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Dealing with Water Scarcity in the Next Century

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Reform of water policy is urgently needed to avert severe national, regional, and local water scarcities that will depress agricultural production and worsen water-related health problems. Water is abundant globally but scarce locally. Of the earth's 1,360 million cubic kilometers of water, 97 percent is in the oceans. Three-quarters of the freshwater is in glaciers and icebergs, another fifth is groundwater, and less than 1 percent is in lakes and rivers. Almost two-thirds of the renewable freshwater provided by annual rainfall over land evaporates. Much of the rainfall transformed into runoff is lost to floods.

Given current global water use of 4,000 cubic kilometers, the remaining 14,000 cubic kilometers of effective runoff would be adequate to meet demand for the foreseeable future if supplies were distributed equally across the world's population. But freshwater is distributed extremely unevenly across countries, across regions within countries, and across seasons.

When does water scarcity become a serious problem? Water analysts use the following rule of thumb: countries with freshwater resources of 1,000 to 1,600 cubic meters per capita per year face water stress, with major problems occurring in drought years. Countries are considered water scarce when annual internal renewable water resources are less than 1,000 cubic meters per capita per year. Below this threshold, water availability is considered a severe constraint on socioeconomic development and environmental quality. Currently, some 30 countries are considered water stressed, of which 20 are absolutely water scarce. By 2020, the number of water scarce countries will likely approach 35. Equally worrisome, virtually all developing countries, even those with adequate water in the aggregate, suffer from debilitating seasonal and regional shortages that urgently need to be addressed.

Challenges for the Future

Low water use efficiency. The foremost challenge related to water scarcity in developing countries is the need to increase generally inefficient water use in agriculture, urban areas, and industry. Irrigated area accounts for over two-thirds of world rice and wheat production, so growth in irrigated output per unit of land and water is essential. Improved efficiency in agricultural water use is required both to maintain productivity growth and to allow reallocation of water from agriculture to urban and industrial uses.

Expensive new water. New sources of water are increasingly expensive to exploit. Water to meet growing household and industrial demand may thus need to come increasingly from water savings from irrigated agriculture, which generally accounts for 80 percent of water diverted for use in developing countries. To truly contribute to reducing water scarcity, improved efficiency in agricultural use should be accompanied by improved efficiency in urban and industrial use.

Resource degradation. The quality of land and water must be sustained in the face of mounting pressure to degrade these resources through waterlogging, salinization, groundwater mining, and water pollution.

Water and health. Pollution of water from industrial effluents, poorly treated sewage, and runoff of agricultural chemicals is a growing problem. Unsafe water, combined with poor household and community sanitary conditions, is a major contributor to disease and malnutrition, particularly among children. One billion people are without clean drinking water, and 1.7 billion have inadequate sanitation facilities. As many as 1 billion episodes of diarrhea occur annually in developing countries. The World Bank has estimated that access to safe water and adequate sanitation could result in 2 million fewer deaths from diarrhea among young children.

Massive subsidies and distorted incentives. Most of the world does not treat water as the scarce resource that it is. Both urban and rural water users receive massive subsidies on water use; irrigation water is essentially unpriced; in urban areas the price of water does not cover the cost of delivery; capital investment decisions in all sectors are divorced from management of the resource. In Mexico, subsidies to operate and maintain water systems (that is, not including capital costs) total 0.5 percent of gross domestic product, far more than is spent on agricultural research. In Jordan, despite severe water scarcity, subsidies encourage overuse of irrigation water. Strict rationing is then required to allocate the resulting scarcities. In most countries, water subsidies go disproportionately to the better-off: irrigated farmers and urban water users connected to the public system.áThe inequity is exacerbated because subsidies are often financed from regressive taxes.

Development of New Water

The development of new water has slowed considerably since the late 1970s owing to escalating construction costs for dams and related infrastructure, relatively low prices of staple cereals, and concerns over the environmental effects and dislocation of persons caused by dam and reservoir construction. Although the construction boom of the 1970s will not return, a portion of new demand for water must be met by carefully selected, economically efficient development of new water, both from impoundment of surface water and sustainable exploitation of groundwater resources. In some river basins, efficiency gains from existing systems may be limited, because whole-basin reuse and recycling of drainage water already occur, even though individual water users are inefficient. Under these circumstances, new water development could be necessary.

As scarcity increases, the rising economic value of water should improve the cost-effectiveness of some new water development projects, particularly multipurpose dams that both supply new water and generate revenue from hydropower.áThe environmental costs and benefits must be carefully weighed in evaluating new water sources. In Laos, for example, new water and hydropower development on the Mekong could offer an alternative energy source to fuelwood, reducing deforestation. This benefit, however, must be weighed against the potentially harmful consequences of construction, including displacement of indigenous people and inundation of reservoir sites.

Sustainable development of groundwater resources also offers significant opportunities for some countries. The extent of groundwater storage and recharge is poorly understood in much of the developing world. Investment in a "groundwater revolution" in Bangladesh beginning in the 1980s was a key stimulant to rapid agricultural growth in the 1980s and early 1990s. Nearly 1.5 million hectares of land was newly irrigated after 1980, in significant part from private installation of shallow tubewells spurred by deregulation of tubewell imports. Although localized problems of groundwater mining have occurred, in most areas in Bangladesh further expansion of groundwater use within the bounds of natural recharge is possible. If dry season water scarcity worsens, investments to divert wet season river flows for artificial recharge of aquifers may become feasible, and could also reduce wet season flooding.

Comprehensive Water Policy Reform

A large share of water to meet new demands must come by saving water from existing uses through comprehensive reform of water policy. Such reform will not be easy, because both long-standing practice and cultural and religious beliefs have treated water as a free good, and because entrenched interests benefit from existing arrangements.

The precise nature of water policy reform will vary from country to country, depending on underlying conditions such as level of economic development and institutional capability, relative water scarcity, and level of agricultural intensification. Additional research is required to design specific policies within any given country. However, key elements of comprehensive reform include the following:

Secure water rights. Reform must provide secure water rights vested in individual water users or groups of water users. In some countries and regions, these rights should be tradable, which further increases the incentives for efficient water use. Such a reform can empower water users, provide investment incentives, improve water use efficiency, reduce incentives to degrade the environment, and increase flexibility in resource allocation.

User management of irrigation systems. In many developing countries, devolving irrigation infrastructure and management to water user associations will be beneficial. In the past, such steps often failed because they were not accompanied by secure access to water. Well-defined water rights provide the incentive for user groups to economize on water use, to bargain effectively with the water conveyance bureaucracy for timely and efficient service, and to undertake operations and management.

Reformed price incentives. Privatization and regulation of urban water services, together with reduced subsidies for urban water consumption, can also improve efficiency. When incremental water can be obtained at low cost owing to subsidies there is little incentive to improve either physical efficiency (such as through investment in pipes or metering) or economic efficiency. Secure water rights held by the urban companies and an active market have encouraged the construction and operation of improved treatment plants that sell water for agricultural or urban use. Removing subsidies on urban water use can have dramatic effects. An increase in the water tariff in Bogor, Indonesia, from US$0.15 to US$0.42 per cubic meter resulted in a 30 percent

decrease in household demand for water.áIn the industrial sector, increased water prices will lead to investment in water recycling and conservation technology. Increased water tariffs induced a 50 percent reduction in water use over a five-year period by a fertilizer factory in Goa, India. In São Paulo, three industries reduced water consumption by 40 to 60 percent in response to effluent charges.

The reforms described would free up substantial resources for both productive investment and targeted subsidies to the poor and groups who might be left out of the reform process. For example, in Chile the removal of general water subsidies has allowed the government to increase the level of subsidies targeted directly to the rates paid for urban water by the poor. Subsidies also go to small farmers to allow them to acquire water rights from new infrastructure.

Appropriate technology. Availability of appropriate technology will be essential as incentives are introduced for water conservation. Small-scale water harvesting techniques can have high payoffs in certain agro-climatic environments. As the value of water increases, sprinklers, computerized control systems, and drip irrigation using low-cost plastic pipes, all of which are common in developed countries, could have promising results for developing countries. In Malaysia's Muda irrigation system, real-time management of water releases from the dam, keyed to telemetric monitoring of weather and streamflow conditions, has significantly improved water use efficiency.

Environmental protection. Greater protection must be afforded to water and soil quality. The appropriate approach to environmental protection is likely to include both regulatory and market elements. In Mexico, the new water law establishing tradable water rights is the first to establish strong explicit protection of the environment. The law stipulates a regulatory, rather than a market or tax/subsidy approach. The government must specify the quality of discharge for nonagricultural uses when it grants a water right, and it can restrict water use in the event of damage to ecosystems, overexploitation of aquifers, and other environmental effects.

Increased water prices or establishment of tradable water rights can cause farmers to take account of the costs their water use imposes on other farmers, reducing the pressure to degrade resources. A simple example is the farmer at the head of a canal who overuses water, thereby waterlogging other farmers' land through excess return flows, seepage, and percolation. If he could trade the excess water instead, he would conserve resources. Although any society can design effective environmental protection policies, how much environmental protection will be provided will be a matter of political choice and commitment.

International cooperation. Water policy reform must transcend national boundaries. In many regions, long-term solutions will require international cooperation between countries sharing scarce water resources. Intergovernmental activities to settle conflicts over shared bodies of water have had mixed success. A 1977 agreement between India and Bangladesh allocated 63 percent of the dry season flow of the Ganges at the India/Bangladesh border to Bangladesh. However, the agreement has not been in effect since 1988, and water disputes remain a serious source of conflict.

More significant headway has been made on talks between Jordan and Israel over the Jordan and

Yarmuk Rivers and on shared groundwater resources.áHowever, the lack of participation of Lebanon and Syria in these talks has made it difficult to reach comprehensive settlement on the use of water from the Jordan and Yarmuk Rivers.

Cooperation between countries sharing the same water basin will become increasingly important as water becomes scarcer. Reconciliation is cheaper than armed conflict. A key to defusing potential international conflicts over water is national water policy reform to ensure the most efficient use of available water supplies. Countries must therefore begin the painful process of reforming national water policies and treating water as a scarce resource.

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"A 2020 Vision for Food, Agriculture, and the Environment" is an initiative of the International Food Policy Research Institute (IFPRI) to develop a shared vision and consensus for action on how to meet future world food needs while reducing poverty and protecting the environment. Through the 2020 Vision initiative, IFPRI is bringing together divergent schools of thought on these issues, generating research, and identifying recommendations. The *2020 Briefs* present information on various aspects of the issues.