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WATER AND FOOD TO 2025

Policy Responses to the Threat of Scarcity

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The world's farmers will likely need to produce enough food to feed 8 billion people by 2025, and to do so they must have enough water to raise their crops. Yet farmers are already competing with industry, domestic water users, and the environment for access to the world's finite supply of water. Will available freshwater meet the rapidly growing demands for household, industrial, and environmental needs and still provide enough water to produce food for a burgeoning population? New research from IFPRI shows what steps policymakers and water users can take now to help ensure that water scarcity will not result in worsening hunger for the world's poorest people.

Irrigation, which consumes far more water than any other use, has generated enormous benefits. By helping raise farmers' yields and stabilize food production and prices, irrigation has been key to achieving food security in many parts of the world. About 250 million hectares are irrigated worldwide today, nearly five times more than at the beginning of the 20th century. Yet inappropriate water and agricultural policies and poor irrigation management have also lowered groundwater tables, damaged soils, and reduced water quality. Moreover, growing populations with rising incomes will further increase the demand for irrigation water to meet food needs.

Other users also have important claims on water. Although the domestic and industrial sectors use far less water than agriculture, water consumption in these sectors is growing rapidly. Access to safe drinking water and sanitation is critical for health—particularly for children. And the importance of reserving water for environmental purposes has only recently been recognized: during the 20th century, more than half of the world's wetlands were lost.

Even as demand for water by all users grows, groundwater is being depleted, other water ecosystems are becoming polluted and degraded, and developing new sources of water is getting more costly. Many people are concerned that water will be the main obstacle to growing enough food in the coming decades.

ALTERNATIVE FUTURES FOR WATER

To assess how water availability and water demand are likely to evolve by the year 2025, IFPRI has developed a global model of water and food supply and demand. Researchers have used this model to study global scenarios revealing how various water policies and investments will affect water availability and food production (see Figures 1 and 2). Three of these scenarios are summarized here.

BUSINESS AS USUAL

In the first scenario—business as usual—current trends in water and food policy, management, and investment persist. International donors and national governments continue to reduce their investments in agriculture and irrigation. Governments and water users reform institutions and management in a limited and piecemeal fashion.

In total, the demand for water for all nonirrigation uses will rise by 62 percent between 1995 and 2025. Industrial water use will grow much faster in developing countries than in developed countries. Although small price increases for industrial water, better pollution control regulation and enforcement, and water-saving technologies will help make industrial water use somewhat more efficient, the sheer size of the increase in the world's industrial production will sharply raise total demand for industrial water in developing

countries and the world. Domestic water demand will also grow rapidly, especially in developing countries, as a result of urbanization and income and population growth. Better delivery and more efficient home water use will lead to some increase in the proportion of households connected to piped water, but many households will remain unconnected, consuming less water of poorer quality compared with connected households. And despite the efforts of environmental and other interest groups, competition from other users means that the share of water devoted to environmental uses will not increase.

Farmers will consume only about 4 percent more irrigation water in 2025 than in 1995, in part because of a lack of available water. The result will be slower growth of food production and substantial shifts in where the world's food is grown. In the face of water scarcity, farmers will find themselves unable to raise crop yields as quickly as in the past, and by 2025 their irrigated cereal production will be 300 million metric tons less than it would have been with adequate water—a difference nearly as large as the U.S. cereal crop in 2000.

Faced with rising food demand and slowing production growth, developing countries will dramatically increase their reliance on food imports from 107 million tons in 1995 to 245 million tons in 2025. Some countries may finance these imports from economic growth in sectors other than agriculture, but when high food imports are the result of slow economic development, many countries may find it impossible to maintain the required imports, further worsening food security. Much of Sub-Saharan Africa and the non-oil-producing Middle Eastern and North African countries could be hit particularly hard.

Figure 1 Total water consumption in three global scenarios, 2025

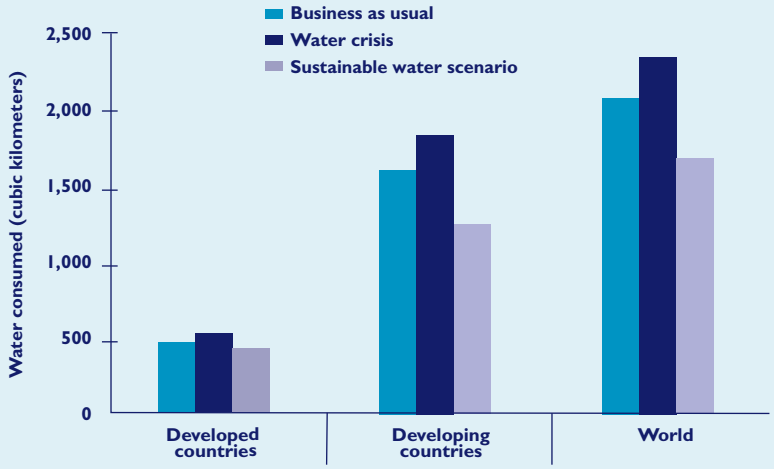
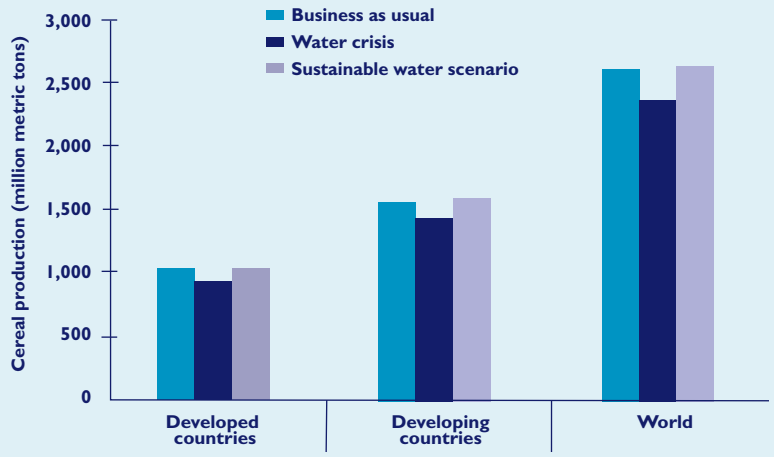


Figure 2 Total cereal production in three global scenarios, 2025



Source: Authors' estimates and IMPACT-WATER projections, June 2002.

WATER CRISIS

If current trends in water and food policy and in investment worsen, even moderately, the result could be a genuine water crisis. In such a scenario governments further cut their spending on irrigation systems and rapidly turn over irrigation systems to farmers and farmer groups without the necessary reforms in water rights. Governments and international donors reduce their investments in crop breeding for rainfed agriculture in developing countries, especially for staple crops.

Total worldwide water consumption in 2025 will be 261 cubic kilometers higher than under the business as usual scenario—a 13 percent increase—but much of this water will be wasted. Virtually all of the increase in demand will go to irrigation, mainly because farmers will use water less efficiently and withdraw more water to compensate for water losses. In search of adequate water supplies, farmers will extract increasing amounts of groundwater, driving down water tables and leading ultimately to the failure of key aquifers. Farmers will also tap environmental water flows, fur-

ther reducing wetlands and compromising the integrity and health of aquatic ecosystems. Owing to inadequate water pricing and regulation reform and slow adoption of improved technology, industrial water demand will be 33 percent higher in 2025 than under the business as usual scenario, without generating additional industrial production. The rapid increase in urban populations will quickly raise demand for domestic water, but without fundamental water pricing reforms, governments will lack the funds to extend piped water and sewage disposal to newcomers.

Naturally, such a scenario will have severe consequences for food harvests. Overall, farmers will produce 10 percent less cereal in 2025 than under business as usual because of declines in both the amount of land cultivated and yields. This reduction is the equivalent of annually losing the entire cereal crop of India. The decline in food production will help push up food prices sharply under the water crisis scenario. The price of rice will rise by 40 percent, wheat by 80 percent, maize by 120 percent, and other coarse grains by 85 percent. Higher food prices will reduce food trade. Developing countries will import 58 million tons less cereal than under business as usual—a 23 percent fall. The ultimate result of this scenario is growing food insecurity, especially in developing countries. Per capita cereal consumption in 2025 in the developing world will actually decline compared with 1995 levels.

SUSTAINABLE WATER SCENARIO

Fortunately, it is possible to envision a sustainable water scenario that would dramatically increase the amount of water allocated to environmental uses, connect all urban households to piped water, and achieve higher per capita domestic water consumption, while maintaining food production at the levels described in the business as usual scenario.

Governments and international donors will increase their investments in crop research, technological change, and reform of water management to boost water productivity

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and the growth of crop yields in rainfed agriculture. Improved policies and increased investment in rural infrastructure will help link remote farmers to markets and reduce the risks of rainfed farming. To stimulate water conservation, the effective price of water to the agricultural sector will be gradually increased.

Governments in many regions will shift water rights and management responsibilities to water users and offer users training and support. As a result, farmers will increase their own investments in water-saving technologies. The overdrafting of groundwater will be phased out as governments assign users rights to groundwater, while also toughening and better enforcing regulations.

Domestic and industrial water use will also be subject to higher prices and stricter regulation. With strong societal pressure for improved environmental quality, allocations for environmental uses of water will increase, reducing pressure on wetlands.

In the sustainable water scenario the world consumes 20 percent less water than under business as usual but reaps greater benefits, especially in developing countries. These water savings will increase environmental flows by 1,030 cubic kilometers globally, well over triple the annual flow of the Mississippi River. Faster growth in rainfed yields will make up for slower growth in harvested area and irrigated yields, and as a result total cereal production in 2025 is 1 percent more than under business as usual. Crop prices under this scenario decline slowly from 1995 to 2025 except for slight increases for maize and soybeans due to heavy demand for livestock feeds.

CONSEQUENCES OF KEY POLICY CHANGES

IFPRI researchers also studied the effects of key changes to individual policies in three areas. Would raising water prices for industry, domestic users, and agriculture result in large water savings that can be used for environmental purposes? What would happen to water and food if the regions that are currently overpumping groundwater returned to sustainable water use? Could faster growth in rainfed cereal production compensate for reduced investment in irrigation and water supply?

Their findings show that policy and investment reform has considerable power to make water use more efficient and sustainable. Higher water prices, the research shows, would indeed save water that could be allocated to environmental uses, although making water use more efficient at the same time is critical to maintaining food production compared with business as usual. The ultimate success of water pricing policies depends on targeting subsidies to the urban poor and compensating farmers for reduced water consumption, rather than charging exorbitant prices to reduce consumption.

Halting the unsustainable pumping of groundwater would reduce cereal production, especially in areas that have large groundwater overdrafts, such as China and India. As a result, the developing world as a whole will increase its net imports, and developed countries will increase their net exports. These changes may be a worthwhile trade-off for restoring sustainable groundwater supplies, but they must be combined with policies to increase the efficiency of water use, to encourage diversification out of irrigated cereals into crops that give more value per unit of water, and to

boost the nonfarm rural economy in overdrafting regions.

Finally, if reductions in investments in irrigation and water supply were combined with increases in rainfed yields and harvested area, the result would be a 16 percent decline in the use of irrigation water. Farmers would produce 153 million tons less irrigated cereal than under business as usual—but 187 million tons more rainfed cereal.

If farmers counteract the reduced investments in irrigation and water supply by increasing water harvesting, conservation tillage, and precision farming, they can raise rainfed production significantly, but not enough to fully compensate for the decline in irrigation. Developing countries would be harder hit by production declines and would increase their cereal imports by 16 million tons. Appropriate investments and policy reforms, including crop breeding for rainfed environments, would be required to enhance the contribution of rainfed agriculture.

IMPLICATIONS FOR THE FUTURE

The scenarios described here point to three broad strategies for national governments, international donors, and water users:

- increase the supply of water for farmers, households, and industries by investing in infrastructure;
- conserve water and make existing systems more efficient by reforming water management and policy and investing in improved technology and infrastructure in these systems; and
- increase crop productivity per unit of water and land by improving water management and directing research and policy efforts toward rainfed agriculture.

It is crucial to invest in expanding household and industrial water supplies, but rising financial and environmental costs will limit the expansion of irrigation water supply. Overall, the most effective means of dealing with water scarcity is likely to be making existing water uses more efficient. Efficiency in irrigation water use can be enhanced by technologies like drip irrigation and precision agriculture, management changes like the adoption of demand-based irrigation scheduling systems, and institutional improvements like the creation of effective water user associations. Industrial water recycling can be a major source of water savings in many countries. Domestic water use can be made more efficient by steps ranging from repairing leaks in municipal systems to installing low-flow showerheads. Innovative water pricing policies that increase the prices for domestic and industrial water while preserving incomes for farmers and the rural poor will encourage water-saving innovation.

Rainfed agriculture also emerges as a potential key to the sustainable development of water and food. Improved water management and crop productivity in rainfed areas would help relieve pressure on irrigated agriculture and on water resources. Exploiting the full potential of rainfed agriculture, however, will require investing in water harvesting technologies, crop breeding targeted to rainfed environments, agricultural extension services, and access to markets, credit, and input supplies in rainfed areas.

These strategies can avert the impending water crisis that much of the world faces, but they will require time, political commitment, and money. If these strategies are to succeed, they must begin now.

This brief is based on the book *World Water and Food to 2025: Dealing with Scarcity* and the food policy report *Global Water Outlook to 2025: Averting an Impending Crisis*, both by Mark W. Rosegrant, Ximing Cai, and Sarah A. Cline and jointly published by IFPRI and the International Water Management Institute (IWMI) in October 2002. For more information on these publications, go to www.ifpri.org.

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