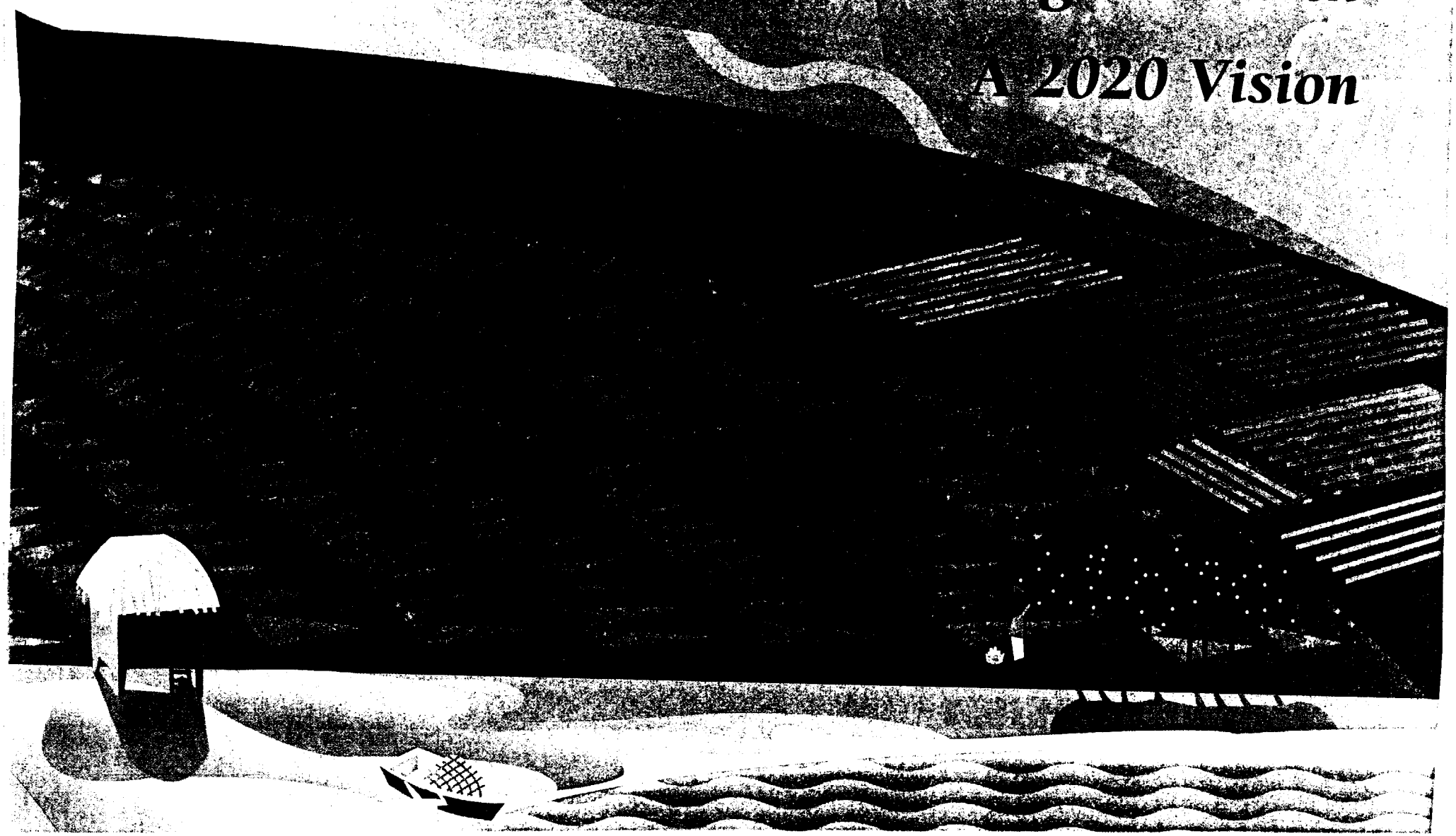
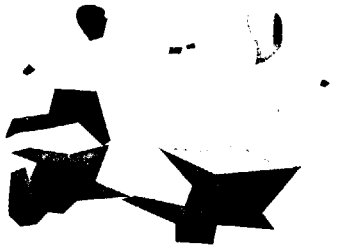
Feeding the World, Preventing Poverty, and Protecting the Earth

A 2020 Vision



We do not wish to impoverish the environment any further, and yet we cannot for a moment forget the grim poverty of large numbers of people. Aren't poverty and need the greatest polluters? How can we speak to those who live in villages and in slums about keeping the oceans and rivers and air clean when their own lives are contaminated at the source? The environment cannot be improved in conditions of poverty. Nor can poverty be eradicated without the use of science and technology.

—Indira Gandhi



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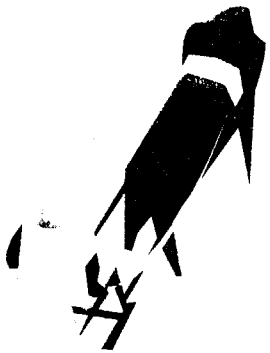

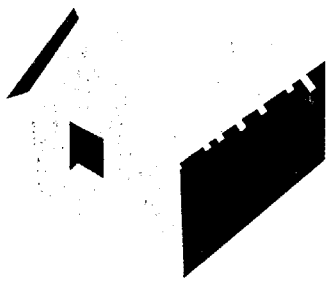

INTERNATIONAL
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The International Food Policy Research Institute was established in 1975 to help developing countries devise policies to ensure the best use of new agricultural technologies and the equitable distribution of food. Without such policies, there is no guarantee that technological improvements will translate into adequate and sustainable food supplies and improved nutrition for fast-growing Third World populations, especially the poor. With the ultimate goal of reducing hunger and malnutrition, IFPRI's research staff studies the social, economic, and institutional forces that determine the availability of food, the viability of the development process, and the quality of the environment in those countries.

IFPRI operates as part of the Consultative Group on International Agricultural Research (CGIAR), a worldwide network of institutions that seek to improve the productivity of agriculture, forestry, and fisheries in developing countries, reduce malnutrition, and enhance the well-being of poor people while preserving their environment.

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CONTENTS

A 2020 Vision

IFPRI's 2020 Vision is a world where every person has access to sufficient food to sustain a healthy and productive life, where malnutrition is absent, and where food originates from efficient, effective, and low-cost food systems that are compatible with sustainable use of natural resources.

Today, more than 800 million people—one in five people in the developing world—are "food insecure." They lack the ability to buy or grow the food required to lead healthy and productive lives. One hundred and eighty-five million preschool children are malnourished. Over the next quarter century, the world's population is expected to grow by an unprecedented 90 million people—the equivalent of Mexico's population in 1995—per year. The resulting strain on food supplies, agricultural production, and the environment will pose enormous challenges to even the most resourceful leaders. A growing body of research, however, shows that these challenges can be met.

"The world's natural resources are sufficient to meet the food needs of every human on earth," says Per Pinstrup-Andersen, director general of the International Food Policy Research Institute (IFPRI). "The most important question today is not whether we can feed the world. Rather, it is whether civil society and governments in both developing and developed countries have the political will to take the actions that are needed to feed the world. Unless concerted action is taken today, hunger and malnutrition will soon become more widespread in many parts of the world."

Troubled by global complacency over the challenge of feeding the world while protecting the environment, IFPRI launched an effort to show the way toward a better future. Called *A 2020 Vision for Food, Agriculture, and the Environment*, this effort has two objectives: First, it aims to develop a vision and an action plan for eradicating hunger and malnutrition to the year 2020 while protecting the environment. Second, it seeks to generate information and encourage debate in order to influence national governments, nongovernmental organizations (NGOs), the private sector, and international development institutions to take action to realize the 2020 Vision.

"The challenges loom large, but visionary leaders have the opportunity and the means to solve these problems," says Yoweri K. Museveni, president of Uganda and chairman of the international advisory committee of the 2020 Vision initiative. "And we in developing countries hope that, through joint efforts such as IFPRI's 2020 initiative, we can forge a better future for the world. We believe that if we work together, we can indeed be partners and not recipients in the development process."

This booklet describes the 2020 Vision through stories of the lives of people in developing countries, for although the 2020 Vision is a global vision, it is also a vision that will affect individuals around the world who struggle to earn a living and feed their families. The text that follows each story describes the root causes of hunger and poverty in developing countries and the principal obstacles to realizing the 2020 Vision.* Each section ends with recommendations based on 2020 Vision research.

If governments, international aid organizations, and individuals begin to act on the recommendations of the 2020 Vision initiative today, the world can make significant headway in eliminating hunger, poverty, and environmental degradation by the year 2020. The first step is to increase understanding of these persistent problems. This booklet is an attempt to do just that.

*If no other source is mentioned, all statistics and findings come from research conducted as part of the International Food Policy Research Institute's initiative **A 2020 Vision for Food, Agriculture, and the Environment**. The eleven stories are examples and composites gathered by researchers from the field.*

Poverty: The Root of Hunger

When their remote village in the northern lowlands of Ethiopia experienced a severe drought on the heels of two years of dry weather, Tesfaye Getachew and his wife, Senait Gebre-Selassie, had to sell off the last of their belongings to buy food. But their assets were meager, and the money was not enough to see them through more than a month or two. When what little food they had ran out, Tesfaye was forced to beg.

As the famine dragged on, conditions worsened for everyone in the region. Desperation cut a violent swath through the couple's peaceful village. Neighbors who had helped each other build homes and work the land now fought over a handful of roots left in the parched fields. Meanwhile, the water supply became contaminated with cholera.

At the peak of the famine, cholera swept through the village. Twenty-five of the 100 families living there were wiped out. Senait was among the victims.

The tragedy of the young Ethiopian couple and their village illustrates how poverty can contribute to a deadly cycle of food insecurity and famine. A lack of assets made the family vulnerable to catastrophe and ultimately to famine and death. But millions of families around the world live day-to-day with hunger because they are poor, whether or not they experience "shocks" such as drought or civil conflict.

"Poverty is one of the most important unfinished tasks of this century," says Senator Sartaj Aziz, former finance minister of Pakistan. "It is atrocious that there are still over 1 billion people living in poverty, half of them in conditions of extreme poverty, and about 800 million people who do not get enough food to eat."

Developing-country governments must work vigorously to lower poverty during times of relative normalcy, before crises hit. No one strategy for reducing poverty is appropriate for all areas. Governments must seek solutions tailored for each region. But generally, a thriving agriculture sector can be an engine of economic growth, providing food for families and leading to the creation of jobs both on and off the farm. Economywide reforms, such as allowing markets to function freely and competitively so that the buying and selling of food is not affected by artificial restrictions, can help families afford to buy or grow food.

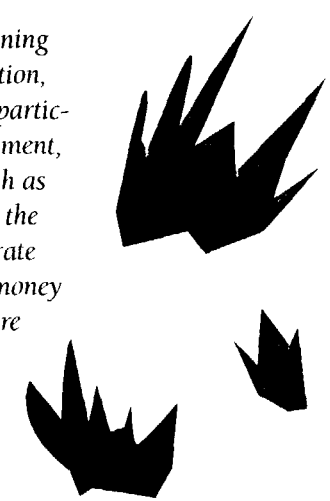
Education, health care, and good sanitation—investments in human resources and in human well-being—are also essential to raise poor people's productivity and incomes. Costa Rica is one country that has seen measurable results from investing in human resources. "We have had favorable outcomes in our literacy rates, fertility rates, and infant mortality because of decades of investment in people," says Dr. Rebeca Grynspan Mayufis, vice president of Costa Rica.

In many countries, however, such investments currently fall far short of the need. In developing countries overall, one out of three primary school children drop out by grade four, one in four people lack access to health care, one in four people drink unsafe water, and one in two people do not have adequate sanitation systems.

One reason that investments in human resources are so low is that many developing countries are burdened by great foreign debt. Because so much of their government spending goes to pay foreign creditors, governments allocate less money to programs such as education and health care. Therefore, efforts to relieve debt burdens must be strengthened.

Fighting poverty will also require making women full participants in the economic and political lives of their countries. Women play a vital role as food producers and guardians of household food and nutrition security. According to the Food and Agriculture Organization of the United Nations (FAO), women provide more than half of the labor required to produce the food consumed in developing countries. But investments in the health and education of women and girls are particularly low, and severe economic and social inequities prevent women from reaching their full potential. Women have much less access to land, money, technology, and education than men in developing countries. "The agricultural revolution must take into account that half of humanity is women," says Speciosa Wandira Kazibwe, vice president of Uganda. "It is imperative that agriculture and natural resource programs address the gender issue."

Achieving the 2020 Vision will require narrowing the widening gap between the rich and the poor by enhancing the education, productivity, health, and nutrition of low-income people—particularly women—and increasing their ability to find employment, to participate in markets, and to own productive assets such as land. Low-income countries will need to use agriculture as the engine of broad-based economic growth. They must accelerate income growth by maintaining sound exchange rates and money supply policies, pursuing reforms to make the economy more open and competitive, and investing in human resources.

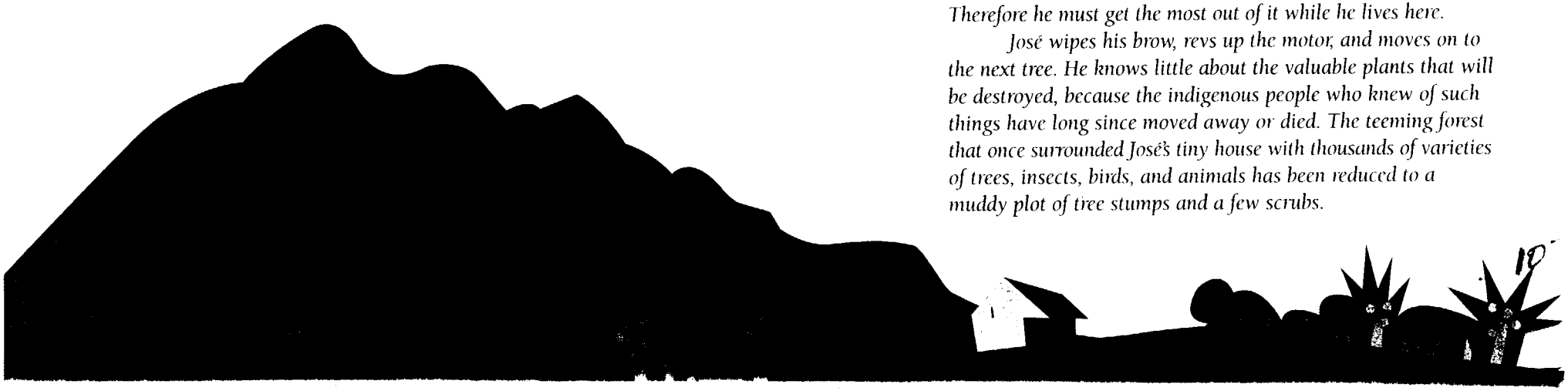


The Links Between Poverty and Environmental Degradation

The whine of José Carvalho's chain saw pierces the humid stillness of the Amazon rain forest. As birds scatter from the canopy high overhead, the saw gnaws at the trunk of a towering tree, which soon falls with a loud crack. José is cutting down the tree to guarantee food on the table and a livelihood for his family of six, which lives in one of the least hospitable places in the world. Torrential rains make life miserable during the wet season. Malaria strikes repeatedly, weakening José and his family and leaving them vulnerable to the ravages of hunger.

Although José grows rice, beans, and manioc, his meager harvests often do not generate enough food for his growing family or enough surplus to meet other needs. His soil lacks nutrients, and he has no fertilizer, good seeds, or access to a bank from which to obtain credit to purchase these needed supplies. Prices for his crops are low in the nearest market town, and transporting them there is expensive. Therefore he is clearing another hectare of land for next year's crops. He will use fields he has already cultivated, now depleted of nutrients, for cattle, which serve both as his "bank account-on-the-hoof" and as a potential source of food. He has never had legal title to his land and is not sure if he will be able to pass it along to his children. Therefore he must get the most out of it while he lives here.

José wipes his brow, revs up the motor, and moves on to the next tree. He knows little about the valuable plants that will be destroyed, because the indigenous people who knew of such things have long since moved away or died. The teeming forest that once surrounded José's tiny house with thousands of varieties of trees, insects, birds, and animals has been reduced to a muddy plot of tree stumps and a few scrubs.



Two billion hectares of land—an area the size of North America—have been degraded in the past 50 years, and 5 to 10 million hectares worldwide are lost annually to severe degradation. More than 15 million hectares of forests are annually converted to other uses, two-thirds by poor small-scale farmers seeking food security. Poverty is a major culprit in the environmental degradation of lands and forests in developing countries.

Like José Carvalho, many of the world's poor try to make ends meet off of rural lands that have some farming potential but are limited by environmentally fragile soils or unreliable rainfall. Today, 500 million people live on severely degraded hillsides, 200 million live in tropical rain forests, and 850 million live in dry areas threatened by desertification. Many of these people must eke out a food supply from already degraded land, and to sustain their families they must move from one plot of fragile land to the next. They can no longer afford to allow land to regain its productive value by leaving it idle for a few years between crops—a practice used in the past when there were fewer people. Migration alone may not improve their situation, for the favorable farmlands have already been settled and the cities are straining with too many people.

"The relationship between poverty and environmental degradation is close and complicated," says Gordon Conway, a leading environmentalist and vice chancellor at the University of Sussex in the United Kingdom. "The poor are not solely to blame. Considerable damage is caused by the irresponsible exploitation of resources by the rich. However, the rural poor depend on agriculture and hence on natural resources for 40 to 85 percent of their income. Environmental degradation sets in when the poor lose the capacity to sustainably support themselves from their natural resource base. Population pressures and a lack of adequate agricultural technologies, among other factors, are major forces driving the poor to make desperate choices."

Research shows that people in fragile areas would be better off if government support were provided for diverse cropping systems instead of cultivation of the same crop year after year, better integration of livestock and "green manures"—plant cover used to improve the soil—into farming systems, agricultural research to develop the right farming technologies, access to sufficient soil nutrients including chemical fertilizers, and sources of income other than farming. Changes in property rights are also needed in these areas because, in many instances, poor people do not own the land they farm. They therefore have few or no incentives to conserve soils, harbor groundwater, or preserve trees.

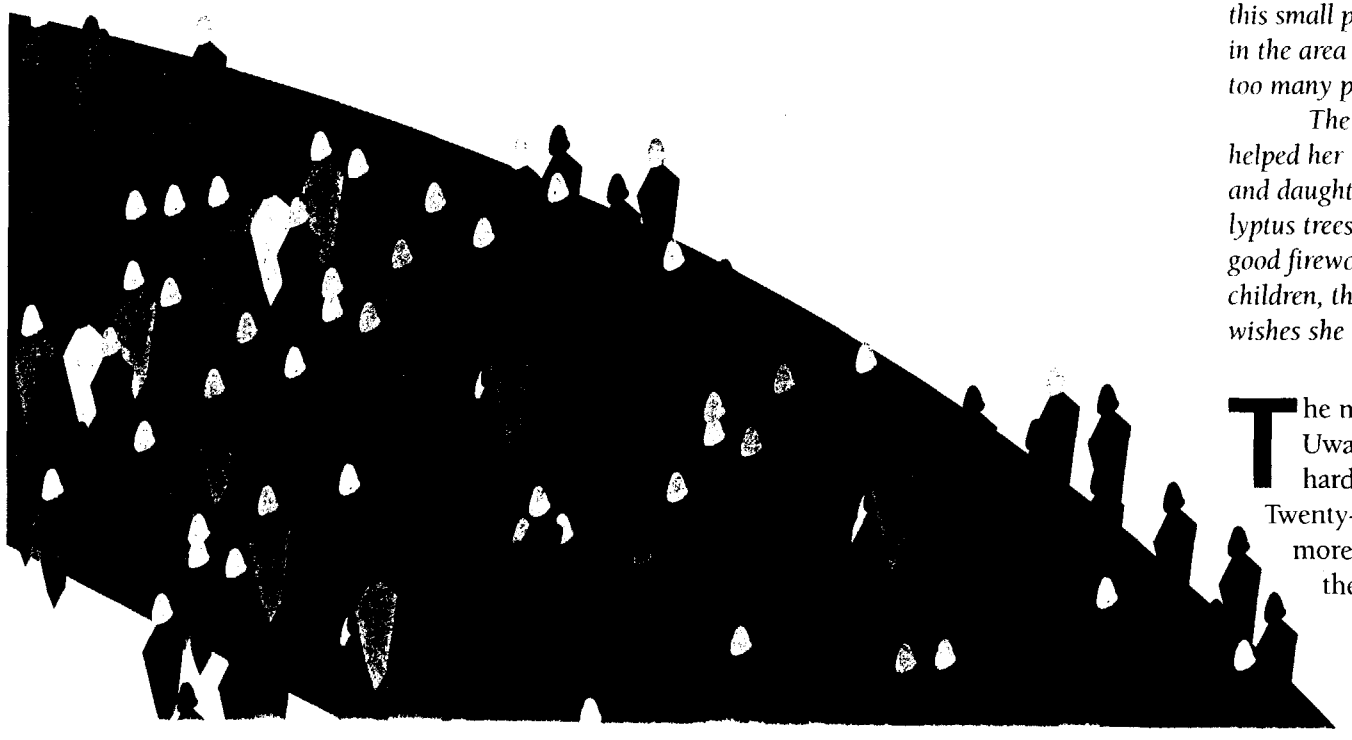
Achieving the 2020 Vision will require preventing further degradation of soils on agricultural lands by improving the lives of the poor, removing government policies that encourage resource degradation, securing property rights for the poor, developing better technologies for producing food in fragile areas, and improving infrastructure such as roads. Already degraded soils should be improved through land husbandry measures, such as mixing in locally available organic materials and adding fertilizers. Where appropriate, countries must encourage farmers to terrace and contour the land so that water does not carry away soils. Finally, intensive reforestation efforts to reclaim areas lost to environmental damage must be pursued.

The Human Cost of Mass Migration and Rapid Population Growth

Maria Ingabire Uwamahoro, a refugee from Rwanda, is walking with thousands of others on her way to Zaire. Only three of her five children are with her. She fears for the two oldest, who were away gathering firewood when she was forced to flee her home suddenly to protect herself and her three youngest children. They may have made it to a refugee camp or may be dead. Her husband, Minani, was killed while working at the tea factory.

On the day Ingabire left home, she had been weeding her fields of sorghum and beans. Her farm was one of hundreds crowded together in a patchwork quilt of small squares that covered the sloping hills and mountainsides. Most of the trees that once protected the topsoil had been cut down. The family had been given that rocky piece of land because Minani was the youngest brother of eight; after the family land was subdivided, this small plot was all that was left. Even before the war everyone in the area was desperate. There was simply too little land and too many people.

The three children with her now on the hot, dusty road helped her work the fields that day. She had sent her oldest son and daughter to gather firewood from a distant patch of eucalyptus trees because the trees nearby had all been stripped of good firewood. Though close to starvation like the rest of her children, the two oldest were stronger than their siblings. She wishes she had never sent them out that day.



The number of refugees like the family of Ingabire Uwamahoro fleeing severe social and economic hardship has increased tenfold since the mid-1970s. Twenty-three million refugees fled their countries and more than 26 million people were displaced within their home countries in the early 1990s. Unless the underlying causes of these massive involuntary migrations are addressed, these trends will continue.

Oppression, the breakdown of civil society, extreme poverty, hunger, and environmental degradation are the best fodder for massive involuntary movements of people. As more people find their own homes inhospitable, they migrate in massive numbers to urban areas, to more fertile, productive lands, and to other countries, both developed and developing.

"You cannot achieve any objective—be it food security or better social services—when the rural people have been displaced as refugees or they lack peace of mind and security to plant and cultivate their land," said General Olusegun Obasanjo, former president of Nigeria and chair of the Africa Leadership Forum, in an interview in early 1995. "Before we can build any productive activity in Sub-Saharan Africa, we must improve governance. We must have measures that ensure stability and security and the prevention, elimination, and management of conflict."

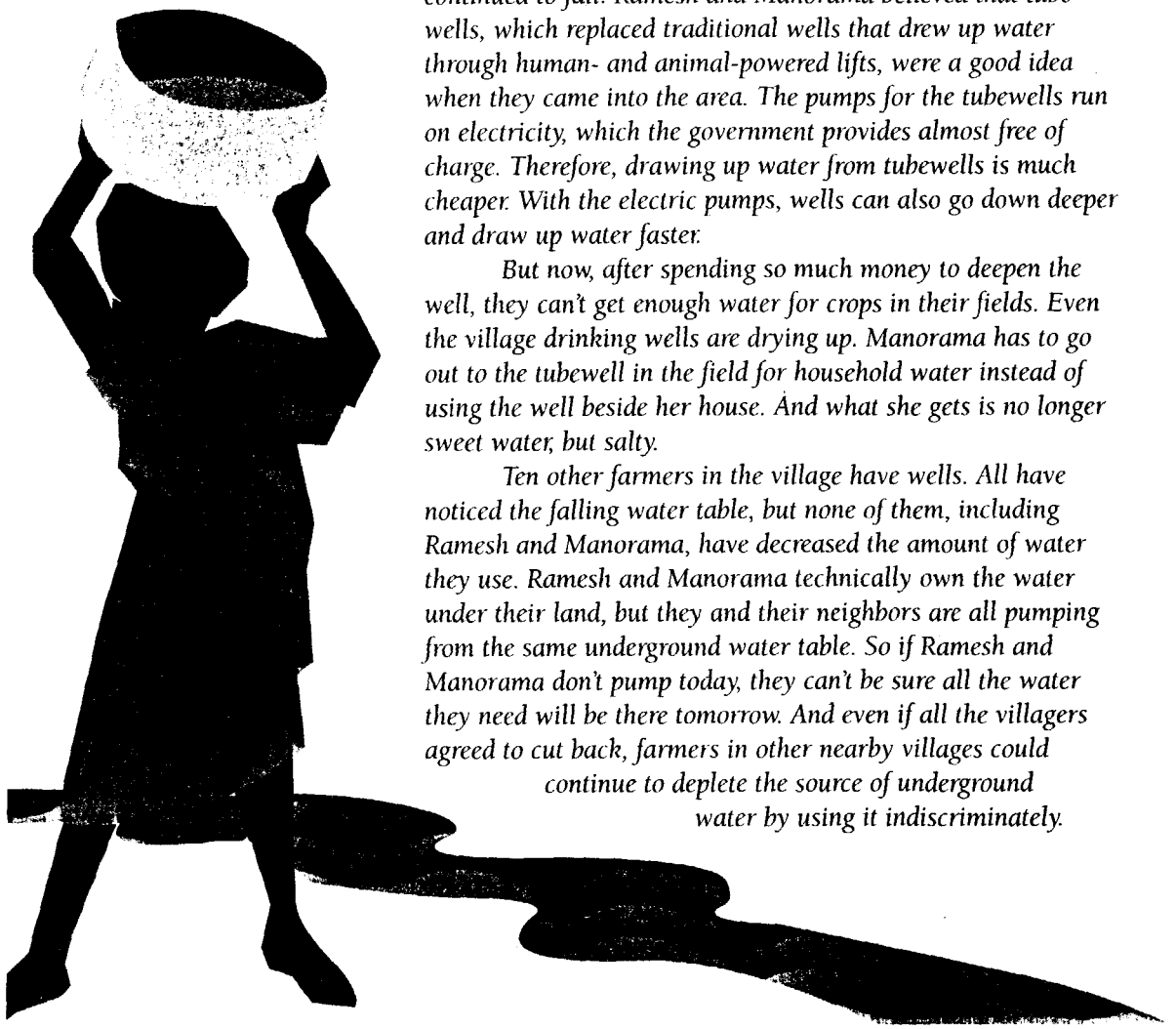
Stability also depends on slower population growth. The United Nations has projected a world population of about 8 billion people in 2020. This figure translates to an increase of about 90 million people each year, the largest annual population increase in history. More than 90 percent of the population increase will occur in developing countries, with the absolute increase largest in Asia, projected to grow by 1.5 billion people by 2020. The rate of population growth will be fastest in Africa, where the population will double to about 1.2 billion in 2020. Even though job prospects in most developing-country cities are not expected to keep pace with the influx of newcomers, the urban population there is expected to double to 3.6 billion by 2020, creating enormous demand for urban services.

Stemming the tide of population growth will be accomplished only through reduced poverty, greater access to affordable reproductive health services, empowerment of women, and education for women and girls. "Women around the world would have preferred to delay or avoid about 25 to 40 percent of all pregnancies that have taken place," says Margaret Catley-Carlson, president of the Population Council. "But desired family size is still higher than two in virtually all developing countries, and this is driven, in large part, by social and economic insecurity. Families will not reduce their numbers of births until they are sure that the births they do have will result in surviving children. Education is closely linked to this. In Asia, Africa, and Latin America, women with seven or more years of schooling have two to three fewer children than women with three years of schooling."

As mass migrations and population growth magnify competition over scarce resources, many more people will live under the shadow of conflict, where food and water are often instruments for warfare and where natural resources are among the first casualties. Improving the quality of life and managing population growth in developing countries are crucial to preventing such conflicts.

Achieving the 2020 Vision will require governments to address three critical trends in demography: rapid population growth, urbanization, and involuntary displacement of people. Countries must reduce population growth rates, particularly in Africa, where population growth rates are especially high, by investing in reproductive health services. They must provide education—particularly for women—create jobs, and alleviate the conditions that lead to excessive migration and the involuntary displacement of people.

When the Well Runs Dry: The Risks of Global Water Scarcity



A trickle of water sputters out of Ramesh and Manorama Patel's well in Boriya village in Gujarat State, India. Their vegetable fields need at least two more good irrigations to come to harvest, but their well is going dry again. They have already spent all of their savings deepening the well twice, but the water table has continued to fall. Ramesh and Manorama believed that tubewells, which replaced traditional wells that drew up water through human- and animal-powered lifts, were a good idea when they came into the area. The pumps for the tubewells run on electricity, which the government provides almost free of charge. Therefore, drawing up water from tubewells is much cheaper. With the electric pumps, wells can also go down deeper and draw up water faster.

But now, after spending so much money to deepen the well, they can't get enough water for crops in their fields. Even the village drinking wells are drying up. Manorama has to go out to the tubewell in the field for household water instead of using the well beside her house. And what she gets is no longer sweet water, but salty.

Ten other farmers in the village have wells. All have noticed the falling water table, but none of them, including Ramesh and Manorama, have decreased the amount of water they use. Ramesh and Manorama technically own the water under their land, but they and their neighbors are all pumping from the same underground water table. So if Ramesh and Manorama don't pump today, they can't be sure all the water they need will be there tomorrow. And even if all the villagers agreed to cut back, farmers in other nearby villages could continue to deplete the source of underground water by using it indiscriminately.

Excessive use of water is lowering groundwater levels in the Middle East, North Africa, and South Asia including in Ramesh and Manorama's village in India. If the world's supply of fresh water were evenly distributed and properly used, it would be adequate to meet people's needs for the foreseeable future. But water is poorly distributed across regions, within countries, and across seasons. Virtually all developing countries, even those with adequate water overall, suffer from debilitating seasonal and regional shortages. About 20 countries today are water scarce, with lack of water severely limiting their social and economic development and environmental quality. By 2020, the number of water-scarce countries could approach 35. With more than 200 bodies of water shared by two or more countries, competition for water is becoming more acute, increasing the potential for conflicts between different groups of water users within countries and for water wars between countries.

"The world does not consider water the scarce resource that it is," says Mark Rosegrant, a research fellow at IFPRI who has studied water issues extensively. "Unless this changes, increasing water scarcity could make water one of the central polarizing forces of the 21st century."

The damming of rivers upstream often causes conflicts with countries downstream. Tension is mounting between Turkey, Syria, and Iraq over Turkey's Greater Anatolia Project, now under construction. The project, which will encompass 21 dams and 19 hydroelectric power plants, could cause Syria to lose up to 40 percent of its water from the Euphrates and Iraq to lose as much as 90 percent. Ethiopia is upriver of Egypt on the Nile River, and Egypt is totally dependent on the Nile for water. Although Ethiopia has never claimed rights to use the waters of the Nile before

they reach the vast reservoir behind Egypt's Aswan High Dam, such a claim could threaten Egypt's lifeline. India and Nepal want to exploit the Ganges-Brahmaputra basin's huge hydroelectric power-generating potential, while Bangladesh wants the water managed in a way that will minimize flooding during monsoon months and water shortages during dry months. Of equal concern are water conflicts between states in India that share river basins.

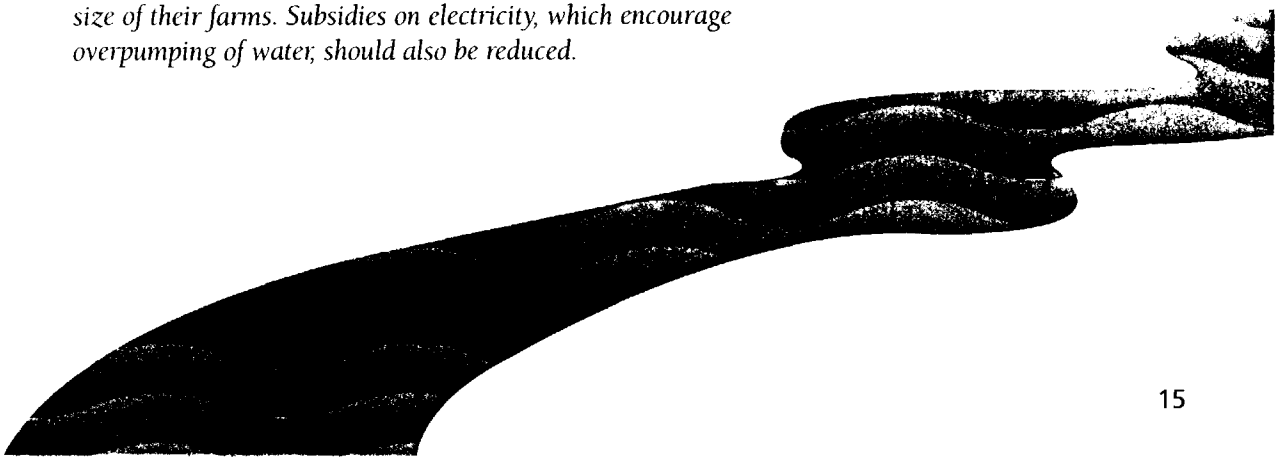
Excessive water use harms the environment. Between 0.3 and 1.5 million hectares of land are lost each year worldwide from waterlogging and salinization that result from overuse of water and leakage from irrigation canals. In Pakistan, salinization of soils makes some areas of once fertile land look like they are covered in snow. Because of the great costs involved in recovery of affected land, severe salinization is essentially irreversible.

Agriculture is the largest user of water in developing countries, accounting for an average of 80 percent of the water used. But most current government policies affecting water use encourage waste. In many areas, urban and rural water users receive massive subsidies. Water for irrigation, the largest use, is essentially free. With water provided by public systems at little or no cost to the user, there is little incentive to conserve. As a result, water is wasted and scarcities result.

Water scarcity could be prevented through water policy reforms. Such reforms include establishing secure, legal rights to water use and transferring management and ownership of water from government to private associations made up of farmers. Creating water rights among water user associations encourages farmers to use only what they need and sell what they do not need. Adopting such an approach, Chile has completely turned over its water companies to private control.

"A market solution can make a great contribution to solving water scarcity in the future and can make investments in water infrastructure more cost-effective in the present," says Renato Gazmuri, former secretary of 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 investment of about US$400 million in new irrigation infrastructure would have been required to generate such water efficiency gains."

Achieving the 2020 Vision will require reform of water rights and water laws, improved procedures for dividing water between groups in society, stronger incentives to use water appropriately, technological advances to make water supply and delivery to farmers more efficient, and better international cooperation in the sharing of water. Countries should reduce subsidies on water so that water's price better reflects its scarcity and should charge farmers based on the volume of water they use instead of on the size of their farms. Subsidies on electricity, which encourage overpumping of water, should also be reduced.



Filling the Pantry with the Help of Roads, Markets, and Trade

It was hard for the farmers from the small, highland village of La Lima, Honduras, to transport their produce to markets outside of their village before 1985. The capital city of Tegucigalpa was less than 30 kilometers away as the crow flies, but the trip often took six hours or more. Farmers occasionally made this long trip by truck to transport vegetables, such as onions and potatoes, to market, but the dirt road was impassable when it rained. The village of about 500 people mainly sustained itself by growing subsistence crops and a limited amount of vegetables for sale.

In 1985, an all-weather road was built between Tegucigalpa and a nearby town, reducing the trip from La Lima to the capital to only 40 minutes and dramatically lowering the costs of transporting produce to the city. This made it feasible for the farmers to grow more perishable vegetables like tomatoes, zucchini, squash, and green beans. These vegetables were much more profitable than potatoes, particularly when grown off-season, and soon a thriving commercial vegetable industry grew. Because the farmers had more money, they could invest more in their farms, constructing small-scale irrigation and taking measures to improve the soil, such as leveling the land, clearing rocks, and adding manure and fertilizers on small plots. Most farmers gradually stopped growing maize on the steep hillsides and concentrated on growing staple foods and vegetables on higher-quality, smaller pieces of land. This change in farming practice decreased hillside erosion and reduced the pressure to clear forest land.

Access to good roads, credit, fertilizer, and other agriculture-related components influence the cost of farming and, therefore, the cost of producing food. Reducing food production costs can lead to lower prices for consumers, or to increased profits for farmers, or both.

When food prices are low, more poor people can buy food, and hunger is reduced. But in many regions, such as in La Lima and especially in Sub-Saharan Africa, the costs of food marketing—the process by which crops leave farmers' fields and are transported to food processing plants or to markets to be sold—are extremely high. Of these food marketing costs, high transportation costs, caused by poor roads, high gas prices, and high automotive maintenance bills, can prove to be major inflators of food prices.

"Lowering marketing costs to farmers through improved transportation infrastructure and marketing facilities may be as important in lowering food prices to consumers as increasing food production," says Victoria Sekitoleko, subregional representative for southern and eastern Africa of the Food and Agriculture Organization of the United Nations (FAO) in Harare, Zimbabwe.

Another inflator of food prices is a lack of effective competition in agricultural markets. In recent years, many Eastern European and developing countries have moved away from state-controlled agricultural markets and toward reliance on private firms that operate in free markets. These reforms are greatly needed but must be undertaken with care. In some cases, inefficient public sector organizations are being replaced by oligopolistic or monopolistic private firms, which, for example, might agree to charge the same high price for trucking produce from farmers' fields to market. Such a lack of effective competition in agricultural markets could result in higher food prices or lower incomes for poor farmers. Governments have an important role to play in ensuring that "free" markets remain competitive.

Governments must also pay close attention to the order in which they implement specific market reforms. Each change in how the market operates will have wide-ranging spin-off effects and, if not implemented correctly, could wreak havoc in the marketplace instead of effectively reforming markets.

Countries must seek to make economic reforms that better link them with the world economy, particularly as more and more trade barriers are broken down in a global trend toward freer trade. The rapid growth of world trade and increased integration of developing countries into the global economy since World War II have changed the nature of the development process. No country can develop in isolation. Increasing international trade on both a regional and a global scale would offer benefits to most developing countries.

However, for the low-income, food-importing countries, global trade liberalization and reduced agricultural subsidies in developed countries are a mixed blessing. Poor countries gain from increased access to developed-country markets, but they are less able to compete in those markets than other, better-situated developing countries. And in the medium term they lose from the higher food prices that may result from cutbacks in agricultural subsidies in developed countries.

Achieving the 2020 Vision will require countries to lower the cost per unit of food by lowering what it costs to grow and market food. Countries must improve the sequencing of market reforms and strengthen the capacity of government to perform its appropriate functions. They must invest more in improving and maintaining transportation, infrastructure, and marketing facilities, and they would do well to pursue increased regional and global trade liberalization in a manner that benefits the poor.

Hunger in a World of Plenty

Abdul Karim and his wife, Ayesha, and three children live in Puthimari village of Chilmari Thana, one of the most distressed areas of Bangladesh. The family's one-room house, with a straw roof and walls made of bamboo and kash*—a kind of tall, wild grass—is too small. It is clear from their skeleton-like features that the family lives in extreme poverty and suffers from malnutrition.*

Two days ago, Abdul worked on a neighbor's land, weeding his radish field. The neighbor gave him 5 taka (about US$0.12) and a meal of rice and dal (lentils) in return for a whole day's work. Yesterday, Abdul went to him again, but the neighbor offered him only 3 taka and a meal, probably because Abdul was so weak. But Abdul accepted and worked from morning until evening.

Abdul spent his 8 taka buying about a kilogram of wheat. Ayesha has not crushed the wheat to make atta *(whole wheat flour) for bread. Instead she soaks the wheat in salt water and then fries it in an earthen pot. The wheat becomes hard and brittle, almost inedible. The wheat is all the family has for today's and tomorrow's meals. If Ayesha made atta from the wheat, she could make only a few* rooti *(pieces of bread). The children are so hungry that they would consume the easy-to-eat* rooti *too fast and soon cry for more, which she does not have.*

Instead, she makes the meal from uncrushed wheat so her children will chew it for a long time.

Until last year the family had some land on the riverbank and produced enough rice to feed themselves. Then one day their eroding and unstable land suddenly collapsed into the river. Except for the house, the family has nothing left. Last month, Ayesha sold her gold nose pin to a neighbor for one-fourth the price her husband paid for it. With that money, the family bought some rice and wheat.

Abundant food in industrial nations often produces complacency among world leaders and the public concerning hunger in developing countries. However, hunger such as that experienced by the Karim family can only be relieved by raising incomes so that families are able to purchase food they cannot grow. One of the most viable ways to spur income growth in developing countries is through increased agricultural production. Research shows that each dollar earned from agricultural activities generates one dollar or more of spending outside the agriculture sector. With their extra farm-related income, people buy goods such as radios, clothes, bicycles, and services such as health care and education. This spending on items not related to agriculture helps to generate jobs and economic growth throughout the country.

When developing countries rely on surplus food from wealthier nations, they do not gain the advantages that agricultural production can offer. Since the early 1980s, food production increases have fallen short of population growth in more than 50 developing countries, especially in Sub-Saharan Africa. Most of these are

low-income countries, with limited capacity to buy the food to fill the gap between what they grow at home and the populations they need to feed.

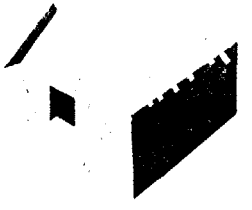
"Having enough food on a global basis does not solve the problem," says James Gustave Speth, administrator of the United Nations Development Programme (UNDP). "The problem is that the poor do not have the income to buy food, whether or not it is available in local markets or in world markets. Developing countries should not strive to become self-sufficient in their own food production, but rather self-reliant. They must be able to import the food they can't grow themselves and must use agriculture and other methods of firing up the economy so that they have the incomes to purchase the food needed by their people. What are needed are broad-based approaches to agricultural development and natural resource management that not only provide more food, but also generate sustainable livelihoods and increasing rural incomes. Food prices must also continue to be lowered through reduction in the costs of producing food."

"We need to improve the distribution of existing food supplies so that we don't have food surpluses in one part of the world and people starving in another part of the world," says Elizabeth Dowdeswell, undersecretary general of the United Nations Environment Programme (UNEP). "Farm subsidies and internal market restrictions, which all play a role in obstructing food from getting to where it's needed, must be examined."

These actions will be particularly important in the coming years as economic growth in poor pockets of the world, particularly Sub-Saharan Africa and South Asia, lags behind that in wealthier areas, which will continue to enjoy food plenty. If investments in agricultural research and infrastructure are maintained at the already reduced levels of the 1980s, wealthy countries and rapidly growing developing countries, mainly in Asia, will have food surpluses or the ability to import food at low prices.

But in South Asia the gap between production of and demand for cereals is forecast to widen from 1 million tons in 1990 to 24 million tons in 2020. In Sub-Saharan Africa, this food gap is expected to triple to 27 million tons in 2020. Sub-Saharan Africa, in particular, is unlikely to be able to commercially import the difference between its food needs and production. In the past, policymakers have turned to food aid to make up the difference. In the future, however, less food aid will be available because of provisions adopted in the General Agreement on Tariffs and Trade (GATT). These provisions call for countries to reduce domestic subsidies to agriculture and will thus lower surplus agricultural production in industrial countries, making grain stockpiles from which food aid comes more scarce.

Achieving the 2020 Vision will require increasing agricultural productivity and reducing the costs per unit of food produced in countries and regions where people are food insecure and hungry. This can be done through investments in agricultural research and efficient, low-cost, effective ways of producing food. In addition to increases in food production, reductions in the costs of marketing, distributing, storing, and processing food are needed. To spur growth in production of the major foods, countries must invest in yield-enhancing research and technology and reductions in pre- and postharvest losses.



Getting Agriculture off the Pesticide Treadmill

Jorge Castillo is a bean farmer living in the Chota River Valley in northern Ecuador. He sprays his snap and dry bean crops with insecticides on a regular basis, on the advice of the representatives of pesticide companies who visit him frequently. "Voy a bañar el cultivo" (I am going to bathe the crop), say he and his neighboring farmers when they head to the fields to apply the insecticides. Castillo sprays against greenhouse whiteflies, leaf miners, and pod borers. He is especially afraid of whitefly damage, which devastated his crops in the late 1980s. He sprays on a calendar basis, often every three or four days, regardless of pest damage or pest prevalence. Occasionally after spraying he suffers from nausea, tremors, and excessive sweating.

Pre- and postharvest losses of crops due to pests are enormous in developing countries. The U.N. Food and Agriculture Organization estimates that, in developing countries, pests, weeds, and disease destroy about 40 percent of crops while they are still in the fields and 6 to 7 percent of crops after harvest. In Africa and Asia, preharvest losses are estimated at 50 percent of crops, according to the latest research. These alarming losses must be reduced if an increasing world population is to be fed largely from existing farmland.

However, past practices of pesticide use cannot be sustained. Farmers such as Jorge Castillo are part of a 42-fold global increase in pesticide use since 1945. Today, 2.5 million tons of pesticides are used. These pesticides cause a range of severe health and environmental problems. In many developing countries, there is little education and training about the health risks of pesticide use, resulting in enormous exposure to chemicals, not only by the farmer, but also by the farming household. Some countries do not have laws to govern the importation, use, and disposal of toxic chemicals. In those countries that do have laws, governments frequently cannot enforce them.

A recent study by the International Rice Research Institute (IRRI) found that the costs of health problems from spraying pesticides far outweighed the advantages of using them. "When health costs are added into the profit-loss equation of rice farmers, the total cost of using pesticides goes up," says George Rothschild, director general of IRRI. "The value of crops lost to pests is usually lower than the expense of treating pesticide-caused ailments."

Pesticides also damage the environment. "Pesticides are not only toxic to humans, they can be toxic to the ecosystem," says Henry Kendall, a Nobel laureate, chair of the Union of Concerned Scientists, and an expert on environmental issues. "They can contaminate soils and water and have suppressed species of animal life in certain areas where there has been intensive spraying. Ironically, pesticides can make pest infestations of crops much worse. They often kill off natural predators of pests, and this can cause

pest resurgence. To limit such damage, pesticides must be used sparingly and carefully, with full knowledge of their effects, and eliminated where possible."

When pesticides are used in great amounts or the same agent is used year after year, pests develop resistance to the chemicals, which then lose their effectiveness. Farmers use more and more chemicals to kill off the same pests in a vicious circle known as the pesticide treadmill. Pesticides can also kill off a primary pest that may be keeping an unknown secondary pest in check.

Environmentally sound alternatives to pesticide use must be developed and adopted by countries around the world. Integrated pest management programs, which rely on natural predators, host-plant resistance to pests and diseases, naturally occurring pesticides, and minimal use of chemical pesticides, should be promoted as central pest management strategies. Countries should also seek to remove pesticide subsidies, which encourage hazardous overuse of pesticides.

Countries that have adopted integrated pest management practices have been able to preserve natural resources without slowing food production. In the Andean regions of Colombia, Ecuador, and Peru, a recent study by the Centro Internacional de Agricultura Tropical (CIAT) has shown that bean farmers there could reduce their insecticide use by as much as 70 percent through integrated pest management without lowering crop yields. Indonesia's integrated pest management program, adopted in the late 1980s, actually increased rice yields.

"In the 1980s, we had several setbacks in agriculture. The most important one was the onslaught of pests and diseases," says Indonesian Minister of Agriculture Sjarifuddin Baharsjah. "Nevertheless, we have shifted away from the use of pesticides—reducing their use by 50 percent since 1988. 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 the friendly ones. 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."

Achieving the 2020 Vision will require countries to adopt more environmentally sound alternatives to pesticides such as integrated pest management. Governments must remove pesticide subsidies, increase investments in research on environmentally sound alternatives to chemical pesticides and facilitate private sector investments in this area, and train research and extension staff and farmers in new, environmentally sound pest-control techniques.

Replenishing the Soils of Africa

Ousmane Kabreogo and his wife, Mariam, live in the Central Plateau region of Burkina Faso, where they farm poor land under conditions of frequent drought. On their plot, part of a larger piece of farmland controlled by Ousmane's extended family, Ousmane and Mariam plant mostly sorghum and millet. Their farming practices are basic; they use seed that they keep from their own harvest and cultivate their land with a hoe. They cannot afford fertilizers, which are usually not available in the nearby village anyway. Nomadic herders graze the remains of their crops with cattle, and the manure provides the only significant source of nutrients for their soil. To improve the soil, the elders of Ousmane's family leave part of the larger family farm fallow each year, but the piece left fallow is becoming smaller over time as the family and its food needs grow.

Ousmane and Mariam know that their low sorghum and millet yields are likely to decline within a few years because they are not able to replace enough soil nutrients. Like many of their friends and neighbors, they are already thinking of abandoning their farm and moving south to settle in a higher-rainfall area. They fear, however, that it may be difficult to find land if they leave.

In parts of Europe and North America, farming areas are plagued by the overuse of fertilizers and their resulting runoff into lakes, rivers, and streams. But in many developing countries, the problem is not excessive but insufficient use of fertilizers. Across Sub-Saharan Africa, farmers such as Ousmane and Mariam are mining their soils of essential nutrients mainly because fertilizers there are scarce and expensive. But the practice has detrimental effects on the long-term viability of farming systems and food security. Just as the human body begins to die when it is deprived of nutrients, soils cannot sustain plants without being replenished with nutrients after each cropping cycle. Nutrients need to be restored to soils either through locally available organic materials or through the use of chemical fertilizers.

"Without a doubt, the single most important factor limiting crop yield on a worldwide basis is soil infertility," says Norman Borlaug, who won the Nobel Peace Prize for developing Green Revolution varieties of wheat. "Until soil fertility is restored, improvements in crop cultural practices and varieties will improve yield only marginally. Many political leaders and economic planners fail to understand the necessity of making large investments in fertilizer."

Achieving the 2020 Vision will require a substantial increase in the use of mineral fertilizers in developing countries. Countries must seek to make fertilizers cheaper and more accessible to farmers, particularly in Sub-Saharan Africa. Organic sources of nutrients should also supply a larger share of plant nutrients in the coming years.

World Fisheries in Crisis

His back to the beach, Massamba Diop scanned the horizon for signs of the fleet. The gaily painted wooden boats were nowhere to be seen. Too old to go out with the younger men, he had been standing in the same spot on the shore since noon. When he was still captain of his own boat a decade ago, he had left at 4:00 A.M. and returned with a full catch of fat sea bream and grouper well before the noon prayer, as all the men had done as long as any in the fishing village just north of Dakar, Senegal, could remember. In the past few years, his sons would leave the previous night and only return at dusk. The boats were having to go farther and farther offshore, even as the catch shrank dramatically. His youngest son, Matar, had returned home yesterday after 24 hours of hard labor in another man's boat with only a few thin sardines to show for his labor. No one else had done any better on that day.

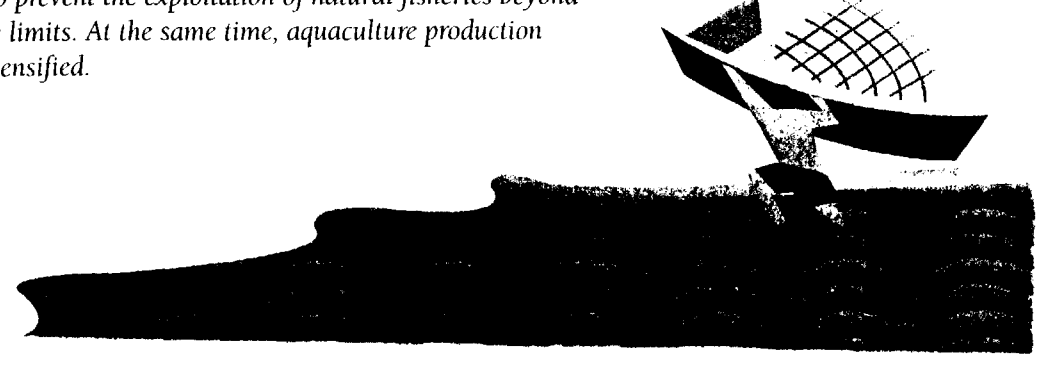
Massamba worried about how his people could possibly compete with the high-speed trawlers from the north with their huge nets and modern equipment, and he worried about possible collisions. Massamba also feared that the boats one day would be caught too far offshore by a storm. Their decrepit outboard motors, which no one now had the money to maintain, might not be powerful enough to keep the boats from being swept outto sea. Indeed, several men on the coast had lost their lives this way last year.

Beyond the narrow confines of Senegal's coast, there are increasing signs that the world's fisheries are in crisis, threatening the future of small-scale fishermen such as Massamba Diop, his local customers, and the supply of fish around the world. Following a period of rapidly expanding harvests from the oceans, more than a quarter of the 200 main marine fisheries worldwide are damaged, while another two-fifths are fully exploited. Resource management has failed to restrain fishermen from exploiting natural fisheries beyond sustainable limits. As fisheries collapse in many parts of the world, international disputes over fish stocks increase.

Twenty-five of the world's main fishing powers signed the United Nations Convention on Highly Migratory Stocks and Straddling Fish Stocks in New York in December 1995. This and the earlier U.N. Law of the Sea are designed to begin the long process of regulating access to the oceans before they are further damaged. However, the process is only beginning, agreement is not universal, and many complex policy and technical issues remain.

"Fish is a critical food supply for the world's poor," says Meryl Williams, director general of the Philippines-based International Center for Living Aquatic Resources Management. "Over 950 million people rely on fish for more than one-third of their animal protein. To meet the future demand for fish, the world will have to rely far, far less on natural stocks from the open oceans and more on aquaculture. We need better managed fisheries and selected breeds of fast-growing fish."

Achieving the 2020 Vision will require the development of measures to prevent the exploitation of natural fisheries beyond sustainable limits. At the same time, aquaculture production must be intensified.



From Rice to Big Macs: Diet Changes and Global Food Markets

Seung Kyung Lee, a manager in a department store, her husband, Young Chul Lee, an engineer, and their 13-year-old son, Chul Soo, are eating dinner at the old family farm in Hampyung village, 100 kilometers from their home in the center of Seoul, Korea. Grandmother Eun Yun has made them the traditional meal of rice and several varieties of vegetables, along with kodungo fish. Seung Kyung reflects on how different her son's life is from her own childhood on the rice farm. When she was growing up, the family ate lots of rice and vegetables. The only time they ate meat was when the family killed a chicken from their own stock on a special occasion such as Chu Sok, the harvest festival. But today, living in Seoul, Seung Kyung serves a meat dish almost every day, choosing from among dozens of kinds at the supermarket. The family's diet now includes bread as well. And Chul Soo loves to eat Western-style fast food. Seung Kyung enjoys the greater variety of dishes, but she worries about her overweight son's health.

In the next 25 years, the world will be challenged to produce enough food to meet more diverse food needs due to urbanization, rising incomes, and changing lifestyles. As more people, such as Seung Kyung and her family, move from the country to the city, their food preferences change. Cities generally offer wider choices of foods in markets, exposure to the foods of other cultures, emphasis on foods that take less time to prepare such as processed foods, and a sedentary lifestyle that requires fewer calories. People moving into cities often begin to eat more meat and fewer traditional grain and root dishes.

The future global demand for meat is expected to outstrip the demand for cereals. Meat demand is projected to grow 75 percent between 1990 and 2020, while the global

demand for cereals is projected to increase 56 percent during this same period. Because of more rapid population and income growth, market demand for foodgrains and livestock products is expected to grow much faster in developing countries than in developed countries. Developing-country imports of meat are expected to increase 20-fold from 1990 to 2020.

Asians are eating more livestock products and are shifting from rice to bread, pasta, and other wheat products. As Japanese society became more urbanized and Westernized during the last three decades, consumer tastes changed dramatically. The consumption of rice in Japan fell 40 percent per person from the early 1960s to the early 1990s, and the demand for meat went up 360 percent per person. If such shifts took place in China, home to one-fifth of the world's population, the impact on world grain markets would be tremendous. China's urban population is expected to double between now and 2020, which will surely boost demand for meat and dairy products. For China as a whole, meat consumption is predicted to triple from 1990 to 2020.

"If the rest of Asia, including China, changes its dietary patterns so that they are similar to those of Japan, this will put enormous pressure on the future food supplies of Asian countries," says Lester Brown, president of the Worldwatch Institute. "An increased demand for meat will place strong pressures on the livestock industry and, indirectly, on feedgrain production. This could require huge increases in both grain and meat imports."

Many worry about whether the world will have enough grain in the coming years to feed the animals that people eat. However, research shows that technological advances will continue to push down the amount of feed needed to sustain healthy livestock, or "feed conversion rates." With less grain needed to feed each animal, the rate of increase in demand for feedgrains should slow, reducing pressures on grain production.

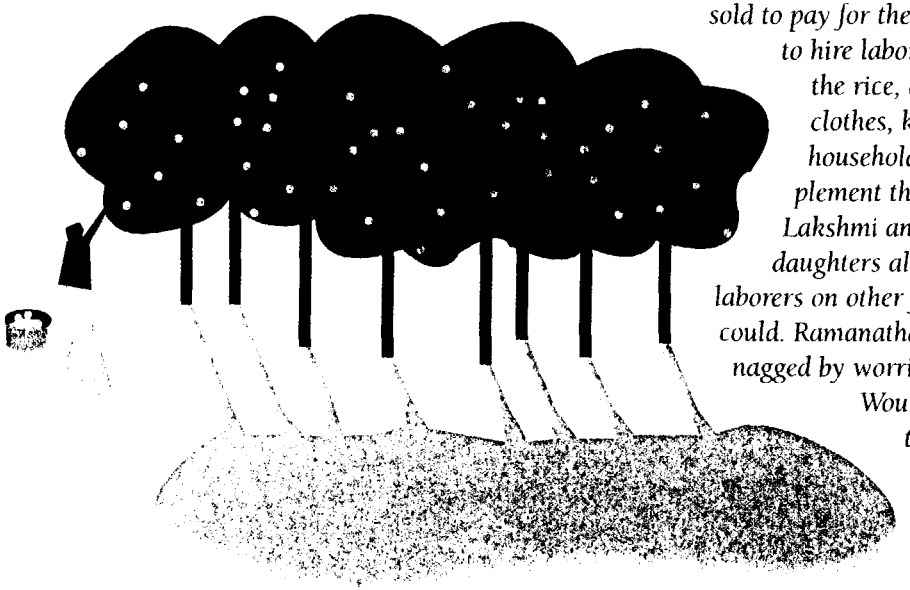
No matter how the world's increasing appetite for meat is satisfied, urbanization and the accompanying more sedentary lifestyle, as well as diets that include more animal fat, sugar, and processed food, will lead to more obesity. Obesity is closely associated with chronic diseases, such as heart problems, diabetes, and hypertension. Significant increases in obesity have occurred in all regions of the developing world since 1957. The prevalence of obesity increased 8.4 percent overall and rose even faster in China, where obesity went up in both rural and urban areas during the 1980s. Developing countries must examine these trends and seek to avoid the problems that more meat-oriented diets have produced in developed countries.

"As people change their diets from being vegetable based to being animal fat based, the problem of obesity worsens," says Professor Chunming Chen, president of the Chinese Academy of Preventive Medicine. "This has certainly been the case in China. There is an urgent need for government policy and nutrition education to prevent undernutrition from becoming overnutrition among the Chinese people."

Achieving the 2020 Vision will require countries to educate their people about the health effects of diet and lifestyle changes. Countries must also slow the increasing demand for feedgrain for livestock by improving feed conversion rates (the amount of feed needed to produce each unit of animal product).

Feeding the World in 2020 Through a New Commitment to Aid and Research

In the early 1970s, Vellore Ramanathan and his wife, Lakshmi, were poor farmers living in the North Arcot region of South India, where Hindu temples dotted the landscape and vibrant green crops grew in vast tracts during the monsoon season. They grew rice and groundnuts (peanuts) and were trying to support Ramanathan's mother, three daughters, and one son on one hectare of land. Most of the rice and groundnut crops they grew were consumed by the family, but enough was sold to pay for the upkeep of the farm, to hire laborers to help harvest the rice, and to buy food, clothes, kerosene, and other household essentials. To supplement the family income, Lakshmi and the two older daughters also worked hard as laborers on other farms when they could. Ramanathan was constantly nagged by worries about the future. Would the family be able to eat and survive each year on its scant income? If another drought came, how would the family cope? How would he find dowries for the marriages of his quickly growing daughters? How would he be able to provide land for his son, who wished to marry and remain in farming?



One day the extension workers in the area told Ramanathan and Lakshmi about a new kind of rice. They called it "IR20" and said it yielded more and grew faster than what farmers in the area were currently using. It was hard for Ramanathan and Lakshmi to consider changing seed varieties. If the seeds failed, the family might go hungry. Yet they began to see other farmers adopt the new rice, and these farmers told them of great harvests in a short amount of time. Finally, they planted the seeds and saw their harvest go up from 1,800 kilograms of rice per hectare to 2,800 kilograms of rice. They marveled at their good fortune. Because the new rice variety grew so rapidly, they were able to grow an extra crop each year with the help of irrigation water from their well.

They also adopted new groundnut varieties that not only were more tolerant of poor rains, but also increased their yield from 1,100 kilograms per hectare to 1,700 kilograms. Because neighboring farmers began to need more labor to help with their bountiful crops, Lakshmi and her two older daughters were able to earn twice as much income as laborers. Ramanathan and Lakshmi gave some of their land to their son while increasing their total rice production on their own smaller parcel of land. By the end of the decade, Ramanathan and Lakshmi's total rice production was double what it had been 10 years earlier.

Two millions of farmers such as Vellore Ramanathan and his wife, Lakshmi, the "Green Revolution" of the 1970s brought high-yielding crop varieties, especially of rice and wheat, increased irrigation, expanded use of chemical fertilizers and pesticides, and better agricultural policies. It largely prevented famines and starvation that were predicted for much of Asia at the time. Asian cereal production rose by a third, mainly driven by a large jump in cereal yields. Wheat production alone grew by 70 percent.

This remarkable advance in Asia's food production came about through the hard work and commitment of scientists and farmers, supported by enlightened national policymakers and international donors. By 1980, the number of people who were hungry in East and South Asia had declined by more than 100 million.

Today, hunger and malnutrition persist in many parts of the world. In recent years the promise and methods of the Green Revolution have been questioned for a variety of reasons—from disenchantment with some of the environmental consequences of overuse or misuse of Green Revolution technologies to concerns about the difficulty of extending the Green Revolution to Africa.

"Bilateral and multilateral assistance to agriculture is in decline," says Klaus Winkel, head of the Department for Evaluation, Research, and Documentation at the Danish International Development Agency (DANIDA). "If national and international institutions cut back further on public investments in agricultural research, health, nutrition, and education, the relatively favorable world food situation could significantly worsen. The current high food prices could become permanent, and the number of malnourished children will increase. The same commitment to agriculture that was exercised during the Green Revolution is urgently needed today. We would like to see many more donors join the small group of donors, such as Denmark, that have increased their investments in these areas."

Aid to agriculture, which helps strengthen the farm-dominated economies in many developing countries, actually contributes to the donor country's own prosperity by increasing the amount of food and other products that recipient countries buy on the world market. In fact, each dollar invested in research on agriculture in developing countries generates four dollars of additional imports by these countries, which make up the largest potential market in the world.

Just like international aid agencies, many low-income developing-country governments are grossly underinvesting in agricultural research in their own countries compared with industrial countries, even though agriculture accounts for a much larger share of their employment and income. Their government expenditures on agricultural research are typically less than 0.5 percent of the value of agricultural production, compared with about 1 percent in high-income developing countries and 2–5 percent in industrial countries.

A commitment to developing-country agriculture by both international donors and developing-country governments is lagging just when the problems are the most urgent and complex. For example, millions of people around the world live in environmentally fragile areas, which are extremely difficult areas in which to grow crops. But research on how to grow crops in these difficult areas has been neglected. Food needs must be met from more efficient use of land already under cultivation, for significant expansion of cultivated area is not an economically or environmentally sound option in most of the world. Efficient use of land can be obtained through increased crop yields, which have provided the major share of food production increases over the last 30 years.

However, this challenge will be much harder to achieve today because while crop yields are still improving, their rate of growth is slowing. The rate of growth of global grain production dropped from 3 percent in the 1970s to 1.3 percent in the 1983–93 period. "The fact that per capita food

production has been flat or possibly falling for a decade is terrifying," says Jessica Mathews, senior fellow with the Council on Foreign Relations in Washington, D.C. "Any future increases in food production must come from technology and research, not new land."

"Unless these challenges are addressed wisely and expeditiously, poverty and hunger could lead to social disruption, political destabilization, and environmental destruction," says Ismail Serageldin, vice president of Environmentally Sustainable Development at the World Bank. "To ignore these challenges is to consign over 1 billion people to lives of permanent wretchedness. This is inconsistent with any definition of human decency."

Many of the food challenges of today will have to be solved through new techniques in farming and through modern science, using the tools of biotechnology and molecular science. Scientists in these fields can speed the process of breeding plants with favorable traits such as resistance to pests and diseases or the ability to grow under difficult conditions, such as in drought or at high altitudes. One project at Cornell University is using molecular maps and markers to identify genes that could boost rice yields in South Asia by 15–20 percent. However, to date, most of the advances in biotechnology have applied to developed-country crops—from genetically engineered "Flavr Savr" tomatoes that have an extended shelf life to cotton that is resistant to the cotton boll worm.

"Biotechnology companies have been investing in the industrialized world, where profits are much higher than in developing countries," says Robert Herdt, an agricultural economist and director of the Division for Agricultural Sciences at the Rockefeller Foundation. "However, biotechnology has the potential to greatly improve human well-being in developing countries. This makes it even more incumbent on the public sector to help developing countries apply biotechnology and gene mapping in their own labs and fields."

However, new technology is only as good as the means of its dissemination to farmers. And this link has been quite weak in many developing countries. According to Speciosa Wandira Kazibwe, vice president of Uganda, "In my country, the bulk of the research findings that have been accumulated over the last 60 years are allowed to gather dust in our archives and research institutions. The challenge is to communicate the findings to the people who need this information—the farmers."

Achieving the 2020 Vision will require increased international assistance to agriculture in low-income developing countries, with primary emphasis on national and international agricultural research. Developing countries must expand support for their agricultural research systems. Financial support for the international agricultural research system must be strengthened to provide the support so urgently needed by national agricultural systems. Partnerships between research institutions in developing and developed countries should be enhanced, bringing modern science to bear on developing-country problems. More research needs to be directed to fragile areas, and public and private sector extension services must be bolstered through innovative means, such as the mass media, to better reach farmers.