



INSIGHTS

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FARMING SMARTER

THE UPHILL PUSH TOWARD
CONSERVATION AGRICULTURE

WHEN MEDICINE IS NOT ENOUGH
Food, Nutrition, and HIV/AIDS

BUILDING A FUTURE
Next Steps in Yemen

INSIGHTS

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The science of farming has moved toward more sparing and efficient use of land, water, and energy. One example is conservation agriculture, a decades-old practice that is producing benefits for the environment and profits for large-scale farmers in some countries. Conservation agriculture is an important focus of CGIAR's Cereal Systems Initiative in South Asia (CSISA). For small-scale farmers in South Asia and elsewhere, conservation agriculture, and complementary activities such as laser land leveling and agroforestry, could be an environmental and economic boon, but the hurdles to adoption are still high. This is where IFPRI researchers come in: they are looking not at the science, but at the economics of conservation agriculture, and proposing ways to make more sustainable farming economically viable even for poor, small-scale farmers. The feature article in this issue of *Insights* explains how.

We welcome your comments on this article as well as the many others describing IFPRI's current work.

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The International Food Policy Research Institute (IFPRI) was established in 1975 to identify and analyze national and international strategies and policies for meeting the food needs of the developing world on a sustainable basis, with particular emphasis on low-income countries and on the poorer groups in those countries. IFPRI is a member of the CGIAR Consortium.

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RAJASTHAN, INDIA

After collecting water from underground rainwater harvesting tanks, women begin the walk home.

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COVER PHOTO: Beans in crop rotation on a conservation agriculture trial plot in El Batán, Mexico. Crop rotation is one of the key principles of conservation agriculture.
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SUMATRA, INDONESIA
Workers load a truck
with palm oil fruit.



© 2011 J. Morgan/Panos

What's behind the Palm Oil Boom?

Is it feeding people or cars?

Scan the ingredients of your favorite candy bar and you'll likely see an oil listed that, until recently, was rarely used beyond West African and Southeast Asian kitchens. A new IFPRI discussion paper, *Revisiting the Palm Oil Boom in Southeast Asia*, helps explain why palm oil has recently caught up with soybean oil to become one of the world's most popular—and controversial—cooking fats.

Belgians introduced Indonesian and Malaysian farmers to palm oil production in the 19th century. Since then, plantations in the two countries have dominated the palm oil market, and in the past 30 years palm oil production has grown ninefold.

"It's quite clear why farmers are eager to grow oil palms: they are relatively cheap and easy to grow in tropical climates," said Guillaume Gruère, a senior research fellow at IFPRI who conducted the study with Daniel J. Sanders and Joseph

V. Balagtas of Purdue University. "What isn't clear, however, is why there has been so much demand lately for this oil as opposed to soybean oil, which is also easy and cheap to produce."



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Some environmentalists associate the rise in palm oil plantations with the destruction of tropical rainforests in Indonesia. They tie the increased worldwide demand for biofuels—fuels made from organic materials—to the palm oil boom.

In their exploratory study, however, Sanders, Balagtas, and Gruère found that

palm oil prices appear to be more closely influenced by soybean oil prices than fuel prices. Their results suggest that food—not biofuels—is most likely the source of palm oil demand.

In fact, Gruère points to recent US and European policies regulating both trans fats and genetically modified (GM) food as two possible factors behind the palm oil boom. The new policies may have induced such multinational food producers as Nestlé and Unilever to move away from soybean oil in favor of palm oil because it doesn't produce trans fats and it isn't made from GM crops.

"Insight from our study," Gruère said, "which we hope to expand in the future, could help policymakers better understand market linkages and potential unintended policy consequences as they develop new food regulations."

— Susan Buzzelli Tonassi

Crowd Cartography

Using eyes on the ground to map global cropland

How much cropland does the world have? Hard to say. Current estimates run as high as 1.7 billion hectares and as low as 1.2 billion hectares. The difference—half a billion hectares—is about five times the size of Ethiopia.

But a more precise answer may be on the way. A team of international researchers has devised a project to use the “crowd”—Internet-connected people all over the world—to develop a global map that can answer this and other important questions. According to Liangzhi You, a senior research fellow at IFPRI and part of the team behind the Geo-Wiki Project (geo-wiki.org) led by the International Institute for Applied Systems Analysis, this cropland map will be the most detailed and accurate ever.

Cropland information is fundamental, says You, like population information. Policymakers and donors can better target

their agricultural and rural development policies and investments if they know what crops are growing where.

In recent years cartographers have developed maps by combining satellite imagery with land use data. But for many areas around the globe, these maps disagree about what type of land is there. Is that agricultural land, forest, or something else? In Europe and the United States, where large-scale commercial farms are prevalent, it's relatively easy to identify cropland in satellite images. But this gets tricky in developing countries, where smallholder plots are tough to differentiate from the surroundings. “Grass and crops and bushes can be hard to tell apart,” says You.

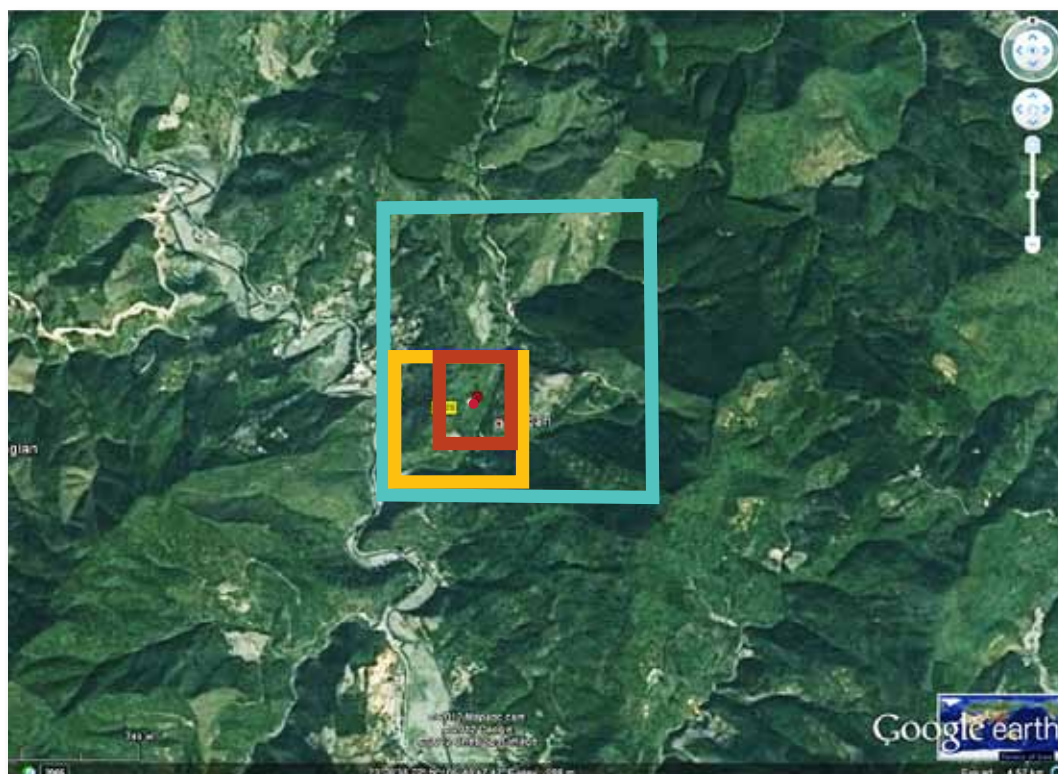
Geo-Wiki incorporates current maps into the Google Earth platform. Where the maps agree, the matter is considered settled. Where they disagree, the “crowd” steps in. Volunteers select a point on the

map to review. By examining satellite images or drawing on firsthand knowledge of the area, they resolve the discrepancy. In addition, a Geo-Wiki application for mobile telephones lets people on the ground take a picture that can be uploaded to Geo-Wiki along with GPS and orientation information.

Geo-Wiki is public, so anyone can access the site and contribute. To help motivate the “crowd,” Geo-Wiki used a recently concluded competition in which top contributors could win gift certificates and participate as coauthors of the scientific paper to be produced by the project. The project itself is ongoing so that it can capture changes in cropland over time.

“Our eyes are better than any satellite, but a satellite can circle the earth in a day. With Geo-Wiki our eyes can cover much more area,” says You.

—*Ian Johnson*



THREE MAPS, THREE ANSWERS

Land use in this area of northern Vietnam is identified in three different ways by three satellite mapping systems. The Geo-Wiki Project aims to clear up discrepancies like this.

Cropland and shrub or grass cover

Shrubland

Woody savannah

GENDER

Power in Numbers

Measuring women's empowerment

When the US government wanted to make sure its global hunger and food security initiative Feed the Future was having a positive impact on women in the countries it was serving, it called on IFPRI to help. The result is the Women's Empowerment in Agriculture Index (WEAI), an innovative tool that was collaboratively developed by IFPRI, the Oxford Poverty and Human Development Initiative (OPHI), and the US Agency for International Development.

"When we were commissioned to do this work, we were mandated to design,

develop, and test an index to measure the greater inclusion of women in agriculture-sector growth resulting from the Feed the Future initiative," explained Agnes Quisumbing, a senior research fellow at IFPRI. Quisumbing, Senior Research Fellow Ruth Meinzen-Dick, and Research Fellow Amber Peterman served as the key IFPRI researchers developing the index.

The WEAI actually comprises two indexes, both based on individual interviews with women as well as the men in their households. The first index

assesses women's empowerment in five areas: decisions about agricultural production, power over productive resources such as land and livestock, decisions about income, leadership in the community, and time use. The second index measures gender parity—that is, whether women are as empowered as the men in their households.

As Meinzen-Dick explained, most gender indexes are based on national data and do not really capture the reality that individual women face. The WEAI, in contrast, is a composite measure that indicates women's control over critical parts of their lives in the household, community, and economy, through one-on-one interviews. "It's a simple, technically robust index that gives powerful insight," she said.

Sabina Alkire, OPHI's director, is co-creator of the Alkire Foster method for measuring multidimensional poverty, which was used to construct the index. She called the index "a major advance in our ability to measure empowerment."

Piloted in Bangladesh, Guatemala, and Uganda, the WEAI is being rolled out in 19 countries hosting Feed the Future programs, where it will be used to understand the connections between women's empowerment, food security, and agricultural growth.

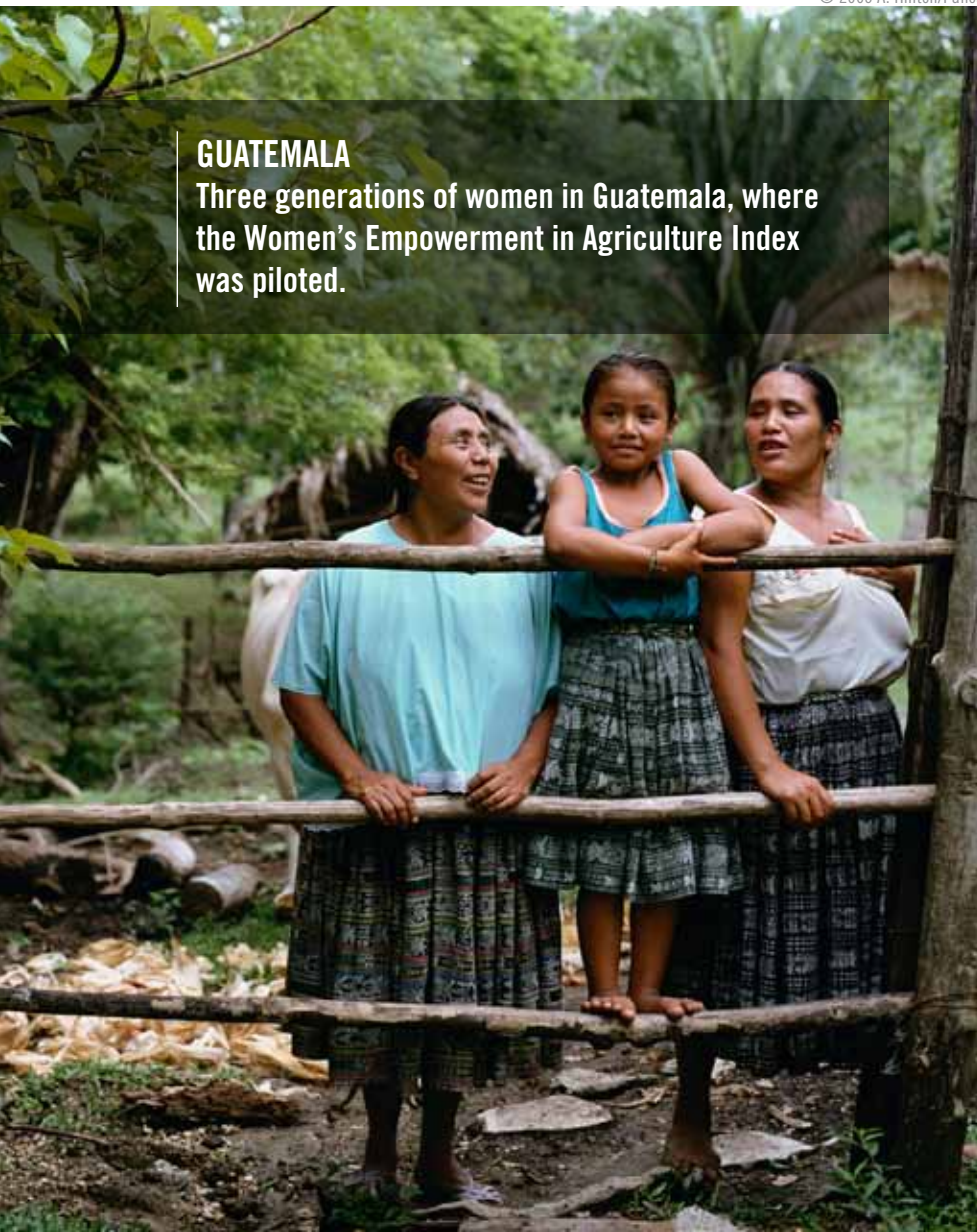
Although women make up 43 percent of the world's agricultural labor force, their yields are up to 20 percent less than those of men. By identifying women who are disempowered and the areas in which they are disempowered, the WEAI can help show program leaders where they should focus their work. Ultimately, using the index to help empower women could not only increase global food production, but also have far-reaching benefits for families and future generations.

—Marcia MacNeil

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GUATEMALA

Three generations of women in Guatemala, where the Women's Empowerment in Agriculture Index was piloted.





A Root Cause

More nutritious cassava makes its debut

NIGERIA

Yellow cassava is separated from white varieties for processing.

© 2010 HarvestPlus

Good news came to Nigeria in December 2011—that’s when three new cassava varieties, with the highest vitamin A content to date, were launched. According to researchers, these new varieties could provide Nigeria’s children and women with 25 percent of their daily vitamin A needs.

And they need the help: about 30 percent of the country’s children younger than five years old and 20 percent of its pregnant women suffer from vitamin A deficiency, which can have devastating consequences, especially for children—from increased risk of illness and disease to impaired vision, blindness, and even death.

The vitamin A cassava is a happy union between a yellow Brazilian type with high levels of beta-carotene (which is converted to vitamin A in the body) and

white African varieties that have virtually no beta-carotene. After screening nearly 100,000 cassava seedlings a year for 10 years, plant breeders, together with farmers, tested the most promising plants in 13 states across Nigeria. Three selections rose to the top.

How did researchers come to focus on this fat, fleshy root crop? Since it’s eaten daily in Nigeria by poor and rich alike, researchers realized it was an ideal vehicle to provide more vitamin A in the Nigerian diet.

More than 8 million farmers already grow cassava, which is virus resistant and high yielding. A program is now in place to deliver the new varieties to 50,000 of these farmers in 2013, says Paul Ilona, a cassava breeder who is the Nigeria country manager for HarvestPlus, which, along with the International

Institute of Tropical Agriculture and the National Root Crop Research Institute of Nigeria, has supported the work.

By putting vitamin A cassava into the hands of farmers, this ambitious program, with support from the Ministry of Agriculture, aims to get this nutritious variety onto the tables of millions of Nigerians. The crop will likely spread as farmers save stem cuttings and share them with their neighbors, as they have always done. “By mid-2014,” says Ilona, “we’re optimistic that farmers will be growing and feeding vitamin A cassava to their families, reaching as many as 150,000 people.”

There is more to come: researchers are already at work breeding cassava varieties with enough vitamin A to provide up to half of the daily needs of women and children.

—Yassir Islam & Andrea Pedolsky

DEVELOPMENT

Going Big

Lessons on scaling up development projects

By the early 1990s, after years of agricultural exploitation and unsustainable herding practices, China's Loess Plateau was a dustbowl where farmers could barely scratch out a living—except in the village of Shageduo. By replacing goat herding with walnut cultivation, Shageduo's farmers had transformed their community into a thriving green landscape. This approach looked like it could be a game changer for millions of people in the Loess Plateau, but how could it be carried out on a large enough scale?

The “pebble in the pond effect” is how Brookings Institution Senior Fellow Johannes Linn describes a common fate of small-scale development projects. A project benefits a few people, and then, instead of expanding, it stays small or even withers away. “You get a bit of a ripple, and then later you have no idea it was ever there,” he says. Institutional barriers, political constraints, and the tendency to focus on project minutia rather than the big picture stand in the way of scaling up a successful project.

More than a dozen examples of scaling up—from the Peruvian Highlands to the West African Sahel—are described in *Scaling Up in Agriculture and Rural Development: Lessons on Opportunities and Challenges for the Future*, a new set of IFPRI 2020 Focus briefs edited by Linn. The briefs, with contributions from 36 authors with expertise in areas such as biofortification, nutrition, supply chains, community development, and agroforestry, show how scaling up can be accomplished by different actors, using different approaches, in different contexts.

Linn and the other authors suggest starting a project with a clear focus on the opportunities for scaling up what works and then continually monitoring progress. This approach can help build the institutional support, effective policies, and partnerships that make scaling up possible.

The briefs, Linn explains, are not meant

to offer a blueprint. “It is an approach and a mindset,” Linn says. “I think the pieces clearly demonstrate that scaling up is not ‘pie-in-the-sky’ but something real that can be done.”

The Loess Plateau rehabilitation project, described in one brief, illustrates the point. Building on Shageduo's small-scale success, the Chinese government, with assistance from the World Bank, created incentives for change by constructing wider, more stable terraces, instituting bans on grazing, and offering farmers long-term leases on land. Although a rigorous evaluation is still needed, the project appears to be more than a pebble in the pond: it is reported to have improved the livelihoods of more than 3 million farmers.

—Justine Williams & Ashley St. Thomas

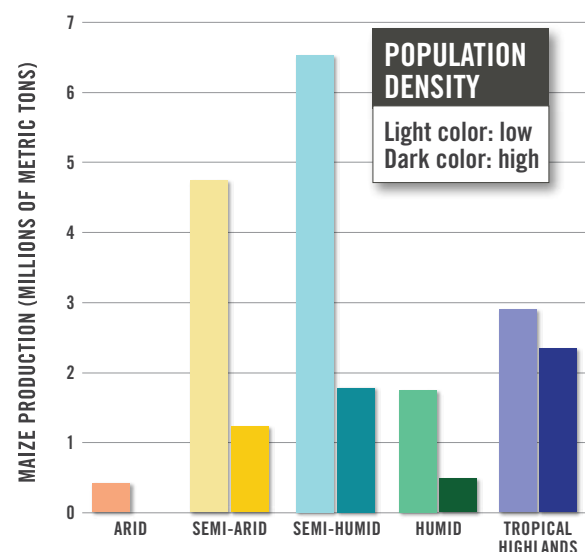
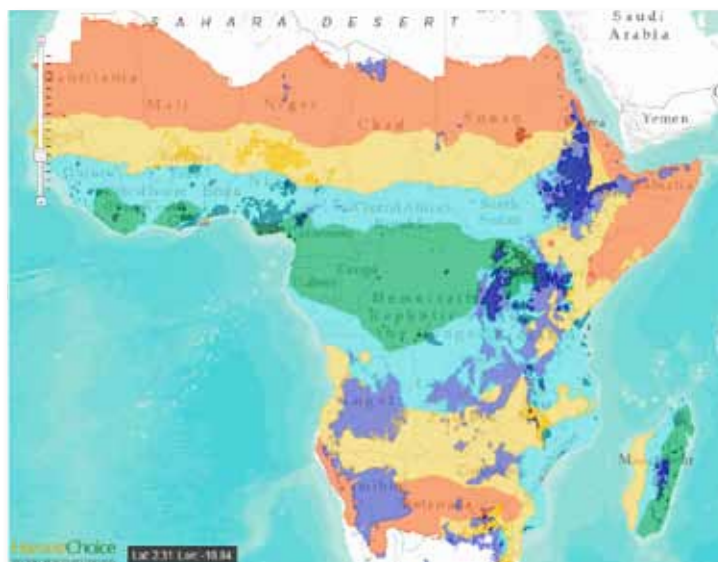
LOESS PLATEAU, CHINA

Terracing and other improvements transformed the Loess Plateau and proved that large-scale ecosystem rehabilitation projects are possible and replicable.



Mapping African Agriculture

A wealth of data comes online



LAYER BY LAYER

HarvestChoice's MAPPR tool can present many layers of data at once. The map shows five agroecological zones of Sub-Saharan Africa and areas of high and low population density within them. The graph shows total maize production in those areas. Production is highest in areas with low population density.

Data of all kinds are notoriously scarce for Sub-Saharan Africa, and geospatial data—that is, maps—on agriculture, poverty, and the environment are no exception. The IFPRI researchers in HarvestChoice, a joint program with the University of Minnesota, have therefore been busy generating new spatial data, harmonizing them with data compiled from a range of other sources, and making the entire collection available at a single website (www.harvestchoice.org), along with tools for exploring the information in creative ways.

In addition to being scarce, data to support agricultural policy and investment decisions in Sub-Saharan Africa have typically been too “coarse”—available only on a national or regional scale. “But there’s actually lots of variation within countries in terms of the environment, farming practices, and market opportunities,” says Stanley Wood, the leader of the HarvestChoice team at

IFPRI. Rainfall, soil fertility, and access to infrastructure, for example, may be quite different for communities separated by just a few kilometers. “At a finer scale,” he says, “you pick up more of the real-world variability that farmers and would-be service providers face.”

To better reveal the spatial distribution and patterns of farming in Sub-Saharan Africa, HarvestChoice created MAPPR, a tool for interacting with the core collection of detailed, high-resolution maps covering all aspects of agricultural production. MAPPR divides the continent into 10-kilometer by 10-kilometer squares, allowing users to home in on any one of 300,000 squares or to summarize indicator values for all squares in a specified watershed, agroecological zone, or market area. There are currently map layers for more than 100 indicators, including population density, poverty, rainfall, crop harvested areas, and travel time to market. MAPPR allows

users to combine indicators from multiple layers to produce customized maps, charts, and tables.

Using MAPPR, a policymaker can identify regions of a country with high concentrations of both poverty and cropland, or an investor thinking about building a food-processing plant can search for locations that combine production of sufficient quantities of a particular crop with good access to markets.

Besides maps and mapping tools, the HarvestChoice website provides datasets, working papers, presentations, and spatial and economic models—all at no cost. “We’ve built a hub of data and compatible tools,” says Wood, “so that practitioners everywhere can leverage our resources to better inform their own policy and investment priority setting and decisionmaking.”

—Cindy Cox & Susan Buzzelli Tonassi

CHINA

Talking with Jikun Huang

Jikun Huang is director of the Center for Chinese Agricultural Policy. A longtime IFPRI collaborator, Huang conducts research on a wide range of issues related to China's agricultural and rural development. We asked him about China's food economy and its role in the world food economy.

In the 1990s some people worried that demand from China would overwhelm world food markets. In fact, China was a net food exporter for most of the 1990s and 2000s. How did it achieve this?

In the early 1990s people talked mostly about grain. At that time they said that if China achieved more economic development, water resources and land for agriculture would decline, and in the long term grain production would decline. On the other hand, they said that as incomes increased, grain consumption would increase. So they concluded that China's foodgrain imports would increase significantly.

To answer the question of why it is not happening, there are a couple of important things on the production side. Grain area has declined a little bit since the early 1990s. But more important, productivity has been rising significantly—particularly yields. So production has been growing. On the demand side, as income increases, demand for foodgrain is declining, not increasing. This is because as income increases, demand for vegetables, fruits, and other commodities increases. Since the 1990s, China has not imported a large amount of grain. So it is a supply story and a demand story.

In 2008, China started to import more food than it exported. What caused this shift? Will China continue to be a net importer?

If you look at the data, the major import to China since the 1990s has been soybeans, for two reasons. One, the demand for feed is increasing as meat consumption is increasing. Soybeans are being imported largely to feed animals. Two, demand for edible oil from soybeans and other sources is increasing over time.

Indeed, it's true that since the early 2000s, China has imported food faster than before 2001. One of the reasons is that China joined the World Trade Organization to open its market. Also, China has grown its economy. As income increases, demand increases, and imports increase.

How will China meet the rising demand for meat, fruits, and vegetables by urban consumers with rising incomes?

For fruits and vegetables, China has a competitive advantage. China exported fruits and vegetables in the past, and I believe it will continue to export them in the future. China also has a competitive advantage in meat production. Most of the increased demand for meat will be produced in China. The major challenge will be the demand for feedgrain. I project that by 2020 China will import probably 20 million tons of maize, due to the increased production of livestock in China.

Why does China have a competitive advantage in these products?

Fruits and vegetables are labor-intensive products. Most of the food is exported to Japan, Korea, Europe, and China—Hong Kong, where labor is much more expensive than in China. Meat production doesn't use a lot of land; it's more of a capital investment. When it comes to crops like wheat, maize, sugar, soybean, which are land-intensive products, China doesn't have a competitive advantage.

Many countries are slowing the growth of their spending on agricultural R&D, or even cutting spending. In contrast, China's investments in agricultural R&D have been growing rapidly. Why are



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China's leaders putting so much emphasis on agricultural R&D?

China has more than 1.4 billion people. It cannot depend heavily on the world market. Given the size of the country and the resource constraints in terms of water and land, the only way to increase food production in China is to increase yields. R&D is a major tool in helping China boost food productivity. China is also heavily investing in water conservation. From 2011 to 2020, China is investing US\$630 billion in improving water conservation.

What do you think China's role in the world food market will be in the next decade or two?

One of China's major roles in the world food market is to increase domestic food supplies. The extent to which China is able to increase domestic food production will have an impact on global food prices. So long as China is able to largely achieve self-sufficiency in major commodities, it can reduce pressure on world prices. Second, China can play an important role in transferring agricultural technologies to other developing countries—particularly African countries that can easily adopt these technologies. China has developed many technology demonstration centers in Africa to show how Chinese technology can be adopted locally by those countries.

— Susan Buzzelli Tonassi

From Bartering to Bidding

Ethiopia's growing commodity exchange

Just a few years ago Eleni Gabre-Madhin was an IFPRI researcher studying market inefficiencies and institutional design in the developing world. Today she's putting that research into practice as CEO of the Ethiopia Commodity Exchange (ECX). In a new essay, *A Market for Abdu*, published by IFPRI, Gabre-Madhin explains how research informed the development of the ECX and what it took to build a well-functioning market from scratch.

In the mid-2000s, Gabre-Madhin's work on the need for a commodity exchange in Ethiopia found a hearing at high levels there. She was invited to lead the effort to design an exchange, which debuted in April 2008 under her leadership.

The ECX gives buyers and sellers of five commodities—coffee, sesame, haricot beans, wheat, and maize—the oppor-

tunity to trade with assured quality, delivery, and payment. These guarantees are unheard of in most other parts of the resource-poor developing world.

The exchange started relatively small but grew fast. In its first year the ECX traded 108,000 tons of commodities. By 2010–11 the volume had risen to 508,000 tons valued at US\$1.1 billion. The exchange's 11,200 customers buy and sell through 450 exchange members who make deals on the trading floor in Addis Ababa. The crops that are traded pass through 55 warehouses with the capacity to hold 47 million bags. Farmers can see prices at dozens of electronic tickers throughout the country.

Now Gabre-Madhin is focused on expanding the reach of the “Ethiopian model” beyond the country's borders. Over the past three years, representatives

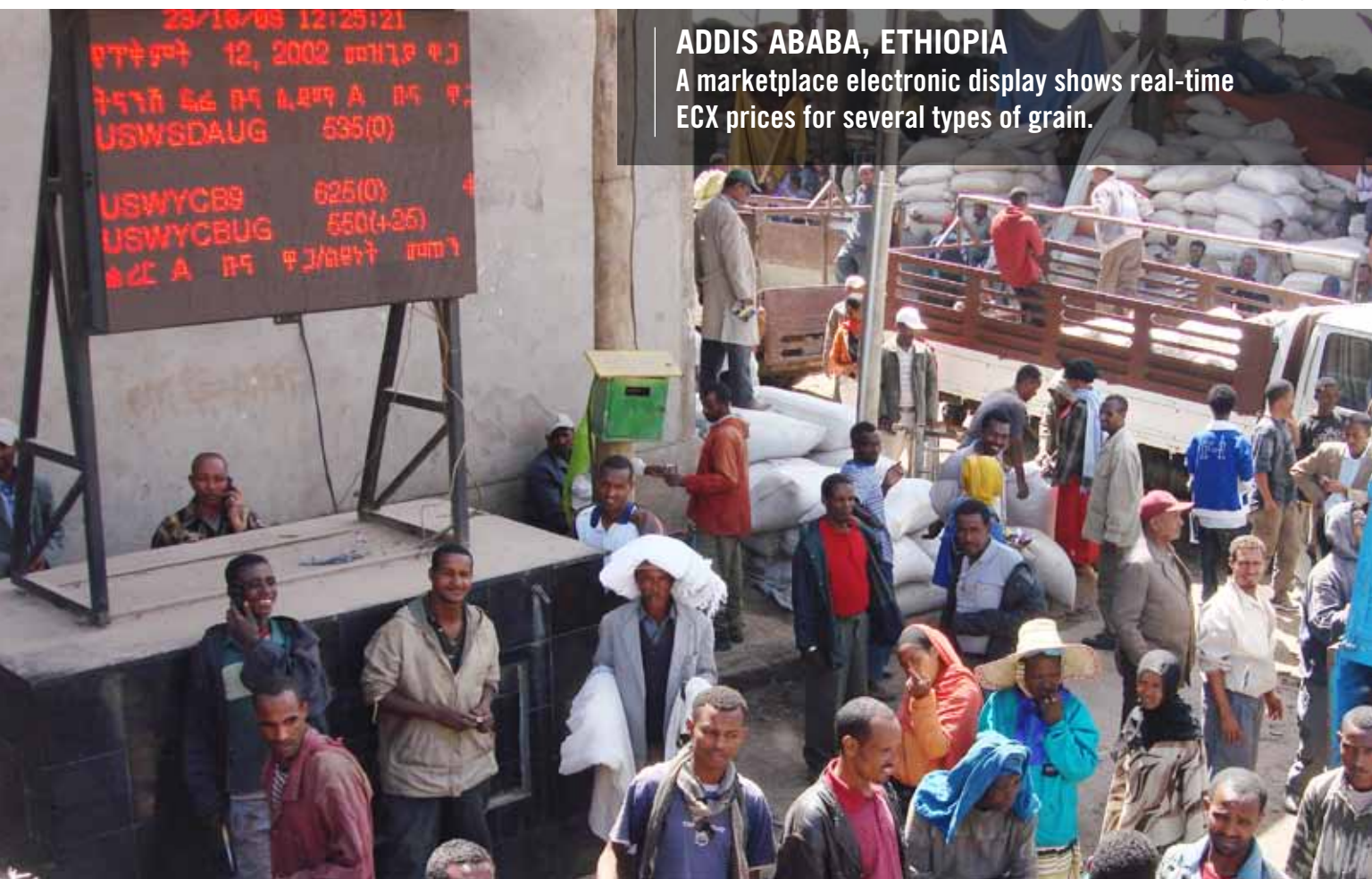
of 18 African countries have come knocking to find out how to launch a similar market in their respective countries. Representatives from Afghanistan, Haiti, and the Philippines have also taken an interest in the ECX.

These visitors, she says, represent “the whole spectrum of countries,” including those that hope to build markets from the ground up and those that have tried—but failed—to set up an exchange and want to learn from Ethiopia.

“The researcher in me is still very much part of how I have been leading the institution as a practitioner,” she said. “I think it's been very beneficial that I come into the job with a deep knowledge of both the research questions involved and the wider context.”

— Susan Buzzelli Tonassi

© 2010 ECX



ADDIS ABABA, ETHIOPIA

A marketplace electronic display shows real-time ECX prices for several types of grain.

Building a FUTURE

Yemen turns to the challenge of reducing poverty and hunger

Ian Johnson



In February, Yemen elected a new president for the first time in 22 years, following a year of street protests, violence, and political unrest. Yemen's new government marks the beginning of a new era in the country—part of the Arab Awakening—and holds the potential for greater freedom and prosperity for its citizens. But the conflict has been costly, even beyond the toll in human lives. Many Yemenis are poorer, more vulnerable, and more food insecure than they were before the uprising.

IFPRI, in collaboration with the European Union, Gesellschaft für Internationale Zusammenarbeit (GIZ), World Food Programme, and World Bank, worked with Yemen's previous government, civil

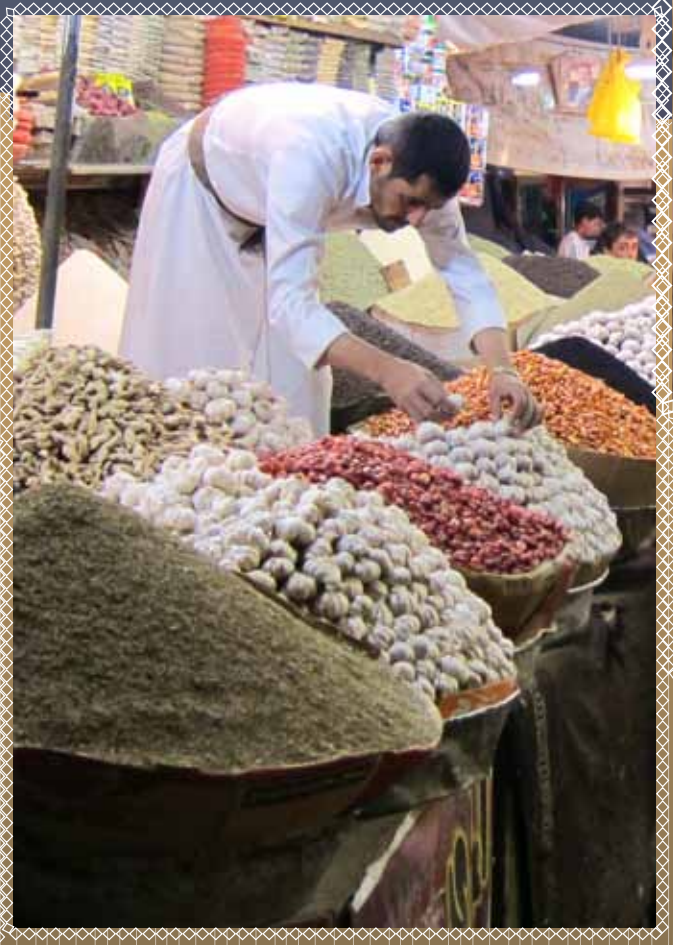
society organizations, and the private sector in 2010 and 2011 to develop a food security strategy. But the uprising came before the strategy could be implemented. Now, IFPRI is supporting the new government and its international partners in efforts to address key development challenges. Clemens Breisinger, a research fellow who leads IFPRI's work in Yemen, says, "Yemen wants to get back on track."

One severe challenge is food insecurity. The country relies heavily on food imports, making it especially vulnerable to price fluctuations in the global market. The global food, fuel, and financial crises of 2007–2009 hit Yemen's poor especially hard. As food prices increased, households struggled to meet their nutritional needs.

The global financial crisis slowed economic growth, reducing incomes and further depressing household purchasing power. In 2009, 7.5 million Yemenis, or 32 percent of the population, did not have access to enough food. Nearly 60 percent of children under five were stunted, or too short for their age, and faced possible developmental and health problems.

Around this time, the Yemeni government invited IFPRI to work with a national food security committee set up under the leadership of the Ministry of Planning and International Cooperation. Working with the committee and the ministry, IFPRI developed the Digital Food Security Atlas for Yemen, a tool for mapping and analyzing food security indicators.

IFPRI's team also helped produce a



European Union, IMF, Islamic Development Bank, United Nations, United States, World Bank, and others, to help the government chart a path forward. In preparation for the meeting, IFPRI contributed—with support from the

10 percent in 2011, and government estimates put this number even higher. The consumer price index rose precipitously between 2010 and 2011. Almost 55 percent of Yemenis are now

estimated to live in poverty, up from 43 percent in 2009. According to Breisinger, “Even getting back to pre-crisis levels may take three to four years.”

While economic and social conditions have worsened, Yemen’s political uprising may raise the country’s profile in the Arab region. Observers around the world are following Yemen’s post-conflict experience; its success will support those pushing for more political freedom in other countries, such as Syria. As Breisinger points out, “Yemen is one of four Arab countries where uprisings have initiated significant political transition processes. The better they do, the better it is for all the countries in the region.”

The international community is rallying support for the new government. A “friends of Yemen” donors meeting in May brought together major international donors, such as the Arab Gulf states,

EU, the International Fund for Agricultural Development, and the World Bank—to an assessment of the costs of the conflict, with estimates of post-conflict poverty levels and the investments needed for recovery and growth. The assessment also calls for government reforms, including those proposed in the earlier National Food Security Strategy. Yemen’s government must meet donors halfway; to ensure efficient use of donor funds, the government must improve governance and public services, push forward with economic reforms, and better target public investments.

Despite the challenges, Breisinger is optimistic about Yemen’s prospects. “It’s a country with great potential in several areas,” he says, noting the country’s strategic location on the Arabian Peninsula and huge potential for improving governance to attract private investment. Furthermore, he says, “Yemen has great potential for tourism if security improves. There are mineral resources. And it has a strong tradition of coffee growing—the word ‘mocha’ comes from a city in Yemen.” The opportunities are there—the task for Yemen is to seize the moment and bring greater prosperity and well-being to its people. 🌱

National Food Security Strategy, which called for reforming petroleum subsidies and water policies, improving food security risk management, and reducing qat production and consumption, among other priorities. (Many Yemenis chew qat leaves as a stimulant, and the qat plant uses up about half of Yemen’s scarce water resources. Getting people to consume less qat would improve public health, and cutting production would free up water for other uses.) Among the suggested measures to reduce qat consumption and production are the introduction of a qat consumption tax, awareness campaigns led by local leaders, and the promotion of alternative crops.

Last year’s protests and violence destabilized the country, and the situation now is even more dire. According to the International Monetary Fund (IMF), Yemen’s economy contracted by more than

when medicine IS NOT ENOUGH

Enlisting food and nutrition in the fight against HIV/AIDS

Jennifer Weeks

When peasant households in Malawi need extra cash, members often leave their own fields temporarily to work for wealthier families, a system known as *ganyu* labor. *Ganyu* helps rural households meet urgent needs for food, but during the widespread famine that struck much of Africa in 2001 and 2002, it took an ominous twist. Women who visited trading centers in search of food came under increasing pressure to offer sex as part of the bargain, which put them at risk of becoming infected with HIV.

IFPRI recently concluded a 10-year research program focusing on interactions between HIV/AIDS and food and nutrition security, such as these instances of transactional sex in Malawi. The Regional Network on AIDS, Livelihoods, and Food Security (RENEWAL) was designed to deepen understanding of how food insecurity and economic inequality contribute to the spread of HIV and, in turn, are made worse by HIV-related illness and deaths.

“There was a lot of research and thinking about livelihoods and food systems and agriculture in Africa, but no one bothered to mention HIV/AIDS. That was strange considering how out of control the disease was, especially in southern Africa,” says Stuart Gillespie, IFPRI senior research fellow and director of RENEWAL. “It has a huge impact on people’s ability to work, especially in labor-intensive sectors like agriculture.”

In 2001 Gillespie and his colleagues launched RENEWAL as a “network of

networks” that would link up organizations focused on agriculture, food, and nutrition with partners active in HIV/AIDS and public health. By bridging these fields, the program forged connections and broadened the scope of many HIV care programs in the region.

RENEWAL initially focused on analyzing interactions between HIV/AIDS and livelihoods, especially for communities that depend on agriculture. “Medical approaches were not yielding the kinds of results that people wanted to see. We thought that there had to be other factors placing people at risk,” said Suneetha Kadiyala, a research fellow in IFPRI’s Poverty, Health, and Nutrition Division.

To understand how agriculture may have been contributing to the spread of HIV and how it was affecting livelihoods, RENEWAL commissioned studies from local researchers in participating countries (Kenya, Malawi, South Africa, Uganda, and Zambia). One survey looked at poor households in rural Zambia and urban South Africa that were struggling with dual epidemics of AIDS and tuberculosis. It found that although these illnesses were costly in both settings, the economic burden was greater in Zambia because patients lived farther away from healthcare providers. Moreover, no local nongovernmental organizations working on

TB or HIV in Zambia provided food aid, even though TB drugs increase patients’ appetites. Households coping with TB and HIV in Zambia were thus especially vulnerable to debt and food shortages.

During RENEWAL’s second phase researchers increasingly focused on ways to help households resist HIV and cope with AIDS stresses through food and nutrition programs. Then, in 2007 and 2008, high energy prices, population growth, and other factors converged to produce a global spike in food prices.

“There was a lot of concern about vulnerability, but not a lot of focus on HIV,” Kadiyala said. RENEWAL made the connections, showing that food insecurity often causes people to move in search of food or work and to engage in transactional sex—behaviors that increase risks of contracting HIV. Additionally, people who are HIV-positive need more daily calories for adequate nutrition, so food shortages can degrade their health and speed up the onset of AIDS. For people fortunate enough to be under treatment, an adequate diet minimizes the side effects



of antiretroviral therapy and thus helps increase the chances that they will stick with the regimen.

“HIV attacks food security through many routes,” said Kadiyala. “It increases medical costs, it incurs stigma that makes it hard for people to access food through social networks, and it affects the next generation. Diet quality is a huge challenge in the context of HIV.” As the links

between food security and HIV/AIDS became clearer, RENEWAL’s emphasis shifted toward reforming policies and programs to make them more effective.

The results of the program’s work are increasingly visible at national and international levels. Kenya and Uganda now include food and nutrition security in their national AIDS strategic plans. Mozambique and Tanzania are implementing HIV/AIDS strategies for their agriculture sectors. And the World Health Organization has called for nutrition to be integrated into a comprehensive HIV/AIDS response strategy.

Agriculture, like any sector, faces major challenges in responding to shocks and stresses that originate outside its core mandate, said Gillespie. But in the early 2000s, the primary livelihood for most people living with HIV in Sub-Saharan Africa was agriculture. People’s agricultural livelihoods generated risk and vulnerability to HIV, and they were not well equipped to adapt to the sickness and death that AIDS brought in its wake. “The more we engaged with this field, the more we realized it was not enough to bring an HIV awareness into agriculture and food systems,” said Gillespie. “We also needed to bring food and nutrition into HIV policy and programming—all buttons needed to be pressed.” 🌱



RWANDA

This farmer and her family, who are all HIV-positive, receive agricultural assistance to help ensure they have enough to eat.

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SOME WORKERS IN AFRICA ARE MOVING FROM MORE PRODUCTIVE TO LESS PRODUCTIVE FORMS OF EMPLOYMENT. WHAT'S GOING ON?

Marcia MacNeil

DEVELOPMENT in REVERSE

One step in successful development is getting a country's workers to be more productive. There are two ways to accomplish this. You can make the workers within each sector—such as agriculture, manufacturing, construction, and retail—more productive. Or you can move workers from less-productive sectors into more-productive ones.

The second approach is what happened in developed countries such as the United States over the past two centuries: workers left subsistence farming and found jobs in factories and other modern, high-productivity industries. Farms became consolidated and targeted urban markets. Their workers either moved to nonfarm rural work or to cities.

Economists call this movement of labor from low productivity to modern sectors “structural transformation.”

More recently, structural transformation has taken place in China, India, and Thailand, where workers have left subsistence farming to take jobs in factories and other modern industries.

“Just about every country that has experi-

enced a sustained increase in income per capita has done so by moving its workers from low-productivity activities such as agriculture into more modern sectors of the economy,” explains Maggie McMillan, deputy director of IFPRI's Development Strategy and Governance Division.

Why, then, are some countries not experiencing this type of growth-enhancing structural transformation? For example, in some Sub-Saharan African countries, workers are going back to the farm after working in manufacturing. It's development in reverse.

McMillan and a group of her IFPRI colleagues, including Deborah Brautigam, Xiaoyang Tang, Shashi Kolavalli, Inigo Verduzco, Alan De Brauw, Valerie Mueller, and Hak Lim Lee, are examining the state of structural change in Africa, and many of their findings will appear in a forthcoming special issue of the journal *World Development*.


A CONUNDRUM

In developing countries, the gap between productivity in agriculture and in more modern sectors is extraordinarily large.

Workers in other sectors are often two to three times more productive than agricultural workers. In Ethiopia, for example, the productivity gaps are so large that if labor were reallocated to resemble the distribution of workers across sectors in the United States, output per worker would rise sevenfold.

Despite the obvious benefits of modern-sector work, labor in Sub-Saharan Africa is moving the other way. Between 1990 and 2005 workers in the region on average moved from high- to low-productivity work, and regional growth declined by 1.3 percentage points a year, according to McMillan.

Migration patterns, demographics, and globalization all provide clues about why this is happening. As a country develops, workers typically migrate from rural farming to more urban areas in search of high-paying jobs. In Africa, however, IFPRI research shows people migrating at an extremely low rate, perhaps because of policies discouraging migration,



weak social networks, low education levels, or strong family ties in rural areas.

Demographics also play a role in stalling structural transformation, McMillan says. The rural population, benefiting from improved health interventions, is growing at a higher rate than the urban population. This can stall structural transformation if the growth rate of jobs in urban areas does not also grow.

Finally, globalization, which was supposed to provide a bracing jolt of competition to make sectors more productive and efficient, can kill industries in developing countries, leaving their workers with nowhere to go but back to the farm.

TURNING THE TIDE

Some African countries have managed to move workers from agriculture to manufacturing and reduce poverty, but researchers agree that economies within Africa could be growing in a more sustainable way through structural transformation. But how?

One solution is to encourage manufacturing. According to McMillan,

manufacturing can absorb a large number of workers with moderate skills and provide them with relatively good wages and benefits. To even break into global markets for manufacturing, agro-industry, and services, however, African governments need to make these sectors internationally competitive. At the very least, this will require more clearly defined and transparent property rights and a properly managed exchange rate regime.

Another solution involves appealing to foreign investors. China, for example, has built special economic zones in Africa and Asia. “These zones have significant potential,” says IFPRI Senior Research Fellow Deborah Brautigam. “The Chinese are building infrastructure, investing in local manufacturing, and creating local employment.”

One thing is clear: African governments need to boost capacity in more modern sectors of the economy such as manufacturing and business-related services. And the time to do this is now. According to Justin Lin, chief economist of the World Bank, wage pressure in China is leading Chinese investors to expand operations overseas in search of cheaper labor. Lin estimates that millions of manufacturing jobs could be relocated from China to Africa over the next decade—if Africa is ready.

In the meantime, most of the poor in Africa are still smallholder farmers and need support to increase their productivity on the farm and transition to nonfarm, higher-productivity work. A consensus among IFPRI researchers, as well as organizations such as the International Labour Organization, calls for a holistic approach: policy action that supports smallholder farmers and industry to allow African countries to join the ranks of their global neighbors who have reached development through structural transformation. 



Measuring the Spending Gap

It's going to take a lot of agricultural research to meet the world's future food needs. So far, say Nienke Beintema and Gert-Jan Stads, we're falling short.

Heidi Fritschel

It's no secret that agricultural research is a good investment that can double and even triple yields of crops and livestock. It's also a necessary investment: global food supplies will need to rise by an estimated 70 percent to feed the world in 2050. So you might expect countries where food insecurity is high to be investing heavily in agricultural research and development (R&D). For the most part, you'd be wrong.

So say Nienke Beintema and Gert-Jan Stads of the Agricultural Science and Technology Indicators (ASTI) initiative (www.asti.cgiar.org).

ASTI is the world's scorekeeper for agricultural R&D spending, staffing, and institutional developments. Without ASTI, no one would really know how much developing countries are spending on agricultural R&D. And as Beintema says, "You can't manage it if you haven't measured it."

With a team of five people based mostly in Rome, ASTI tracks down the data on R&D spending in about 60 countries around the world, with a special focus on Sub-Saharan Africa and South Asia.

The work is painstaking. It involves surveying hundreds of agricultural research institutes, government agencies, universities, and private companies and persuading them to take the time to share their data on who is spending what and how many researchers are involved in pursuing agricultural innovation. The data are transmitted to Rome, where the ASTI team compiles and analyzes them with a network of national and international partners, and then publishes their findings. The goal is to spread the word that spending on agricultural research matters.

ASTI grew out of small, ad hoc data collection activities that began during the mid-1980s at the International Ser-

vice for National Agricultural Research (ISNAR) in The Hague. Beintema studied economics at Groningen University in the Netherlands, where she worked on comparing labor productivity across countries. "That's how I found out that I like crunching numbers," she says. After graduating she took a job at ISNAR and started working on what is now the ASTI program.

ASTI was officially established in 2001 as a joint program between IFPRI and ISNAR. Beintema became its leader and soon after hired Gert-Jan Stads, who was returning to development economics after a stint doing online media work for a Google subsidiary.

Early on, ASTI drew financial support from CGIAR and IFPRI. But its work remained small in scale until 2008, when a grant from the Bill & Melinda Gates Foundation brought in a consistent flow



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of funding and the program relocated to a new home in Rome.

“We moved the project from ad hoc data collection to a much broader scale,” says Beintema. The Gates Foundation grant allowed ASTI to start building a system to regularly monitor and analyze agricultural R&D data. For the moment, work remains focused on Sub-Saharan Africa and South Asia, but Beintema and Stads hope to secure funding to make ASTI a truly global program.

What do the latest findings show? A 2011 ASTI report on agricultural R&D spending and human resource capacity in Sub-Saharan Africa reveals that although some countries have substantially increased their investments, most countries have slowed the pace of growth in R&D spending or even made cuts. In October 2012 ASTI will issue a new global report that may show a widening gap between countries

that spend big on agricultural innovation and those that don’t.

The numbers that Beintema and Stads are seeing are worrisome. “Many developing countries are seeing rapid population growth. More mouths need to be fed, and every hectare needs to be more productive,” says Stads. “The evidence says that countries should be investing heavily in agricultural research.”

One percent of agricultural GDP is a commonly accepted target for public spending on agricultural R&D. So far, only a handful of Sub-Saharan African countries have met this target.

Why aren’t countries spending more? Part of the reason is the amount of time it takes for meaningful agricultural research. Stads gives an example: “If you invest in rice research, you may get results in about 15 years. This time frame is out

of step with election cycles and short-term political considerations.”

Another reason is that for many Sub-Saharan African countries, a large proportion of research funding comes from outside donors. “Donor money is mostly ad hoc and short term,” says Stads. A donor may support a three-year research program, he explains. Money arrives, staff is hired, and equipment is purchased. When the project ends, though, researchers leave and

equipment falls into disrepair. The work comes to a halt.

Spending levels for research are not the only concern. ASTI’s 2011 report notes that agricultural scientists, especially in West and Central Africa, are aging, and there aren’t enough young scientists being hired to replace them. In Senegal, for example, about 60 percent of researchers at major government and higher education agencies are older than 50. And new young scientists often lack postgraduate degrees—a clear signal, says Beintema, that “there’s not enough investment in education and training.”

Like any scorekeepers, however, Beintema and Stads are not in a position to win the game. They can only report to the players—governments, donors, and R&D managers—who make decisions and allocate funds. “We provide the data,” says Stads. “It’s up to the policymakers to use the data to their advantage.”



Farming Smarter

Conservation agriculture, a set of farming practices designed to reduce water use and improve soil fertility, is increasingly common on large commercial farms. The tricky part is making it work for small-scale farmers.

In a way, it was a tropical storm that blew conservation agriculture into South America. In October 1971, when heavy rains and wind hit Herbert Bartz's farm in Rolândia, Brazil, they washed away not only his crop, but also the soil it was growing in. Bartz had heard about a more sustainable way of farming known as no-till—that is, farming without plowing—and he decided to travel to the United Kingdom and the United States to learn more.

In the late 19th and early 20th centuries, farmers plowed up the prairies of the US and Canadian plains, leaving little or no organic matter, not even crop residue, to hold the soil together and conserve moisture. As a result, when drought hit in the early 1930s, the soil was blown away in destructive dust storms. After the Dust Bowl, farmers returned to farming—but instead of plowing, some innovators dropped seeds into narrow slots cut into the soil, leaving the surrounding vegetation untouched. Their farms became both more productive and more sustainable, and the method became widespread.

This is the type of farming Bartz saw on his visit. He immediately put in an order for a no-till planter of his own and in 1972 began cultivating his land without tilling it. His neighbors called him crazy—until

they saw the results. Gradually, they started to emulate him. Now, 40 years later, 75 percent of Brazil's cropland is grown without tillage, benefiting farmers' yields and profits and enhancing the health of the country's soils and water.

Today no-till cultivation is a key element in conservation agriculture and is one of many practices designed by farmers, extension agents, and scientists to make agriculture more sustainable. While these practices are increasingly used by large-scale and commercial farmers in developed and developing countries, adapting them for small-scale and poor farmers has been a harder sell.

"These are great technologies. But how do you make them work for farmers where markets are thin—where the services, inputs, and technologies aren't always available—and where farmers don't know much about them?" says IFPRI Senior Research Fellow David Spielman.

SOILS & WATER TAPPED OUT

Globally, an estimated 15 percent of land—and 40 percent of agricultural land—is degraded. That is, the land suffers from a range of natural- and human-caused problems including soil erosion, loss of nutrients, desertification, salinization, and waterlogging. As soil quality declines, crop yields take a hit.

Water resources are also under strain. Excessive and unchecked water extraction for irrigation in many countries has depleted aquifers far faster than they can be naturally replenished. According to the World Water Assessment Programme, about 10 percent of the world's irrigated land suffers from waterlogging and salinization owing to poor drainage and irrigation practices.

Much of the soil and water degradation comes from unsustainable farming practices. Farmers plow their land, for example, to prepare fields for planting, incorporate fertilizers into the soil, aerate soil, and control weeds and pests. But plowing reduces valuable organic matter in soil, disrupts the channels created by roots and worms, and increases the risk of wind erosion. On natural land where vegetation seals in soil and water, soil loss is normally very low: less than half a ton per hectare per year. In contrast, on each hectare of traditionally farmed agricultural

land, farmers lose 45–450 tons of soil a year.

“Most scientists have been working to increase yields for the last 40 to 50 years,” says Spielman. “Only recently have we seen a real awakening around the need for sustainable yields.”

FAREWELL, PLOW

In some ways, conservation agriculture mimics a natural landscape. Because soil is not disturbed and the ground is always covered with plant matter, microorganisms and earthworms do the job of “tilling” the soil and balancing soil nutrients. The permanent plant cover prevents the soil from getting too hot in tropical climates. In fact, conservation agriculture has been likened to the floor of the rainforest.

And so, in addition to retiring the plow, conservation agriculture requires permanent ground cover—usually residues from the previous

season's crop—and regular crop rotation. The crop residues add organic material to the soil, help retain moisture, and protect against erosion from runoff. The rotation of crops—particularly legumes—improves soil fertility and prevents buildup of pests and diseases.

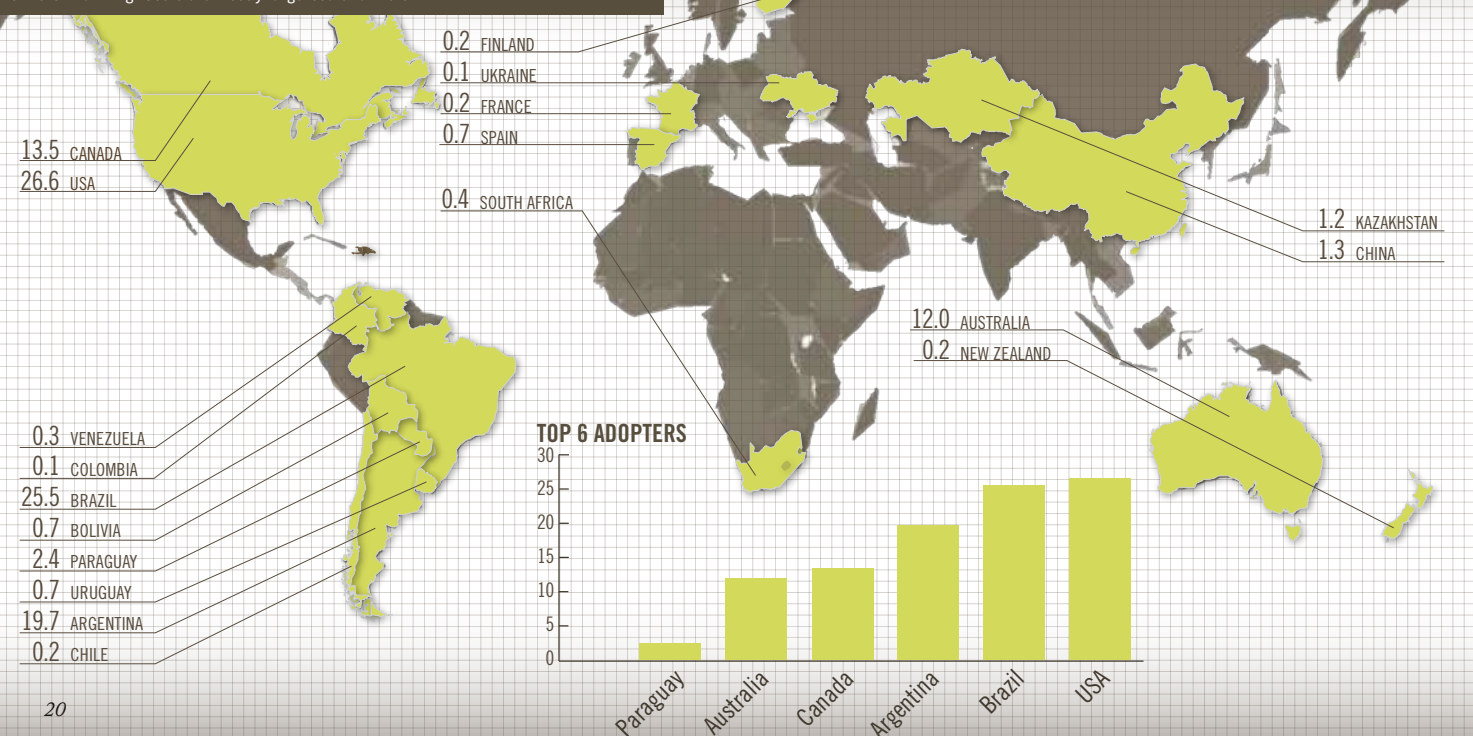
For small-scale farmers, conservation agriculture can be less expensive and time consuming than conventional tillage farming. In the areas of the Indo-Gangetic Plains of India where rice and wheat are grown in alternate seasons, a study shows that farmers using conservation agriculture spend an average of US\$55 less in cultivation costs, save 50–60 liters of fuel and 15–50 percent of water, and raise crop yields by 247 kilograms per hectare.

Indeed, the practice is now used on an estimated 105 million hectares of farmland worldwide, though still mostly in North and South America and mostly by large-scale farmers cultivating soybeans, wheat, and maize.

Source: R. Derpsch and T. Friedrich, “Development and Current Status of No-Till Adoption in the World,” paper presented at the 18th Triennial International Soil Tillage Research Organisation conference, Izmir, Turkey, June 15–19, 2009.

NO-TILLAGE ADOPTION WORLDWIDE [IN MILLIONS OF HECTARES]

About 105 million hectares worldwide are now farmed using conservation agriculture or no-till farming. Users are mostly large-scale farmers.



FLAT, FLATTER . . .

Leveling with farmers about water conservation

IFPRI's David Spielman and Nicholas Magnan are studying how small-scale farmers can be incited to adopt laser land leveling—a precursor technology for a more holistic conservation agriculture system—to make their fields really, really flat. Their work among small-scale rice and wheat farmers in the eastern reaches of the Indian state of Uttar Pradesh is part of a larger CGIAR program called CSISA—the Cereal Systems Initiative for South Asia.

To get the most out of conservation agriculture, it helps to have level fields where irrigation water can flow evenly, preventing waterlogging in some places or drying out in others. Laser land leveling is also a resource-conserving technology on its own: it can reduce farmers' use of water, and diesel fuel for pumping the water, by 20–30 percent.

Yet adopting laser land leveling is not simple for the small-scale farmer. Operators of level-

ing services find it more profitable to serve large-scale farmers—they can spend less time on the road between clients and more time earning money in the field. Many farmers know little about the virtues of laser land leveling because few extension agents or local agricultural departments promote it. Moreover, the farmers in eastern Uttar Pradesh, like those in many countries, don't actually pay for their water—water is available at no charge beyond the small cost for fuel to pump it. “Where groundwater is free, farmers don't pay the full price of water so they don't have the incentive to save,” says Magnan.

In cases where the benefits to society from laser land leveling—in terms of reduced water and fuel use and lowered greenhouse gas emissions—could be greater than the benefits to some individual farmers, or where some farmers are unsure how laser land leveling will benefit them, how do you persuade them to adopt the technology?

One solution is to offer a discount system that makes the service available at an affordable price, at least initially. Spielman and Magnan set up an experimental auction in India to find out how the government and the private sector could work together to create

a pricing mechanism that would be affordable for both the government and the farmers. They found that at the market price of 500 rupees per hour, only 5 percent of small-scale farmers' land would be leveled, whereas cutting the price by half would bring the amount of land to be leveled up to 50 percent.

If this mechanism were targeted to specific types of farmers—for example, farmers who were members of vulnerable social groups or castes—then more farmers could enjoy the benefits of leveling. The challenge is designing a pricing mechanism that serves everyone's interest.

“Ultimately, we wanted to find out how the public sector and the private sector might work together to promote the technology in a cost-effective manner that's both profitable for service providers and beneficial for small farmers,” says Spielman, “without being overly costly for the government.” It's a tough balance to strike, but it helps to have a level field. And once the farmers learn about the benefits by using the technology and watching others use it, they may be willing to pay more for it.

PUNJAB, INDIA

This farmer used laser land leveling to conserve water and reduce fuel costs on his wheat and rice fields.



NEVER HEARD OF IT

Sustainable farming approaches look like win-win solutions, but small-scale farmers have not adopted these practices in large numbers. “Each technology faces barriers to adoption that are very context specific. You need to understand the particular market failures or other barriers in each situation,” says Magnan.

One important barrier for conservation agriculture is lack of awareness and understanding. “The barriers to adoption include lack of technical know-how both by farmers and extension staff,” says Kufasi Shela, chief land resources conservation officer in Malawi’s Ministry of Agriculture, Irrigation and Water Development. “Some extension staff are yet to understand what conservation agriculture is and what it is not, and this ultimately affects the way they relate to their farmers.”

Work by IFPRI Senior Research Fellow Ephraim Nkonya confirms this. When extension agents in Nigeria and Uganda were asked what advice they give to farmers about improv-

ing yields, about 70 percent advised using better seeds as a first response, followed closely by chemical fertilizers, then pesticides. Only 1 percent of the respondents talked about organic practices such as intercropping with trees, an element in the wider suite of conservation agriculture practices.

The problem is similar in Morocco, where two-thirds of cereal farmers depend on rainfall and the frequency of drought has risen from an average of one in eight years in the mid-20th century to a more recent average of one in two years. Conservation agriculture has been shown effective in improving soils, sustaining yields, and lowering farmers’ costs in the region. But Rachid Mrabet, director of research for Morocco’s Institut National de la Recherche Agronomique, says because extension staff are unfamiliar with conservation agriculture practices they aren’t strong promoters.

A NEW MINDSET

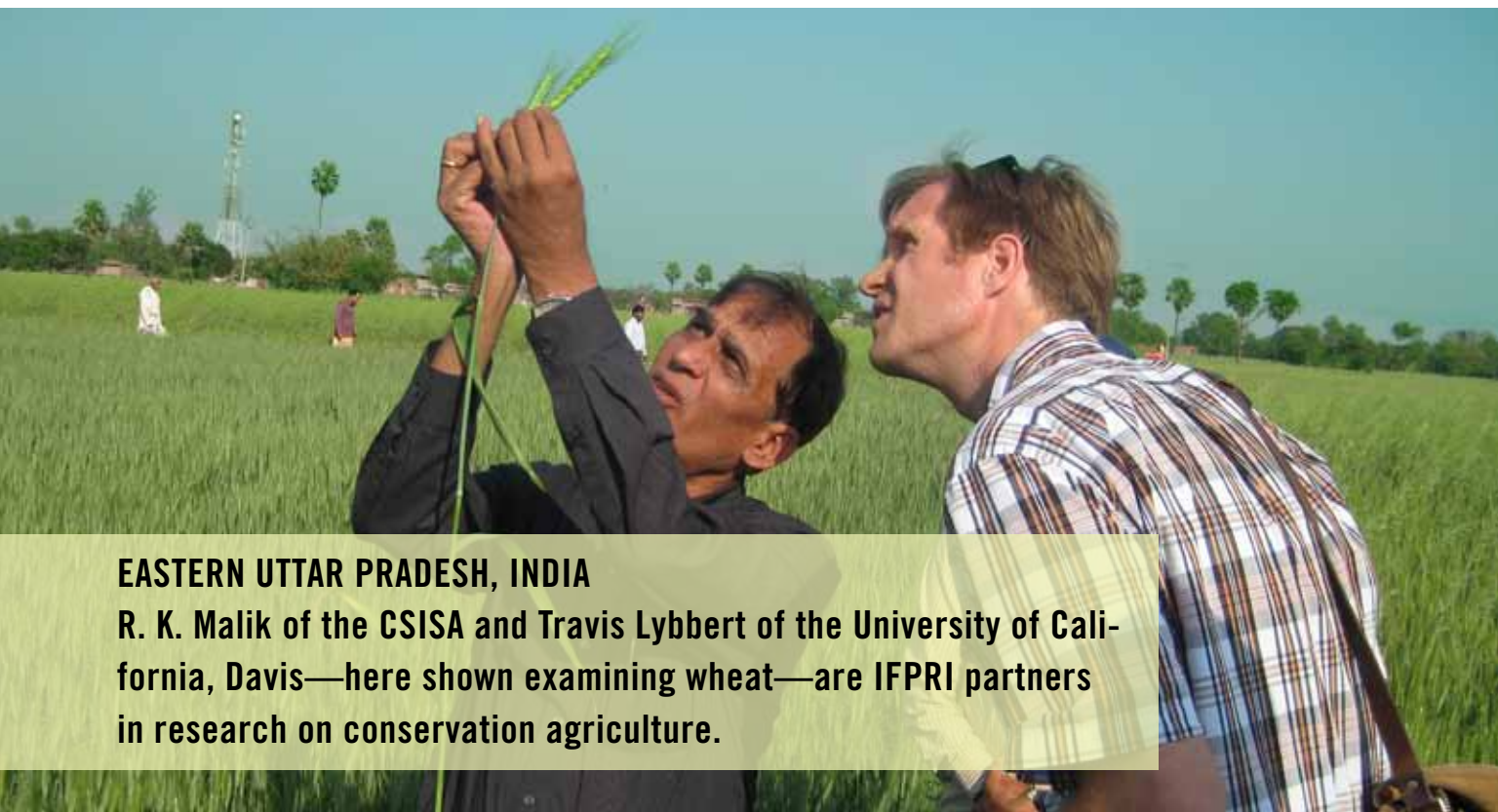
Abandoning the plow requires a different vision of what farming entails.

“You need a mindset from farmers and researchers to go from plowing a field to not doing anything,” says Bruno Gerard, who leads the Conservation Agriculture Program of the International Maize and Wheat Improvement Center (CIMMYT).

There are other practical considerations as well. Like other agricultural technologies, conservation agriculture works only if it is adapted to the needs of the local ecology, the farming system, and the farmer’s own plot.

This demands a lot from farmers, who need to make complicated and informed decisions about how to allocate labor, fertilizer, seed, and equipment, as well as time and effort. If immediate yield gains are not assured, they can be reluctant to adopt the practice. Still, Gerard says, their savings in fuel and water and the possibility of lengthening the growing period—by eliminating the time required for plowing—can raise profits, even if yields don’t rise in the first year.

Small-scale farmers are often reluctant to leave crop residues in the field because they normally feed the resi-



EASTERN UTTAR PRADESH, INDIA

R. K. Malik of the CSISA and Travis Lybbert of the University of California, Davis—here shown examining wheat—are IFPRI partners in research on conservation agriculture.

HELLO, TREES

Persuading farmers to adopt more sustainable practices

For millions of poor farmers cultivating small plots in Sub-Saharan Africa, agroforestry should make sense. Traditional farming methods and the constant search for fuelwood have stripped landscapes of trees. Planting leguminous trees alongside a field of, say, maize adds nutrients to soil and has been shown to double yields. “You can reduce fertilizer use by more than half,” says IFPRI Senior Research Fellow Ephraim Nkonya.

The benefits of agroforestry are especially striking when rains fail. Farmers using agroforestry in years of poor rainfall can match the yields achieved by farmers using traditional farming practices in years of good rainfall. And when agroforestry is combined with fertilizer use, yields are even higher. Plus, the trees help prevent erosion and can provide fodder, fuelwood, and fruit. Yet poor farmers in most African countries typically don’t adopt agroforestry.

IFPRI researchers Ephraim Nkonya and Paswel Marenja decided to find out what it would take to get

farmers to practice agroforestry and use fertilizer. They conducted an experiment with 271 randomly selected maize farmers in central Malawi to try to understand which policy solutions would be the most effective incentives. Farmers could choose to receive fertilizer subsidies, cash payments, or crop insurance on the condition that they practiced agroforestry.

A big part of the researchers’ project involved using games to educate farmers on the workings of insurance, with which they were completely unfamiliar. Some farmers who played the games did express an interest in insurance. Most, however, preferred fertilizer subsidies, which promised to increase their yields.

These results suggest that better information could help farmers make better decisions and that despite its shortcomings, returns to the current fertilizer subsidy program could be greatly enhanced if the coupons are given on the condition that the beneficiaries adopt conservation agriculture, agroforestry, and other improved land management practices.

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Intercropping of cabbage, sugarcane, and poplar trees in Punjab, India.

dues to their livestock or sell them to others as fodder. IFPRI’s Magnan points out that for some farmers, the benefits of using these residues for livestock feed outweigh the benefits of conservation agriculture, in terms of their immediate income.

“You have trade-offs between a relatively short-term return on feeding crop residues to livestock and a more long-term return on protecting the soil and maintaining good nutrient balances,” says Gerard.

To achieve the large-scale public environmental benefits of conservation agriculture, says Mrabet, governments should support farmers willing to try the technique.

And it’s important to look beyond yields. Without effective markets, increased yields can, in fact, depress prices. Without infrastructure, there

can be no effective markets. Conservation agriculture produces concrete benefits in the field, but like all development efforts, it needs markets, roads, value chains, and more to sustain its impact.

In the face of dramatic land and water degradation, the main obstacle to advancing sustainable agricultural practices, says Spielman, is not a lack of potential solutions. “Many methods have been proven effective both for farmers and for the greater good,” he says. “What we need is more knowledge dissemination, more coordination among researchers, extension agents, governments, and wholesalers. We need better infrastructure and reliable markets.”

We also need to think differently. “The immediate need for poor farmers is just to produce in a given year,” says Gerard. “They don’t think about

productivity in five or ten years.” So it could be that the fastest route to sustainability is to boost farmers’ productivity and then push them toward more environmentally friendly practices. “The pathway to sustainable systems may not be a straight one. You might have to go through transient unsustainability,” he says.

Of course, as IFPRI’s Paswel Marenja points out, governments could decide to promote these sustainable practices, through policies and extension services, just as they currently promote more conventional practices. “Just imagine if every smallholder farmer used conservation agriculture practices like these just a little,” he says. “Not only could they potentially improve their own productivity and livelihoods, but they could help reduce or repair harmful environmental consequences of unsustainable land management practices that affect us all.”



FARMING FOR THE LONG HAUL

How conservation agriculture works

1

RETIRE THE PLOW

Use a seed drill to insert seeds into the soil without tilling. The disturbed area of soil should be less than 15 centimeters wide or 25 percent of the cultivated area—whichever is less.

3

SWITCH CROPS

Ideally, rotate between three different crops. This helps prevent a buildup of pests and diseases in the soil.

2

KEEP IT COVERED

Leave the residues of the preceding crop on the field to act as mulch. Keeping the soil covered—permanently—helps prevent erosion, retain water, and encourage beneficial microorganisms and earthworms.

YIELDS

Yield increases may not be immediate, but studies have shown that crop yields can rise by 20–120 percent.



LABOR

Conservation agriculture can cut the cost, time, and drudgery associated with plowing, especially where people till the land by hand or with animals. This is a big advantage in areas with scarce labor.

SOIL

Conservation agriculture helps increase soil organic matter—microorganisms, plant residues, and humus—which makes soil less compacted and better at holding moisture.

WATER

Because conservation agriculture helps soil retain moisture, it requires less irrigation water, allowing groundwater to be used for other purposes like drinking. Water savings of 15–50 percent have been reported.

TREES

Agroforestry—planting trees beside and among field crops—can complement conservation agriculture by preventing soil erosion and boosting soil fertility. Trees can also provide fuelwood, fodder, and medicinal products.

WEEDS

Weeds can be a problem, especially when a farmer is transitioning a field from tillage to no-tillage farming. Herbicides and herbicide-resistant crops may be necessary.

FUEL

Farmers' fuel savings can be significant: they can stop using fuel for plowing and reduce the amount of fuel used to pump water.

FERTILIZER

Conservation agriculture can make more efficient use of fertilizer because the seed drill allows fertilizer to be placed precisely where it's needed. In India's rice-wheat farming areas, fertilizer efficiency has improved by 10–15 percent.





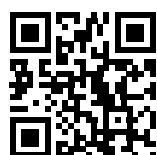
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PHOTO: A new zero-tillage seeder under construction. © 2009 CIMMYT



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