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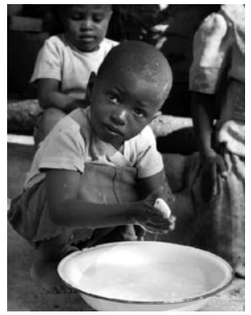

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Preface

I asked two friends, one Mexican, one West Coast USA: "If I gave you all the money you need to fix the drying Colorado River what would you do?" There was a long silence – a very long silence – then both spoke at once. "It really isn't about money. We need to change the way people think about water. We don't have the public climate of thought to make the right decisions."

How often do we really *think* about this essential, ever-present marvel called water? We bathe in it, drink it – even eat it, given the huge amount needed to grow food. We transport goods by water, we take vacations to be near water, and we fish in rivers and lakes. Industries could not function, energy be generated, nor books or clothing created without water. We send rockets into space to find water on nearby planets. Poets extol its beauty and worshippers purify themselves with it before prayer. Despite all of this, we behave as if water can manage itself.

Surely we should take better care of it? As you will learn in this Atlas, there is a world water crisis today, a crisis of underground water levels declining, serious pollution, lakes and water sources disappearing. As many as 70 rivers are so over-used that they are *closing*, which means that we cannot afford to take more from them. While around 1 billion people have no consistent access to drinking water, 2.5 billion lack sanitation – a threat to their health and dignity and often to the water around them.

It takes about a litre of water to produce one calorie of food. As prosperity increases, so does demand for high-protein, water-intensive food. And it takes up to nine times that much water to produce the same unit of energy, whether by pumping oil, growing bio-fuels, or in the other ways we produce power for heat, light, transport and production. As populations increase, all these demands will skyrocket.

The Earth today has the same amount of water that existed for the dinosaurs. Where that water lies and how we treat the water close to us is the issue at stake. Around half a billion people in 29 countries already face water shortage. The combination of population growth, pollution, and climate change means that by 2025, fully one-third of the expected world population will be in regions facing water scarcity – and paradoxically, at higher risk of water disasters: floods and severe storms.

Where there is strong competition over water resources, two outcomes are predictable: the environment suffers, and poor people have more trouble gaining access to the water they need for drinking and living. There is also a risk of dispute, even conflict, in one of the 260 river basins shared between countries. Development itself becomes more difficult as water-short areas fail to attract investment.

We do have responses for these problems. A 35-percent increase in water productivity (more "crop per drop") could reduce the agricultural share of water consumption from 80 percent to 20 percent in many areas. Supplemental irrigation, groundwater harvesting, and recycled wastewater can be used. Drought resistance can be added to plants via traditional breeding and also by biotechnology – although declining biodiversity, also related to water stress,

reduces our chances of finding the right characteristics.

We cannot create water but we can manage it better, much better. Absurdities need to be fixed: many major cities lose over 40 percent of their supply in leaking pipes. In some cities, few bills are sent out and even fewer paid, meaning no funds for maintenance or service extension to low-income areas. Some irrigation systems waste 70 percent of their water.

There is enough water for all our purposes if it is managed properly – and equitably. Poor water management threatens the woman walking to the distant well, the farmer at the end of the irrigation canal, and the slum dweller paying several times as much per litre as a richer citizen. It also threatens the survival of freshwater fish, forests, crops in fields parched by recurring drought, and inland lakes diminishing year by year. New technology helps, but cannot solve these problems. Water scarcity is as much about the inadequacy of financing and management, as of water resources.

Some remedies may be obvious, but few are simple. There are taboos against the re-use of wastewater. Cleaning out corrupt or inept water administrations raises huge political problems. And there are controversies – over genetically modified crops, regulations and their enforcement, the involvement of the corporate sector in water management, the construction of large dams and many other issues. Some "solutions" generate more enemies for governments than friends.

I welcome this wide-ranging Atlas, created by knowledgeable and caring authors, Maggie Black and Jannet King. I know it will inform – but I also hope it will inspire readers to *do something*. We all can. Start by turning off the tap, and talking about it. Only drink bottled water when absolutely necessary. Might a couple of veggie-only days per week improve your health and that of the planet? Get to know your own river. Find out about pollution in your area – who is polluting (it may be you), and what it might take to reduce this. What part of the natural environment is at risk from local water depletion, and how wasteful is your city's water system? Be vocal, and on the right side of difficult areas of national and municipal decision-making.

There are no silver bullets and difficult times are on the horizon. But Water *is* Life; and life itself is at stake.

Margaret Catley-Carlson
Patron of the Global Water Partnership www.gwpforum.org
Chair of the World Economic Forum Agenda Council on Water,
and member of the Secretary General's Advisory Board
on Water and Sanitation.

Introduction

Water means life – a truism so often repeated that its significance becomes lost. This vital natural resource – falling from the sky, bubbling up into springs and lakes, flowing in streams and rivers – is so fundamental to human activity that it has to be managed in such a way that everyone has access. Leaving aside questions of unequal power over resources, the very nature of water militates against this. Rain falls equally "on the just and on the unjust", but everything depends on where they are standing. There is nothing just about annual rainfall distribution, which varies from a few millimetres in some places to thousands in others. And as the climate comes under increasing pressure, the meteorological patterns that scientists have worked for generations to understand are becoming less predictable. Rainfall, which regenerates all other surface and underground sources, may be about to become even more unjust than before.

Rain's erratic choice of landing place, from deserts to forests, tropical to temperate zones, mountains to valleys, is not the end of this complicated story. Unlike other elements on which life depends, it frequently changes its state – from liquid to vapour, from liquid to ice, and *vice versa* depending on the season. Water in lakes and reservoirs is constantly evaporating. And water in the landscape never stands still – it is always on the move. It seeps into the soil for use by plants and creatures, or percolates into aquifers where it renews underground supplies. It travels downhill on even the slightest of gradients. Navigating around whatever impediments it finds in its way, surface water enters a complex system of streams and tributaries connecting river basin to river basin, joining an ever larger flow destined for the sea. Many of these linked river networks are occupied by different peoples, states and jurisdictions.

At any and every stage along its journey, water is used – and sometimes re-used several times – to support life and economic activity. Maximizing its potential for different uses and environments requires technology, investment, control of pollution, regulation, and efficient service delivery. For example, some of the rain falling on the Tibetan Plateau finds its way into China's Lancang river. At many stages downstream, water is diverted by hydraulic construction and human ingenuity into paddy fields to support rice growing. Elsewhere, the flow generates electricity as it is channelled through hydropower turbines. Towns and cities remove water for human consumption and industry, and discharge wastewater back into it. As the river slows and broadens in its lower reaches, becoming the Mekong, it supports a vast aquatic environment on which local fisherman and wildlife depend. Eventually it enters the South China Sea, having passed through six countries and been endlessly manipulated and exploited along the way.

Heightened demand

In an ever more crowded world, the processes involved in this manipulation and exploitation are becoming increasingly complex. Much more is being demanded of hard-pressed water resources. Rivers have been increasingly fragmented by dams. Upstream users are reducing both the volume and the quality of water descending downstream. Non-renewable supplies, in the

form of fossil water aquifers formed millennia ago, are becoming rapidly exhausted. Every drop of available supply has to be harnessed to agricultural, industrial or domestic use – and sometimes all three in sequence. The volume of renewable supplies remains constant and is unlikely to falter, even though fluctuations caused by global warming are affecting the performance of the hydrological cycle. But the pressures exerted on this finite supply, both from increased population, and from the increasing numbers of people expecting to enjoy an industrialized lifestyle, are profound. Competition between different types of use, and between upstream and downstream users, is becoming more acute. The extraordinary nature of the substance compounds the many difficulties of managing water in such a way that all these conflicting interests are adjudicated fairly.

Awareness of the critical limits on freshwater supplies has been growing over the past 20 years, alongside more general appreciation of environmental constraints. Indeed, the circulation of water in the environment – to preserve wetlands, conserve biodiversity, and protect climate stability – has itself become recognized as a category of "water use" necessary to nurture the planet and its other life-giving resources. One strategy for water conservation has been to attach an economic value to all its uses and apply market instruments, such as water-pricing, to prevent profligate extraction and consumption. But the treatment of water as a commodity like any other, to be traded and used for corporate profit-making, has caused huge resentment. In those societies where poverty is acute, and rural farmers and urban dwellers are surviving at levels close to subsistence, unsubsidized water services effectively mean no water services at all. However important it is to conserve supplies, the story of water will be even more unjust if the least well-off bear a disproportionate burden of the costs.

In fact, the problem of water as it relates to people in non-industrial environments is that most of them use too little water, rather than too much. Around one billion people are still without a reliable source of drinking water, and 2.5 billion people are without sanitation. Having no tap at home constrains water use to the point where lack of personal hygiene is at least as much of a disease risk as lack of safe drinking water. Any attempt to improve water management in such a way as to make distribution more just should spread services to those without, many of whom currently spend much more on water, purchased by the litre and carried home in a pot, than those living where pipes and taps are prolific.

With water, as with pressure on other natural resources, it is not the poor who are pumping up industrial-scale quantities to market it in bottles, or to irrigate sugar or cotton plantations in unsuitable dryland environments. Nor are they manufacturing or buying televisions, computers, cars or other sophisticated consumer products. It is not the disadvantaged and underfed who are polluting rivers with pesticide residues and chemical wastes, or eating farmed fish or hamburgers requiring large quantities of water for their production. The industrial lifestyle is propped up by water, as much as or more than it is propped up by oil.

Water profligacy

Food is one of the most thirsty water consumers. Over 70 percent of water withdrawals are used for agriculture, to flood fields or spray crops. But much of this water fails to reach its target – the roots of the plants; it is lost to the atmosphere, or returned to the water system unused. If poorly managed, irrigation can actually damage the soil, leaving it saline and unproductive. For this and many other reasons, including the social disruption and environmental damage caused by large dams, it is generally acknowledged that the train of "progress", in which large-scale irrigation projects opened up new agricultural land for cultivation, has run into the buffers.

Despite the uneven distribution of land ownership and cheap food, since the expansion of food production that accompanied the Green Revolution it has been possible to envisage a time when no child would go to bed hungry. But over 850 million people are still without a sufficient or nutritious diet, and the day when these figures will improve may now be receding into the future. If food production is to keep pace with increasing population, and prices are to be kept in check, water efficiency in agriculture will have to be given far more attention. Volumes available for agriculture are likely to decline or remain static as industry and expanding urban centres increase their share.

Technology will have to be harnessed to reducing water wastefulness. Up to now, hybrid seeds have mostly required extra water for cultivation; more attention will have to be focused on plant strains that require less water. Farmers will have to rediscover respect for environmental parameters, with drylands used for drought-resistant grains and tubers. Investment is needed in small-scale irrigation and water-harvesting techniques, which could improve the livelihoods of millions of farming families, especially in Africa but also in South Asia. Irrigation needs to be carefully managed, and combined with measures to improve the water-holding quality of the soil, nurture its fertility and increase yields from rain-fed crops. As pressures mount, food production will have to focus on items that use less water per unit of energy or nutrition than the red meat so highly prized in Western cultures.

Reduction of water profligacy and improved efficiency are also needed for water use in manufacturing. In many Western countries, water conservation has been enforced by regulation and pricing to the point that recent expansion in industrial water use has been relatively constrained. The challenge is to ensure that these kinds of measures are taken up by newly industrializing countries where water governance and regulatory frameworks are less developed and more frequently flouted. On the domestic front, appliances such as toilets and washing-machines that use less water are now widely available, but even these, as they are taken up by the new middle-class in countries such as China and India, will have a major impact on the quantity of fresh water used in towns and cities, and on the quantity of wastewater discarded.

The amount of water used per household varies enormously around the world, and a large part of it is invisible. Consumption is not limited to drinking, bathing, flushing the toilet, using the dishwasher and watering the garden, adding up to well over 100 litres per capita a day. Everything that is manufactured – from electronic equipment to newspapers and kitchen gadgets

– has involved water in its production. The total amount of water each person consumes if such products are factored into our "water footprint" is far higher than the figure for direct consumption. Nor is usage restricted to water from local sources: it also includes water embedded in food and goods imported from elsewhere. Thus water-stressed areas in Africa, America, Asia and Australia may be used to produce consumer items for export, while – with real injustice – local farmers and herders go short.

Pollution

At the same time as demand on volumes increase, pressures mount on freshwater quality. No longer can natural water from springs, dug wells and running rivers automatically be assumed to be clean and safe to drink. The natural capacity of waterways to act as the world's inbuilt washing-up apparatus is inadequate to cope with the overload of wastes from increased population density. Many towns and cities in the developing world suffer the indignity of London 150 years ago when, in a hot summer season, the Thames was reduced to a Great Stink by a combination of upstream take-off and raw sewage inflows. Around 90 percent of human waste in the developing world is still discharged untreated into rivers. Since the threat of a cholera epidemic by the intake of foul breath no longer causes the alarm it once did, the public-health incentive for dealing with this nuisance is not what it used to be.

Human waste is an organic substance, and although overload in rivers, lakes and streams destroys plant and aquatic life and presents serious disease problems, the pollution caused by chemical wastes and industrial spills is far more damaging. Failure to regulate or to enforce regulation on polluters who discharge wastes at industrial sites can have disastrous effects on the aquatic environment, killing fish stocks and the ecosystem on which they survive. Some pollutants are not absorbed in water, and may be traced thousands of miles away from their original discharge. Where chemical fertilizer and pesticide residues, or pharmaceutical components, are washed into rivers or leached into the soil, and from there enter the food chain, their toxic effects may build up in human tissues and cause long-term ill-health. For too long, the world's freshwater and seawater network has been considered as having an unlimited capacity to function as humanity's sink. As a result, many parts of the network have become degraded.

Co-operation over water

The increasing pressure on water resources has led to intense competition. Within one community, it is often hard to agree who has the right to take freely from the source for irrigation purposes, or whether people with a tap in their yard should pay a water-rate higher or lower than those still obliged to walk to the pump. Should fines be imposed on people whose tannery, or cloth-dying business, or latrine has fouled the local source? These are questions that have exercised communities for centuries. At the local level, water governance has always demanded co-operation, often reinforced by water's venerated place in human affairs. But as lifestyles become more water-intensive, and the supply is

tampered with at ever greater distances, these problems become more acute, especially at the wider level of district or nation, up to multinational level.

Many fear that water is becoming a commercialized commodity, with market forces left to decide who gets to use it or abuse it. Fortunately, that prospect is retreating. Irresponsible profit-making and corruption over water services – the result of inflated expectations from the privatization of services and the efficacy of markets – and the difficulties entailed in persuading customers and authorities to accept much higher pricing regimes, has induced a major re-think about the best distribution of water management between public and private sectors. Compared to the late 1990s, there is now a much wider appreciation that water is a common good, and that it ought to be managed in the common interest, by authorities that are answerable in the public domain. When the task of reconciling all the different user interests is understood in all its parameters, it seems likely that a new business of "water diplomacy" among all sorts of public and private practitioners is going to be a growth industry for the 21st century.

The idea of "integrated water resources management" sounds so reasonable and just – reconciling upstream and downstream users, allocating so much to agriculture and so much to industry, bringing in all parties across all political boundaries to the river basin forum – that it ought to be adopted universally and without delay. But its realization requires a complex process of reconciling competing claims, and a willingness to share a natural resource in an equitable way; such an achievement would be virtually unprecedented in human history. The omens, however, are more positive than might be thought. Despite all the talk about "water wars", experience shows that co-operation over water has occurred more often than conflict, and that antagonists with deeply held differences in almost every sphere can manage to find common cause over water. In the end, the unjust distribution of water in the landscape may provide the stimulus for humanity to find a way of sharing this life-giving resource, and thereby further the cause of peace.

Maggie Black
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