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A fresh approach to water

The water shortage that threatens humanity will have wide-ranging consequences for agriculture and energy production, requiring significant shifts in the way this precious resource is managed.

From space, most of our planet is a deep, satisfying blue. Water, the essential ingredient for life, seems to be everywhere. But, as this issue highlights, the prospects at ground-level are not so agreeable. It is salutary to realize that in our issue of this very date 5 years ago, we wrote an Editorial that, with small amendments, we might well have simply reprinted this week (see *Nature* **422,** 243; 2003). Our planet is facing a water crisis in public health: more than a billion people in developing nations lack access to safe drinking water, and more than 2 billion lack proper sanitation (see page 283). And in the near future, water shortages are likely to spread into other key sectors — notably agriculture (see page 273) and energy (see page 285).

Some of this looming world crisis will be driven by climate pressures, as rising temperatures lead to drier soils and less reliable rainfall (see page 270). But much of it will also be driven by population growth and rapid economic development. As nations such as India and China grow more prosperous, for example, their citizens are switching to more protein-rich Western diets. It takes some 15,500 litres of water to produce a kilogram of industrial beef, ten times as much as is needed to produce 1 kilogram of wheat. These nations are likewise shifting their energy consumption towards intensities common in the developed world. The United States alone is already using more than 500 billion litres of fresh water per day — over 40% of its freshwater withdrawals — for cooling electric power plants. That's roughly the same as the quantity used for irrigation.

The resulting pressures on water supplies are unrelenting. Global energy demand is projected to increase 57% by 2030, and water demand for food production might easily double. By 2050, feeding the world's growing population may require some 12,000 cubic kilometres of water — the volume of Lake Superior — every year. Yet many of the world's rivers and lakes are already dramatically overused: China's Yellow River doesn't always reach the ocean, and Lake Mead in the American southwest could be dry by 2021 if water usage is not curtailed. Such bleak realities have led some countries to contemplate ambitious, and arguably ill-considered, schemes for redirecting their water supplies (see page 278).

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Shaking off the blues

And yet, the situation is far from hopeless. There are many new ideas and fresh approaches that could greatly ease the water crisis — if only we can collectively figure out how to implement them. In previous decades, for example, water research and policy have focused mostly on the 'blue water' in rivers, lakes, reservoirs and underground aquifers. But blue water accounts for only 40% of the world's freshwater balance, and for much less in dry regions. The key to tackling the crisis in the most food-insecure parts of the world is managing 'green water': the less spectacular, but more abundant moisture that infiltrates the soil from rainfall, and that can be taken up by the roots of plants. Experts estimate that in regions such as sub-Saharan Africa, where more than 95% of crops are rain-fed, only 10–30% of the available rainfall is being used in a productive way. The fixes they suggest are decidedly low-tech: harvesting rainwater, planting roots deeper, better terracing, and switching from ploughing to tilling. Yet the potential gains could be enormous. In heavily irrigated regions such as south Asia, meanwhile, equally simple improvements in water usage could take the pressure off precious blue-water supplies, and hence drinking water.

This emphasis on low-tech agricultural solutions should take nothing away from efforts to develop hardier, more drought-resistant crops through breeding programmes and genetic manipulation. The world is going to need all the solutions it can get. Nonetheless, low-tech efforts can offer big gains at comparatively modest costs. The policy challenge is to figure out who is going to bear those costs, and do the hard, unglamorous work of translating ideas into action. Who, for example, will teach poor farmers how to make better use of their natural resources? And where will they get the financial support to make risky-seeming changes to farming practices in the face of unreliable rains?

A question of control

For the energy sector, meanwhile, there are big gains to be had from water conservation and reuse. Instead of using pristine freshwater, for example, power plants could switch to brackish groundwater or treated wastewater. And this is another arena in which new technologies also have a role (see pages 260 and 301).

Here again, the fundamental challenge is to agree on who is in charge. The two countries doing best in that regard are Israel, where severely limited water supplies have led to a national system in which nearly every drop is recycled; and the Netherlands, where an overabundance of water encroaching from both sea and sky has led to a national strategy to control every aspect of the resource. But these countries are the exceptions, not the rule. More typical is the chaotic situation in the United States, where more than 20 federal agencies deal with some aspect of water — from flooding control to coastal commissions. Water policy is rarely coordinated at a regional or national level, and coherent solutions are almost impossible.

That situation has recently begun to change in the United States, as in the efforts to coordinate water usage in the Colorado River basin. But it has to change everywhere. Unless policy-makers want water resources to be constantly squabbled and fought over, with farmers pitted against city dwellers, upstream users against downstream users, and region against region, every nation needs to think about water strategically. ■