for concern, as all are dependent on the glacier melt from the Andes for water supplies. In 1980, 75 percent of the European alpine glaciers were advancing. Today, 90 percent are in retreat. The Swiss Alps – the major source of water for the Rhine, the Rhone and the Po rivers – are melting twice as fast as any other in the world. In Canada, the glacier that feeds Alberta's Bow River is melting so quickly that in fifty years, there will not likely be any water left in the river except for the occasional flash flood.

The state of the world's mountains – the source of half of humanity's drinking water, now referred to by scientists and environmentalists as "water towers" – should be a major concern to us all as global warming strips away their ancient glaciers. Receding glaciers at sea are another loss of freshwater, as they melt into saltwater and add to the rising of the oceans. Glacier melt is yet another piece of the "running out" puzzle – another example, such as groundwater mining, where water is removed from where it has been stored for millennia to provide life for humans and nature, and ends up lost to both.

Virtual Water Trade

Water is also massively displaced through the trade in what is called *virtual water*, a term that describes the water used in the production of crops or manufactured goods that are then exported. Israeli economists first used the term *virtual* or *embedded* water in the early 1990s when they realized that it didn't make sense from an economic point of view to export scarce Israeli water. This is

what was happening, they said, every time water-intensive oranges or avocados were exported from their semi-arid country. Because of poor water management systems used around the world (more than half of all water used in flood irrigation is lost to seepage or evaporation), even a small bag of salad takes three hundred liters of water to produce. It takes about a thousand liters to produce a kilogram of wheat and five to ten times as much to produce a kilogram of meat. Up to thirty thousand liters of water are used to produce one kilogram of cotton.

Water that is used in the production of food is "virtual" because it is not contained anymore in the product, even though a great deal of it was used in the production process. If a country exports a water-intensive product to another country, it amounts to exporting water in a virtual form, although no water is technically being traded or sold. This diminishes the amount of water consumed in the importing country. Wealthy countries with low water supplies, such as Saudi Arabia and Netherlands, import much of their water through food imports from countries that either have lots of water or who are too poor to have a choice but to exploit what is left of their water. Japan, for instance, imports about 65 percent of the total volume of water that it uses to produce the goods and services consumed by its citizens (this is called the water footprint of a country) through the import of crops and goods that use other countries' water for production. For some water-rich countries such as Canada, this practice may appear to be benign. But many poor countries are exporting huge amounts of water through virtual water trade because of a desperate need for income and because they have been strongly pushed by the World Bank and the International Monetary Fund to pay off their debts through monoculture crop exports, even if it means using their best, most arable land and their remaining water supplies to do so.

India, with its water crisis on the doorstep, is a major virtual water exporter, as is Thailand. Vietnam is destroying its water table to grow coffee for export. Africa supplies much of Europe with out-of-season fruits and vegetables, just as Latin America

provides for North America. Kenya is destroying the waters of Lake Naivasha to grow roses for export to Europe. Scientists predict the lake, the source of water for Africa's largest population of hippopotamuses, will be a "putrid muddy puddle" within five to ten years if its draining for flower irrigation is not halted. (Knowing this, the big European flower companies are already planning to relocate to Ethiopia and Uganda.)

As well, many developing countries are growing "biofuels" – energy replacements derived from sugarcane, corn, palm oil and soy – to meet demands in global Northern countries for alternatives to oil and gas. Biofuels – food to feed cars – have come under intense criticism not only because they take up vast areas of agricultural land to cultivate and are energy-intensive crops in themselves – thus exporting the energy costs of the North to the South – but because they use massive amounts of water. As agricultural sciences professor David Pimentel of Cornell University reports, it takes seventeen hundred liters of water to produce one liter of ethanol, when the water used to process the corn to biofuels is added to the water used to grow the corn, usually using wasteful flood irrigation practices. China imports about twenty million tons (about eighteen billion kilograms) of soy biofuel every year, mostly from Brazil (a factor perhaps in the biofuel pact that was signed by Presidents Bush and Lula in the American President's March 2007 visit to Brazil). For this, the producing countries use forty-five cubic kilometers of water – about half the annual domestic consumption of water for the whole world. In northern Brazil, where the big biofuel plantations are numerous, whole rivers are drying up. (Not all biofuels are for export. The Canadian and U.S. governments are also promoting the growth of biofuels in their agriculture sectors with large subsidies. *The Sacramento Bee* estimates that, to meet California's stated goal of ethanol production, the state will have to find ten trillion liters of extra water a year.)

Many poor countries are exporting their way to drought. Between 15 and 20 percent of the water used in the world for human purposes is not for domestic consumption but for export,

according to the UN, in what is considered by many to be a conservative estimate. But with the continued emphasis of the World Bank and other global financial institutions on export growth, this practice is bound to increase and, with it, the transfer of water from the poor to the rich. Oddly, two wealthy but water-stressed countries are also major virtual water exporters: the United States and Australia. Net exports of water from the United States amount to one-third of the total water withdrawal in that country and are a major factor in the drying out of the American Midwest and Southwest. Not coincidentally, both Australia and the United States have governments in denial about their water crises and completely wedded to economic globalization and its false promise of unlimited growth.

Urbanization and Deforestation

Yet another answer to the question of where the world's water has gone is that it is displaced from the hydrologic cycle by massive urbanization and paving over of natural environments. In a groundbreaking study, Slovakian scientist and Goldman Prize–winner Michal Kravçik showed that when water cannot return to fields, meadows, wetlands and streams because of urban sprawl and the removal of green spaces, there is less water in the soil and local water systems and, therefore, less water to evaporate from land. It is as if the rain is falling on a large cement umbrella, which carries it out to sea. The destruction of water-retentive landscapes means that less precipitation remains in river basins and continental watersheds; this in turn equates to less water in the hydrologic cycle.

Kravçik chronicles the death of many other societies in the past from the very water-destructive practices we use widely today. He explains that water is a thermal regulator that moderates weather extremes. The more water the atmosphere has, the stronger will be the moderating effects on temperature and weather. Most evaporating water in the closed hydrologic cycle condenses again in the local watershed. There, it needs plentiful vegetation for the process of "transpiration" – the process whereby plants and trees "sweat" water, cooling the air in the process. If the water cycle is disrupted because the vegetation has been removed, water vapor is lost to the local watershed. The elimination of vegetation from the soil by removing forests, overgrazing land or using poor farming methods was a major cause of the downfall of past civilizations. Modern humans have added urbanization and the practice of removing huge amounts of freshwater through sewage systems, many of which dump freshwater directly into the oceans. Kravçik says the destruction of vegetation, combined with the directing of rainwater from continents into the oceans, is as great a cause of global warming and rising seas as greenhouse gas emissions.

An added problem is the creation of urban heat islands that are warmer than the surrounding rural areas. As *Science News* reported, "impervious surfaces" the size of Ohio now cover the United States and actually affect the local climate. When precipitation doesn't soak into urban landscapes, it isn't available to absorb heat, evaporate and thus cool the environment. Cities lose their capacity to "sweat."

The problem is exacerbated by deforestation. In a March 2005 study by the Australian Nuclear Science and Technology Organization, scientists analyzed variations in the molecular structure of rain along the Amazon River. This allowed them to "tag" the water as it flowed into the Atlantic, evaporated, blew back inland to fall again as rain and finally returned to the river. The study showed that since the 1970s, when intensive deforestation began, the ratio of the heavy molecules found in the rain over the Amazon had declined significantly. The only possible explanation was that the molecules were no longer being returned to the atmosphere to fall again as rain because the vegetation was disappearing. The team found a clear connection between the degraded forest and reduced rainfall – an association with a long anecdotal history but lacking in scientific proof until the Australian study.

Desertification and Climate Change

This drying trend has recently been verified by a number of important sources. The U.S. National Center for Atmospheric Research (NCAR) reports that the percentage of the Earth's land area stricken by serious drought more than doubled between the 1970s and 2005. Widespread drying occurred over much of Europe, Asia, Canada, western and southern Africa and eastern Australia. In Nigeria, two thousand square kilometers is becoming desert every year.

As well, researchers from the NASA-sponsored Gravity Recovery and Climate Experiment (GRACE) are using a pair of roving satellites to measure changes in the water supply around the world. The two satellites measure the gravitational field of the Earth; minute changes in the data can then be extrapolated to show where water is "displaced," even if it is captured in snow, rivers or aquifers. Although the project is relatively new (launched in 2003), it has already identified the central valley of California, parts of India and large areas of Africa for special concern. The annual 21.6-millimeter shrinkage in the depth of the Congo translates to 260 cubic kilometers, or roughly the annual flow of fourteen Colorado rivers. *Every year.*

A major October 2006 report from the U.K. Meteorological Office reproduced total global water trends over the last fifty years and then applied the model to forecast the future. The study clearly showed that the current extent of drought could double by the end of the twenty-first century, threatening the survival of millions of people around the world. In contrast, in the second half of the last century, just 1 percent of the world was affected by extreme drought.

There are several ways in which climate change affects freshwater sources. As seas rise, they will take out more wetlands, which are already under siege. Wetlands have been called the kidneys of freshwater systems, as they filter and purify dirt and toxins before they reach rivers, lakes and aquifers. (Forests are the lungs of the water system, absorbing pollution and preventing flooding.) Further, as global warming raises the temperature of the Earth, the soil water needed to sustain the freshwater cycle will evaporate more readily. Water in lakes and rivers will evaporate more quickly as well, and the snow packs and ice cover that replenish these systems will become more rare.

Climate change and reduced water in the hydrologic cycle will create as many as one billion climate-change refugees, many of them from water loss, warned the development agency Christian Aid in a May 2007 report titled *Human Tide: The Real Migration Crisis*. Citing research by Oxford academic Norman Myers, which concluded that by 2050, five times as much land is likely to be under "extreme" drought as today, another Christian aid group, Tearfund, has called on world leaders to get beyond rhetoric. In its report *Feeling the Heat*, Sir John Houghton, one of Britain's leading climate scientists, warned that water shortage would be the most visible and terrible climate threat in developing countries.

High Technology Solutions Are Part of the Problem

Where they are taking proactive steps to alleviate the water crisis, many nations and the international financial institutions are promoting the high-technology solutions of dams, diversions and desalination. While it is difficult to imagine a world without these fixtures, in the long run, all are part of the problem and they will not provide the answers we need. On the contrary, these expensive technologies all have the potential to do great harm to the ecosystems in which they are placed, further exacerbating the global water crisis.

Dams

More than forty-five thousand large dams (higher than fifteen meters) have been built around the world at a cost of around US$2 trillion. While dams can provide some benefits, such as generating electricity, supplying water, controlling floods and facilitating navigation, much evidence suggests that these are

As far back as sixty years ago, water was massively diverted from the Aral Sea through a dredged canal and sent to the desert to grow cotton for export. At the time, the Aral was the world's fourth largest lake and its basin was shared by Afghanistan, Iran and five countries of the then Soviet Union. The Aral Sea is a modern ecological tragedy; it has lost more than 80 percent of its volume and what is left is salty brine. Canal diversion for irrigation was also (with drought) the major cause of the destruction of Lake Chad – once the sixth largest lake in the world (and the third largest in Africa), now all but gone.

Desalination

The third technology being touted either enthusiastically (by the water industry) or reluctantly (by governments of some water-stressed countries) is desalination. Desalination is the process whereby salt is removed from seawater or brackish water either by evaporation or by forcing the salty water through tiny membrane filters in order to create fresh, drinkable water. According to the International Desalination Association, there are now 12,300 desalination plants worldwide in 155 countries with a collective capacity to produce forty-seven million cubic meters of water a day.

These statistics are not as impressive as they sound. Most desalination plants are small, and used for highly localized, high-valued and industrial needs. Only in a few places, such as the Middle East and the Caribbean, is desalination an integral part of a country's water solution. Two thousand of these plants are in Saudi Arabia, which accounts for one-quarter of the world's desalinated water production. This is not a coincidence; desalination of seawater is very, very expensive and very few water-stressed countries have the resources of that oil-rich nation. Globally, says the Pacific Institute, current desalination plants have the capacity to provide for only three one-thousandths of total world freshwater use.

However, as the global water crisis becomes more evident, many politicians and bureaucrats are looking to this technology

for salvation. Some very large plants are under construction in Israel, Singapore and Australia, and there are thirty large-scale ocean desalination plants in the planning stage for California. Global demand is projected to grow by 25 percent every year, according to the International Desalination Association. It is very important, then, to ascertain whether desalination is truly the answer some are claiming.

Any close examination of this technology reveals major environmental and human health hazards. First, desalination plants are highly energy-intensive and put a huge additional burden on local power grids. In *Twenty-Thirst Century*, Australian environmental writer John Archer's scathing book on his country's water crisis, Archer gives the example of a proposed plant in Sydney. Initially it will only be capable of producing one hundred megaliters of water a day – a mere one and a half hours of Sydney's current needs – but will require enough energy to produce 255,500 tons (about 232 million kilograms) of greenhouse gases every year. Worldwide, large-scale desalination technology would radically increase greenhouse gas emissions that, in turn, exacerbate the water shortage crisis the plants were built to alleviate.

Second, all desalination plants generate a lethal by-product – a poisonous combination of concentrated brine mixed with the chemicals and heavy metals used in the production of freshwater to prevent salt erosion and clean and maintain the reverse osmosis membranes. For every liter of desalted water, a liter of poison is pumped back into the sea. Archer notes that the proposed Sydney plant would create more than thirty-six billion liters of waste every year. Aerial photos of the big Saudi Arabian plants show a massive black brine slick fanning out into the ocean, resembling the purple ink discharged from a giant squid. Worldwide, current desalination plants produce twenty billion liters of waste every day. As well, the discharge contains the decomposed remains of aquatic life – such as plankton, eggs, larvae and fish – that are killed during the intake process; these remains reduce the oxygen content of the water near the discharge pipes, creating additional stress on marine life.

Third, the water fed into the desalination system may contain dangerous contaminates that are not filtered out by the reverse-osmosis process. These may include biological contaminants such as viruses and bacteria; chemical contaminants such as endocrine disrupters, pharmaceuticals and personal-care products; and algal toxins such as paralytic shellfish poisoning. These contaminants are found everywhere.

But there is a huge additional problem when desalination plants are built in countries that discharge their waste into the ocean, thereby guaranteeing that much of the intake water will be polluted. Sydney, for instance, dumps a billion liters of sewage into the ocean every day; much of this would be sucked back into the planned desalination plant, where only the salt would be filtered out. This water would then be used for the daily water needs of Sydney's citizens. When we remember that the Third World still discharges 90 percent of its waste, it is not hard to imagine the quality of water that would be processed by desalination plants for human consumption. Desalination plants are also big, bulky plants that block ocean vistas. As well, they are noisy and produce a foul odor.

The Pacific Institute's Peter Gleick is not in principle opposed to desalination technology. Yet in a detailed report on desalination in *The World's Water, 2006–07*, Gleick concludes that, between the environmental concerns and the astronomical costs, this technology is still an "elusive dream" and far less of an answer to the global water crisis than the "soft path" of conservation, reclamation of polluted water, energy efficiency, sustainable agricultural practices and infrastructure investment. John Archer would agree but is more blunt. He writes, "Desalination of the sea is not the answer to our water problems. It is survival technology, a life support system, an admission of the extent of our failure." In a June 2007 review of desalination plants worldwide, the WWF agreed with the Pacific Institute, saying that desalination poses a threat to the environment worldwide and will exacerabate climate change. Large desalination plants may soon become "the new dams," said the WWF, obscuring the need for conservation of rivers and wedlands.

Our Political Leaders Are Failing Us

So here, then, is the answer to the question, Can we run out of freshwater? Yes, there is a fixed amount of water on Earth. Yes, it is still here somewhere. But we humans have depleted, polluted and diverted it to such an extent that we can now actually say the planet is running out of accessible, clean water. *Fast.* The freshwater crisis is easily as great a threat to the Earth and humans as climate change (to which it is deeply linked) but has had very little attention paid to it in comparison.

The world is running out of available, clean freshwater at an exponentially dangerous rate just as the population of the world is set to increase again. It is like a comet poised to hit the Earth. If a comet really did threaten the entire world, it is likely that our politicians would suddenly find that religious and ethnic differences had lost much of their meaning. Political leaders would quickly come together to find a solution to this common threat.

However, with rare exceptions, average people do not know that the world is facing a comet called the global water crisis. And they are not being served by their political leaders, who are in some kind of inexplicable denial. The crisis is not reported enough in the mainstream media, and when it is, it is usually reported as a regional or local problem, not an international one. Water policy is raised as a major issue in very few national elections, even in water-stressed countries. In fact, in many countries, denial is the political response to the global water crisis.

In November 2006, former Australian prime minister John Howard hosted a high-level summit in Sydney to deal with what one scientist called "the worst drought in Australia in 1,000 years." Howard's answer? Allow farmers to "trade" country water to the city, thereby draining already thirsty rivers of yet more