

NEWS & VIEWS

A 2020 Vision for Food, Agriculture, and the Environment

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Is Agriculture Raiding South Asia's Water Supplies?

Water Scarcity and Water Reform in South Asia

Water is increasingly scarce around the world. In South Asia, where half of the world's poor live, international water conflicts are brewing and riots over water are taking place with increasing frequency. Many researchers, environmentalists, and others believe that agriculture is using more than its fair share of the resource. Around the world and in South Asia, agriculture, on average, uses about 80 percent of the water supply in a given country.

According to some researchers, agriculture is drinking so much water in South Asia not out of necessity, but because of poor water policies that induce excessive water use. They say that water use could be reduced without adversely affecting crop yields, and call for comprehensive reform of water policies. These reforms could save irrigation water, freeing it up for nonagricultural uses, and, at the same time, decrease irrigated water's negative effects on the environment. But others challenge the assumption that increasing water efficiency could free up a lot of water. They hold that there is simply not enough water to go around. In the future, this edginess over water will only increase as population pressures make the need to produce greater amounts of irrigated food staples even more urgent.

"There are no easy answers to water scarcity and water allocation issues," said Prabhu Pingali, senior economist at the Philippines-based International Rice Research Institute. "But what is happening all over Asia is that water scarcity is increasing. As it does increase, farmers will become more conscious about their water use. Farmers have shown the ability to organize themselves to solve certain problems in the past. I think we will see farmers organizing to create solutions to water scarcity in the future. And one of the most important solutions will be to increase water efficiency."

Water Scarcity

Researchers say there are water shortages during the dry season in parts of rural areas and in every major city in South Asia. These shortages are leading to conflicts. According to Peter Rogers, Gordon McKay Professor of Environmental Engineering at Harvard University, "The major conflict between Pakistan and India about the Indus River waters was largely diffused in the



1960s. Now there is a conflict between India and Bangladesh over the Ganges. But of even greater concern are the water conflicts between the states in India on every boundary that crosses a major flow of the Ganges. And also in the south of India, which is not in the Ganges River basin, people have been killed in riots about intrastate water conflicts.

"In Madras, there is no water in the city pipes," continued Rogers. "Mobs of desperate people must chase water delivery trucks twice a week to get their share. There is plenty of water during

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the monsoons. But this water is not stored properly and is mainly used for agriculture."

Many researchers believe that water is being used excessively in agriculture. "For our water-intensive crops such as rice and sugar cane, we are going deeper and deeper underground," said Ashok Gulati, a director at the National Council for Applied Economic Research in India. "In the modern part of India's Punjab, so much water is being pumped from wells, the water table is going down by one and a half feet per year."

"With water provided . . . at little or no cost to the user, no one in the water allocation business, whether it's the bureaucrats, the farmers, or urban citizens, has an incentive to conserve water."

—Mark Rosegrant

Irrigated water in agriculture has had and continues to have negative environmental effects. "Unless there is proper drainage, bringing irrigated water onto fields can cause waterlogging and salinity buildup in soils," said Ruth Meinzen-Dick, research fellow at IFPRI. "This has become especially problematic over large areas of prime irrigated land in Pakistan and northern India."

This water-induced land degradation is leading to long-term declines in the very crops the irrigated water was supposed to be spurring into ever-increasing production. "In addition, intensively irrigated land leads to long-term declines in the soil's nitrogen supply, and this affects the ability of the soil to produce the same yields as before," said Pingali.

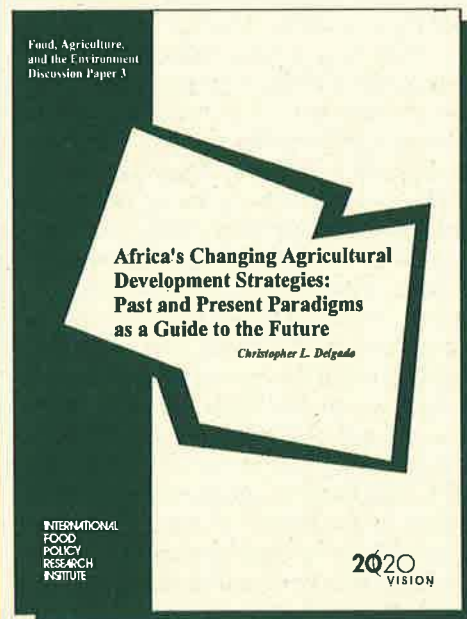
Declining growth in crop yields makes the prospect of decreasing the use of water on farms particularly scary. But surprisingly, researchers have found that if farmers decreased their water use on rice paddies, there would be little or no impact on yields.

"We have enough field level experiments, conducted in various countries in South Asia, which show that you can reduce irrigation water by as much as

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Africa Has Had Many Agricultural Development Strategies, But Few Have Been Home Grown

Few continents are as diverse as Africa, and, over the past 35 years, few places have had such rapid change in agricultural development, states Christopher Delgado, research fellow at IFPRI and author of a new 2020 Vision discussion paper. Agricultural development, which is especially important in Africa, has often undergone almost complete reversals in emphasis. However, there have been remarkable similarities between the main lines of agricultural development from country to country at any one time during this period.



The explanation for these similarities, according to *Africa's Changing Agricultural Development Strategies: Past and Present Paradigms as a Guide to the Future*, is that Africans have had relatively little input in the design of strategies that have affected how their countries have grown and developed over the years and how their wealth has been distributed. Instead, shifting development strategies, fashioned outside the continent, have influenced what occurred, with expatriates and foreign institutions playing a preponderant role in intellectual affairs.

Since the early 1960s, when most of the countries obtained independence, African policymakers have been "bombarded with advice on agricultural development strategies, often conflicting and often motivated by divergent theoretical views," according to Delgado. Present-day strategies are no exception.

Delgado continues, "This alone separates modern African development experience from elsewhere in the world, and it accentuates the fact that the main challenge for development is to increase the capacity of African entities to analyze past experiences and to formulate new strategies for a better future. This is undoubtedly an important explanation of why the dominant development paradigms have shifted so much over so short a period of time as 35 years."

Delgado reviews the dominant strategies of agricultural development in Africa since 1960, explores their intellectual roots and evolution, and shows how they have shaped current thinking. The paradigms, reviewed in overlapping chronological order since the colonial era, are commercialization via cash cropping, community development, basic human needs, regional integration for industry with national self-sufficiency for food, structural adjustment through demand management, supply-shifters in agriculture, regional integration putting food first, structural adjustment through equity with growth, and sustainable development.

Despite this shifting search for a magic bullet to put the continent on the path to sustained agricultural development, Delgado argues, the challenges remain greater than ever. The paper states that there may be an emerging consensus about the key issues that need to be addressed. These include raising agricultural productivity, lowering high transportation costs, increasing rural employment, re-integrating remote and difficult areas into national growth strategies, and ensuring that Africans

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Report Finds Population Growth Far Exceeding Arable Land in Year 2025

According to a recent report by the Washington, D.C.-based nongovernmental organization Population Action International, world population is growing eight times as fast as cultivated land area, and the food security of hundreds of millions of people may be at risk early in the next century.

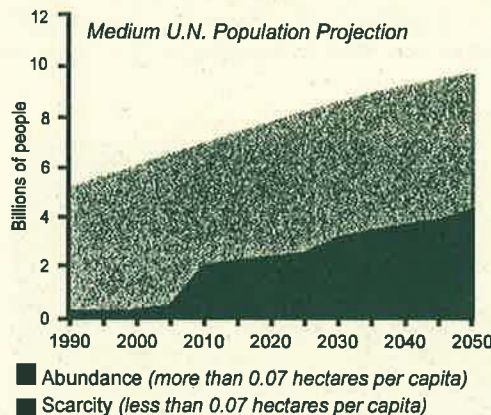
The new study, *Conserving Land: Population and Sustainable Food Production*, employs a benchmark of land scarcity of 0.07 hectares of arable land per capita, compared with the current world average of 0.27 hectares per capita. Based on the United Nations low and high population projections for the year 2025, the study predicts that 1 to 3 billion people will be living in 26 to 37 countries that, by then, will have only 0.07 hectares of arable land per capita.

"Scarcity of arable land will have the biggest impact in Africa, where farmers are least able to afford fertilizers and other means to boost agricultural production," said Robert Engelman, coauthor of the study. The study reports that 8 of the 29 countries projected as land scarce under the medium population projection for 2025 are in Africa; another 6 African countries—including Malawi and Rwanda—are projected to be only fractionally above the 0.07 hectare benchmark.

According to the study, in the early 1960s, only four countries—Japan, Kuwait, Oman, and Singapore—had insufficient arable land to feed their populations without highly intensive agriculture, but they were wealthy enough to either import food or increase agricultural productivity with modern farming methods. By 1990, the number of countries with scarce arable land had risen to nine. By 2025, however, at least 17 additional countries are projected to join the ranks of countries suffering from a scarcity of arable land, among them some of the world's poorest nations such as Bangladesh, Mauritania, Somalia, and Yemen.

The study also reports that fully 12 of 29 countries projected as land scarce in 2025 will also be classified as water scarce, with less than 1,000 cubic meters of renewable fresh water available per person for agricultural, industrial, and domestic purposes each year.

World Population and Arable Land Availability, 1990–2050



Source: Population Action International, 1995.

2020 Workshops

The following workshops, sponsored by the 2020 Vision initiative, have taken place since the last issue of NEWS & VIEWS or are planned for May.

A 2020 Vision for Latin America, co-sponsored by IFPRI, the International Center for Tropical Agriculture (CIAT) and the Inter-American Institute for Cooperation on Agriculture (IICA), March 20–22, Cali, Colombia

A 2020 Vision for Food, Agriculture, and the Environment: Issues Facing South Asia, cosponsored by IFPRI and the Institute of Integrated Development Studies (IIDS), March 27–29, Kathmandu, Nepal

Food and Nonfood Inputs for Nutritional Security: New Opportunities and Challenges for 2020, April 3, IFPRI, Washington, D.C.

Land Degradation in the Developing World: Implications for Food, Agriculture, and the Environment to the Year 2020, April 4–6, Annapolis, Maryland

Projections for Food Demand, Supply, and Unmet Needs to 2020, April 11–12, IFPRI, Washington, D.C.

Pest Management, Food Security, and the Environment: The Future to 2020, May 10–11, IFPRI, Washington, D.C.

The Expected Impact of Biotechnology on Future Food Supplies, May 12, IFPRI, Washington, D.C.

Plant Nutrition Management, Food Security, Sustainable Agriculture, and Poverty Alleviation in Developing Countries, cosponsored by IFPRI and the United Nations Food and Agriculture Organization (FAO), May 16–17, Viterbo, Italy

An Ecoregional Perspective on Malnutrition

Based on the 2020 brief of the same title by Manohar Sharma, Lynn Brown, Aamir Qureshi, and Marito Garcia

To date, poverty and malnutrition have been tracked according to their presence within national borders. But scientists think that regional climates—or "ecoregions"—which often cross national boundaries, might be better indicators of poverty.

In agrarian developing countries, the natural environment is a key determinant of both poverty and nutritional status. Climate, terrain, and soil characteristics drive the agricultural system, influencing, in large part, cropping

patterns, choice of crops, yield rates, production potential, and the size of population that an area can support.

Building on earlier work by the United Nations Food and Agriculture Organization, the Consultative Group on International Agricultural Research (CGIAR) is developing a system of nine ecoregional zones based on mean daily temperature during the growing season and the number of days when moisture and temperature permit crop growth. When these zones are superimposed on the

prevalence of malnutrition in the four major geographic regions of the developing world—Asia, Latin America and the Caribbean, Sub-Saharan Africa, and West Asia/North Africa—they are referred to as ecoregions.

Understanding the ecoregional dimensions of poverty and malnutrition will help researchers better pinpoint where anti-poverty and malnutrition programs should be targeted and could prove to be a major step forward in alleviating poverty, sustainably, to the year 2020 and beyond.

In Indonesia's Success Story, Support of Agriculture by All Economic Sectors Crucial

Editor's Note: "2020 Views" seeks to generate dialogue and discussion through interviews with participants in the 2020 Vision initiative. For this issue, NEWS & VIEWS interviewed Dr. Sjarifuddin Baharsjah, Minister of Agriculture for Indonesia. Dr. Baharsjah is also a member of the 2020 International Advisory Committee.

NEWS & VIEWS: Along with several other countries in Southeast Asia, Indonesia has been a success story in its ability to increase food production. How were you able to accomplish this?

We started very early, before 1965, and very seriously. At that time, we made use of the high-yielding varieties of rice, IR5 and IR8, released by the International Rice Research Institute (IRRI). Some of the measures that we took also included providing necessary technologies and inputs to farmers, including fertilizer. We enlarged the governments' production of fertilizer from about 750,000 tons in 1965 to the current level of more than 4 million tons a year. This has made fertilizer accessible and affordable to farmers. We also provided farmers with the necessary credit, at low interest rates, in order for the farmers to purchase farm equipment and other necessities.

We have also sought to support a price policy that keeps the retail price of rice stabilized. The rice price policy is designed to guarantee farmers a floor price which is set at a level that is high enough to provide them with an incentive to apply more advanced technology—high-yielding varieties of seeds and fertilizers—to their paddies. If, at harvest time, prices fall below the floor price, the government stands ready to buy the rice at the floor price. When prices are higher than the floor price, farmers are free to sell their rice to any party.

We have also encouraged farmers to work in groups on larger plots of land. In 1965, 18 million farmers in Indonesia were each producing rice on land that averaged less than half a hectare. This is not very conducive to the application of new technologies; it was very hard for farmers to be efficient in their rice production. So we encouraged them to work in groups to cultivate farm plots of



Dr. Sjarifuddin Baharsjah

about 25 to 40 hectares of land per group. Each farmer now owns his or her own land but cooperates with other farmers in the purchasing of inputs and in the working of the soil. This way, our farmers can achieve higher rates of rice productivity. We have also had a strong system of agricultural extension. We now have 36,000 extension workers, who work closely with these farmer groups, keeping them well informed about advances and new technologies that are available. In 1984, for the first time, we produced more food than was needed by our population, which at that time was 164 million people. We have since maintained our self-sufficiency in food production.

NEWS & VIEWS: Indonesia has also been able to reduce the use of pesticides and to adopt other environmentally sustainable agricultural practices. How did you achieve these changes? Have they adversely affected food production?

In the 1980s, we had several setbacks in agriculture. The most important one was the onslaught of pests and diseases. Nevertheless, we have shifted away from the use of pesticides—reducing their use by 50 percent since 1988. At the beginning, it was rather hard to

reduce pesticide use, but we have sought to do so through integrated pest management. Since 1984, our researchers have been continuously breeding for high-yielding, pest-resistant varieties, again working closely with IRRI. We have finally developed a number of high-yielding varieties, including IR64, 42, 36, and 74, which are resistant to our most damaging pests and diseases.

We also banned 36 chemicals from agricultural use and followed that up by educating our farmers to be more knowledgeable about the incidence of insects in their fields—both the dangerous and friendly ones. We have found it to be very important for farmers to closely examine their fields to determine the quantities of pests and the quantities of natural enemies of the pests. The farmers received integrated pest management "packets," which helped them to intervene at the most effective times in the life cycles of pests and diseases. We have done this with the help of outside experts and the U.N. Food and Agriculture Organization.

Since we have applied these methods and reduced our pesticide use, we have not experienced any serious outbreaks of pests and diseases nor have these changes had a detrimental impact on food production. The farmers are happy because the use of fewer pesticides reduces their costs. The government is happy because it must subsidize fewer and smaller amounts of pesticides.

NEWS & VIEWS: Indonesia is fortunate in having a bountiful supply of water. How has the state managed this resource while also increasing food production?

Indonesia is still not using water as efficiently as we should. Last year we experienced a very dry season and have begun to promote more efficient

use of water. In cultivating rice, our custom is to inundate our paddies with water. One of the major reasons for this is to control weeds. Our researchers are now promoting the use of less water and the application of more efficient weeding practices.

NEWS & VIEWS: The government is now transferring the management of irrigation systems to farmer-based water user groups. Has this been successful? What are the benefits of transferring this responsibility to farmers?

Of course, we have very old farmer water user institutions, such as the *subak* in Bali, which has a long tradition of effective management of irrigation water. Most recently, new water user groups have been organized on irrigated lands, such as the Darmatirta in East Java and the Mitra Cai in West Java. They have been quite successful in reaching consensus on the distribution of water among group members. This has prevented friction and illegal diversion of water, which often results in crop damage. However, the groups have not been able to convince their members to pay for the water, and, therefore, they still have to be assisted by the government in the upkeep of canals and minor irrigation works.

NEWS & VIEWS: Although Indonesia has been successful in reducing population growth rates, it is still among the most densely populated countries in the world—and its population is still increasing. Will Indonesia be able to increase food production enough to feed its population by the year 2020? If so, how?

The problem is that 60 percent of our rice is produced in Java, the most densely populated island in Indonesia, where there are great land pressures not only from agriculture, but also from housing and industry. What we are doing now and will do in the future to feed our country is to open up new land to agriculture on other islands in Indonesia, such as on Sumatra and the Celebes, among others. It is not always possible to build large irrigation systems in these areas. Thus we hope to build smaller irrigation systems. We just released four varieties of dryland rice,

which produce four tons per hectare in a rather short period of time—after three months. This is important because in the dryland areas, there are often only about four rainy months per year. Being able to cultivate rice during this period will increase rice production tremendously.

NEWS & VIEWS: Has the intensive food production in Java resulted in severe land degradation, and what action is needed to avoid such degradation during the next 25 years?

No, since the most intensive food production in Java takes place on irrigated lowlands or on well-developed, rainfed paddies. These paddies are stable. Dryland food production, especially on hilly land, is more prone to erosion. But we have upland agriculture projects that are promoting proper, and in many cases minimum, tillage of the soil. This protects the soil surface from exposure throughout a yearlong cropping pattern. These projects also increase farmers' income and spread that income more evenly throughout the year. The more serious danger of soil degradation stems from absentee ownership of land for nonagricultural, speculative purposes. Since more and more land is being demanded for housing and industry, land values appreciate rapidly. The government has issued regulations to depress this land speculation, but very often the prices offered to the farmers are so high, farmers are induced to sell their land.

NEWS & VIEWS: Are there any lessons from Indonesia that can be applied to other parts of the developing world?

We could not have accomplished what we have in food production without full support for farmers by every sector of our government and economy—from the low levels to the upper echelons. Coordination among all sectors of our economy has also been important. This has ensured that farmers receive timely inputs when they need them—from credit to fertilizer. In Indonesia, farmers specifically and agriculture generally are supported by public works projects, the banking system, the right price policies, the producers of fertilizer, and other industries.

South Asia's Water Supplies

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40 percent without affecting crop yields," said Pingali. "The problem is that farmers have no incentive to reduce their water use because water is free or costs very little."

Water: A Business or a Social Program?

Across South Asia, both urban and rural water users are provided with massive subsidies on water use; irrigation water is essentially unpriced. The government also subsidizes the electricity required to draw groundwater up from wells.

"With water provided by public systems at little or no cost to the user, no one in the water allocation business, whether it's the bureaucrats, the farmers, or urban citizens, has an incentive to conserve water," said Mark Rosegrant, research fellow at IFPRI. "As a result, water is overused. Any excess water ends up going downstream or seeping into the groundwater, or is otherwise lost to the system, requiring costly pumping to recover. What is needed is an improvement in the overall, systemwide efficiency of water use on farms."

"You can't ask farmers to pay more [for water] without improving the quality of the water service in return."

—Ashok Gulati

However, some believe there is no water to spare on farms. "If you're looking for more water in Asia, be careful about thinking that improved water efficiency will free up a lot of water," said Harald Frederiksen, principal engineer at the World Bank. "Farmers are short of water, just like everyone else, during the dry season because every river runs dry. When push comes to shove, South Asia, like so many other regions around the world, is out of water."

"To solve the problem, there are four choices," continued Frederiksen. "One, displace people out of urban areas by not providing water; two, displace people around reservoir sites by building new reservoirs to capture water in

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the wet season; three, displace people out of agriculture by turning off irrigation to the rural areas; or four, population control, the only painless solution. In the longer term, the solution must be population control, but it's getting pretty late."

Nevertheless, there is no disputing the fact that governments across South Asia seem to be foundering under the burden of water subsidies. "Water reforms will be increasingly well received because the past policies have become self-defeating," said Rosegrant. "Water costs more now because of its growing scarcity. And the costs of maintaining the subsidies and centralized control of water are skyrocketing."

One obvious solution to water overuse and escalating costs is to put a price on water. "Irrigation should be a business and not a social program," said Harvard's Rogers. "Farmers must be required to pay a price for water that is at least as much as it is worth to them. Governments should seek to reclaim the full cost of water. No one will die of thirst. If we just increased the price from close to zero to a price that is 10 percent more, this would produce so much water, people wouldn't know what to do with it."

But Is Priced Water Feasible?

How feasible would it be to ask farmers to pay for something that was once free? "It will take great political will and institutional reform to raise the cost of water to its true cost," said Gulati. "You can't ask farmers to pay more without improving the quality of the water service in return."

Current irrigation systems do not serve many farmers' needs, making farmers ever disgruntled customers. In addition, there is wasteful leakage from current irrigation systems. According to Basawan Sinha, the former chief engineer of irrigation for Bihar State in India, the major problem with water is that the old canal and distribution systems were not planned and designed to provide water to farmers on demand, in sufficient amounts, at the right time. "And there are many hectares of land for which we have failed to provide water at all," said Sinha.

Researchers also warn that raising the price of water would not do much to conserve water unless the method of billing farmers for water use was revised. "Farmers are currently charged on a per-hectare basis," said Meinzen-Dick of IFPRI. "If you just raised the charge, farmers would likely use even more water to get more for their money. If farmers were charged for the volume of water they use, then raising the price might encourage conservation."

However, Meinzen-Dick adds that measuring and monitoring volumes of water used on farms would be an enormous logistical challenge. "If countries do not have the administrative capacity to adequately bill for electricity when the technology is fairly simple, then I have serious doubts that they can bill individual farmers for their water consumption."



Empowering Farmers with Water Rights

Researchers call for reform of water policies to help solve some of these problems, including establishing farmer water associations and granting them legal rights to water. "Strengthening the role of water user associations is one of the most promising ways to improve the quality of irrigation service while at the same time reducing the financial burden on governmental agencies of managing irrigation systems," said Meinzen-Dick. "Associations could purchase water for several hundred hectares of land, divide that water among their members, and encourage water conservation. Many countries, ranging from the Philippines

and Indonesia to Mexico and Chile, have transferred management responsibility from state agencies to farmer organizations. But for this to work, farmers have to have incentives great enough to offset the added costs of managing the irrigation systems. Improvements in water service and clear water rights for the organizations can provide such incentives."

According to Rosegrant from IFPRI, water rights could also be bartered or sold to other farmers or other farmer associations, thus encouraging farmers to use less water and sell off what they don't really need. Farmers would also approve new investments in irrigation system hardware, have more say about when and where the water is allocated, and ensure that the water reaches all who need it. It would also be necessary to make minor capital improvements in the old systems and make these systems more flexible in accommodating farmers' evolving needs. Portions of the water system would still be owned by the state; the rest would be owned by the farmers.

"In the past, turnover of water infrastructure management to farmers has often failed because it was not accompanied by secure access to water," said Rosegrant. "Reform in Chile" shows that well-defined water rights provide the incentive for user groups to economize on water use and to bargain effectively with the governmental water bureaucracies for timely and efficient service."

Chile's water companies have been completely privatized. "A market solution can make a great contribution to solving water scarcity in the future and can improve the efficiency of investments in water infrastructure in the present," said Renato Gazmuri, former secretary for agriculture in Chile. "Farmers will not approve unprofitable capital improvements. Because of their increased water efficiency, Chilean farmers now irrigate 22 percent more land with the same amount of water as before."

An increase in the flexibility of water systems would also better accommodate a possible shift from rice monocultures in the dry season to less water-intensive crops, such as corn, vegetables, or fodder legumes. Such high-value crops

**See "Comments" for article on Chile's water reforms.*

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could help farmers pay for priced water. "However, there must be a market demand for these crops or they can't be grown," said Pingali. "We have seen a tremendous shift to nonrice crops in the dry season in Thailand, driven mainly by an increasing demand from wealthier urban populations for vegetables and fruit. A large-scale shift across South Asia would have to be preceded by dramatic income growth. This won't happen overnight."

Water Marketing

In the future, farmer water rights could also free up water for nonagricultural uses through a system known as water marketing. Farmers could sell their water rights to the cities, which would be more than willing to pay for scarce water. "We've seen this work in Califor-



nia where the drought disappeared because of water trades between the agriculture sector and the municipalities," said Rogers. "The government in California ended up with more water than it could deal with. At the end of the year, it still had about 200,000 acre-feet left unsold." But to make this work, again, there must be a water measuring and monitoring system, and an adequate "plumbing system" between the farms and the cities, another expensive logistical challenge.

No one believes that large-scale water marketing can happen quickly in

Privatization of Water in Chile Saves Water, Fights Poverty

By Renato Gazmuri Sch., former Secretary for Agriculture in Chile and currently President of Asesorías y Servicios Cetra Ltda.

In Chile, one of the most important outcomes of the privatization of our water system has been that the huge government deficit that was financed by poor people has disappeared. All of the resources that are saved because of the efficiency of Chile's reformed water system now go to fight poverty with more professional and technical solutions.

The process of privatization began in 1985. We are still in the final stages of discussion, and we hope these talks will be completed by December of this year. By that time, all of Chile's water companies should have at least half of their shares held by private shareholders.

Before the companies were privatized, water projects and water delivery systems did not pay for themselves in Chile. The companies had an ineffective system of collecting tariffs. The water pipes leaked and were wasting water. Politically, there was a misconception that water should be free. All the governments in the past had fixed the tariffs below the cost of the water. As a result, the water companies were always in financial trouble, and their deficits had to be covered by taxes.

From a taxpayer's point of view, this was a regressive distribution of wealth. Those who pay the highest taxes, as a share of income, are the poor. The poor spend a much larger percentage of their income on taxes through sales taxes because they must consume almost all of the money they earn, having no surplus for savings or investments. So, the poorest people were paying for the cheap water with which the rich were filling their pools in Santiago. The poor, marginal sections of Santiago had no water at all.

So, we created a new type of enterprise where shares of water were transacted in the financial marketplace. The new water companies had to finance themselves. The price of the water in the marketplace had to include all the

costs of managing, operating, and maintaining the water systems; collecting water tariffs; and making capital improvements.

In the agricultural areas, farmers formed water user associations, which have purchased the water irrigation infrastructure. Any new construction must be approved by 51 percent of the users. Because the farmers have to pay for such new construction, unprofitable, expensive ventures no longer exist. Farmers do not sign for any new projects unless they are sure their money will come back to them. They have approved small improvements in water system infrastructure and channels rather than large projects. The last major expansion of the water system was constructed in 1976.

Because farmers buy and rent their water, their water efficiency has improved. With the same amount of water, Chilean farmers irrigate 22 percent more land than before. The country has made a huge shift from traditional crops to export crops. Chile is now one of the world's largest exporters of fruit.

Chile is a country with extreme poverty, and many of the poor previously had no access to water. The most important item in the reforms is that, by law, the government must provide water subsidies to the poorest, smallest farmers and rural citizens who lack access to water. Now that everyone else is paying what water really costs, there is money left over to pay for this. We have also been able to initiate health, nutrition, and education programs.

Our water system is now far more equitable than it was before. Far more people have potable water than before. We now have a potable water coverage rate of 97 percent in the cities, compared with only 63 percent in 1970, and in the agricultural areas, we have a potable water coverage rate of 94 percent, compared with only 27 percent in 1970.

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Africa Development Strategies

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design and implement future strategies. According to Delgado, actions to resolve these issues will be much more effective if African governments and their foreign partners invest heavily in Africans and African institutions, which can ensure continuity in the formulation, implementation, and evaluation of development strategies.

Photo credits: Page 1, N. Bliven; page 6, H. DeGroot; page 7, M. Svendsen

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most developing countries, but some reform of water is on the horizon. "Exactly what sort of institutional reforms will take place remains to be seen," said Gulati. "India is just beginning to change in a direction that is a more bottom-up versus a top-down approach. As a result, users—the farmers—will be involved in the ownership and management of irrigation and electricity. We are trying to sell this idea to chief ministers of different states in India. We hope that some of the reforms in water will take place within the next two to three years

in some of the states. Changes could take place in electricity as soon as within the next year or two."

Some have faith that the farmers may move faster than anyone expects. According to Rogers, "I met a farmer, who, on three hectares of land, was growing roses and delivering them to the airport each day to be sold around the world. He used to grow sorghum. Now he's buying color televisions and sending his kids to college. Farmers are now using subsidized irrigation water to grow citrus, table grapes, and roses. They can afford to pay for water. The farmers are ready to begin to make more rational choices about water use."

A 2020 Vision

A 2020 Vision for Food, Agriculture, and the Environment is an initiative of the International Food Policy Research Institute (IFPRI) to identify solutions for meeting future world food needs while reducing poverty and protecting the environment. The 2020 initiative will sponsor and conduct research, technical workshops, and conferences on the issues of food, poverty, and the environment. The initiative will also convene an international conference in June 1995 to set priorities for meeting the world's food needs by the year 2020 and beyond. Following the 1995 conference, the 2020 initiative will disseminate the findings at a series of symposia and press briefings and through other activities around the world. For more information on the 2020 Vision initiative and/or for a copy of the 2020 Vision discussion paper series, call IFPRI at 1-202-862-5600.

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