A large red tractor with a long spray boom is moving through a cornfield at sunset. The sun is low on the horizon, creating a warm orange glow and long shadows. The tractor is spraying a fine mist of liquid over the rows of corn plants.

Foreign Assistance Investments Contribute to U.S. Economic Growth and Employment

Foreign agricultural assistance supports growth in household incomes abroad, increasing demand for U.S. agricultural and manufactured exports with broad impacts on economic growth and employment.

Agricultural development in poorer countries with limited access to international markets is an important pathway to economic growth, poverty reduction, and integration into the world economy. In many developing countries, agriculture is the dominant source of employment. Boosting agriculture therefore spurs the growth of entire economies and stimulates demand for U.S. exports. In 2018, U.S. agricultural exports totaled \$140 billion, with developing countries accounting for \$90 billion, or nearly two-thirds of total agricultural exports.

Many U.S. agribusinesses and food and agricultural product exporters view developing regions of the world as their best opportunity for market expansion. The companies are attracted by the large and rapidly growing population in those regions, the high rates of economic growth in many developing countries, and the well-known shift by consumers to higher-quality and higher-priced food products as incomes rise. This shift in consumption patterns occurred decades ago in today's high-income countries, and growth in the demand for food has leveled off. In contrast, developing countries are still at the beginning of this transition toward higher-quality and higher-priced foods as a growing share of the population joins the middle class, creating market opportunities for U.S. exporters.

China and India both provide examples of strong U.S. export growth driven by income-induced changes in food consumption patterns. U.S. agricultural exports to China have increased by 2,300 percent and agricultural exports to India have increased by 1,693 percent since 1990. Similar potential for growth of U.S. exports exists in many other developing countries where U.S. foreign aid is designed to boost incomes. U.S. exports to Africa have grown, but there is potential for still far higher growth. Between 2000 and 2018, grain imports in sub-Saharan African countries grew by almost 6 percent annually, vegetable oil imports by 6.6 percent, and meat imports by 8 percent. Those trends are expected to continue. Poultry imports to sub-Saharan Africa are projected to account for 17 percent of global poultry trade by 2027 and rice imports in the region are expected to grow to 35 percent of global rice trade by 2027.

Agriculture is the predominant source of income for the majority of the population in most low-income developing countries. Foreign aid that makes agriculture more productive boosts incomes throughout the

economy and increases demand for U.S. exports. The end result is more jobs for Americans producing goods and services for export, and more income in the American economy.

Between 2015 and 2050, 98 percent of global population growth is projected to occur in developing countries. The growth of global demand for food creates opportunity for continued expansion of U.S. agricultural exports. For this to happen, the agriculture sectors and the entire economies of developing countries must continue to grow. U.S. government investment in foreign agriculture is a “win-win” for the American economy.

Measuring the broader benefits of agricultural exports

USDA's Economic Research Service estimates that each dollar of agricultural exports stimulates an additional \$1.87 in business activity in the United States. The economic multiplier effect is due to multiple rounds of income and spending that circulate through the entire economy, including manufacturing, trade, and transportation, as farmers purchase fuel, fertilizer, and other inputs to produce commodities for export. In 2018, total agricultural exports of \$140 billion are estimated to have produced an additional \$261 billion in U.S. economic activity, resulting in a total change in economic output of \$401 billion. Agricultural exports in 2018 supported an estimated 1,203,000 full-time U.S. jobs. Every \$1 billion in U.S. agricultural exports supported 8,619 full-time jobs throughout the American economy. Approximately 379,000 of these jobs were on the farm while 824,000 were in nonfarm sectors including food processing, services, trade, and transportation.

Over the past 20 years, total U.S. agricultural exports grew by 63% in real terms. Most of the growth was in exports to developing countries.

All the inflation-adjusted growth of U.S. bulk exports, and most of the growth of high-value products, is due to sales to developing countries.

	Bulk Commodities	High-value Products
Developing Economies	+77%	+125%
Developed Economies	-4%	+27%

1,203,000

U.S. jobs supported by agricultural exports in 2018.

Calculations by author based on USDA, GATS database.

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This report was prepared for the International Food Policy Research Institute by David Kraybill and Stephanie Mercier under the direction of Joseph Glauber.

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American Wheat Farmers Benefit from U.S. Agricultural Investments Abroad

Research supported by U.S. foreign agricultural assistance has produced new wheat technologies now widely adopted by American farmers. Wheat is the third most important field crop in the United States in planted acreage, production, and gross farm receipts and is produced at large scale in 29 states, with the largest production occurring in Kansas, North Dakota, Montana, Washington, and Oklahoma.

A Green Revolution in wheat productivity occurred globally, and most pronouncedly in South Asia, in the 1960s and 1970s. Much of the improvement in productivity came from the development of new high-yielding wheat varieties bred from semi-dwarf wheat from Japan. American wheat researcher Norman Borlaug and other scientists at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico developed the new varieties and released them in many countries, including the United States. CIMMYT is one of the founding research centers of CGIAR, a partnership of 15 agricultural research centers, which USAID began supporting financially in the 1960s. Compared to conventional varieties of the time, the new varieties were more responsive to fertilizer and shorter in stature, which reduced losses from lodging (falling over) of the stalk as the grain head matured. Though the research had originally targeted wheat production in developing countries, semi-dwarf breeding lines developed by CIMMYT were also used by plant breeders developing wheat varieties for the United States. By the early 1990s, about a fifth of total U.S. wheat acreage was sown to varieties with CIMMYT ancestry. Today, semi-dwarf wheat accounts for 99 percent of wheat acreage globally. While not all these varieties have CIMMYT parentage, CIMMYT and U.S. support for its research played a catalytic role in the development of this new wheat technology now widely used by American farmers.

Today, USAID-supported wheat research programs at Kansas State University and Washington State University are using cutting-edge scientific methods to reduce the length of the wheat breeding cycle. USAID's financial support has enabled the programs to build infrastructure and systems to refine research tools and disseminate them to wheat breeders in both developing countries and the United States. An important goal of both programs is to develop heat-tolerant wheat varieties. Heat stress is a major limiting factor for wheat varieties commonly planted worldwide, including in the United States. The researchers, by investigating heat stress in even hotter climates such as those of India, gain greater understanding of the genetic factors that affect heat tolerance. This knowledge, together with the use of genomic, molecular, and physiological methods, speeds up the development of heat-resistant wheat varieties and ultimately will benefit American farmers in the form of new breeding lines and new released varieties that maintain or improve productivity.

In addition, the USAID-funded Kansas State wheat lab has analyzed over 45,000 lines of wheat from around the world to increase plant breeders' accuracy in predicting traits at different stages of the breeding cycle. Improved prediction of wheat traits reduces the time and cost of producing new varieties.

Research on wheat stem rust protects U.S. and developing country crops

Historically, wheat stem rust has been the most damaging disease for wheat. Within weeks, a healthy-looking crop near harvest can be largely destroyed, reducing yields by 70 percent. An estimated 90 percent of the world's wheat production is vulnerable to wheat stem rust. Nine outbreaks of wheat stem rust occurred in the United States during the 20th century. In 1935, 1953, and 1954, wheat stem rust destroyed up to 50 percent of the wheat crops in Minnesota and North Dakota and at least 20 percent of the wheat crops in South Dakota. Researchers identified a wheat gene, Sr31, that suppressed wheat stem rust, and new wheat varieties based on this research kept the disease under control for three decades. However, in 1999, a virulent strain of wheat stem rust known as Ug99, which cannot be suppressed by the Sr31 gene, was discovered in Uganda. Since then, Ug99 has spread to 12 countries in Africa and Asia. Wheat industry experts believe the disease could spread to North America and pose a serious threat to the wheat industry.

Research is an important part of the U.S. government's action plan to minimize the risk of Ug99, and USAID is one of the agencies funding the research. The plan involves monitoring, germplasm enhancement, gene discovery, development of molecular markers for rust resistance, and wheat variety development. Some of the research is conducted at the Cereal Disease Lab operated by the USDA Agricultural Research Service at the University of Minnesota. Scientists there are breeding new rust-resistant wheat varieties suitable for agronomic conditions in the United States. A cooperative agreement between USAID and USDA provided funding for a state-of-the-art greenhouse at the lab. Researchers at the lab, funded in part by USAID, have identified wheat genes resistant to wheat stem rust. This is an important step toward the development of wheat varieties that can save the wheat harvest in the United States and other countries from the ravaging damage of wheat stem rust.

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Sorghum Germplasm from Overseas Builds Profits for U.S. Farmers

Many American producers of sorghum now plant improved varieties developed through a sorghum research program sponsored by USAID. The new varieties were developed by the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL), a research program managed by the University of Nebraska in collaboration with other land-grant universities from 1979 to 2013. It then transitioned to become the Feed the Future Innovation Lab for Sorghum and Millet, now managed by Kansas State University.

A major focus of the lab is development of sorghum varieties with resistance to biologically and economically damaging insect pests. In the 1980s, the greenbug aphid emerged as a serious threat to sorghum farming in the United States. Through the use of germplasm collected by INTSORMIL from many parts of the world, one of the INTSORMIL researchers, Gary Peterson of Texas A&M University, worked with a group of researchers to screen thousands of sorghum lines in search of greenbug aphid resistance. The outcome was the development and release of new varieties that greatly reduced damage from the greenbug aphid.

Research collaboration with the private sector increases U.S. benefits

Mutually beneficial collaboration with private seed companies was a feature of the INTSORMIL program. The researchers needed up-to-date information on sorghum traits desired by farmers, and Crosbyton Seed Company of Crosbyton, Texas, shared insights on the agronomic challenges faced by its customers in Central America, Africa, and the United States. INTSORMIL researchers at Texas A&M University then set out to develop new breeding lines possessing the targeted traits, using germplasm collected through INTSORMIL. After the lines were developed, the university and company entered into a "material transfer agreement," and INTSORMIL became a prime source of germplasm for Crosbyton for use in its own commercial seed breeding. By 2006, INTSORMIL had released 213 sorghum breeding lines to private industry, and 60 percent of sorghum hybrids grown in the United States had a least one parent from INTSORMIL.

While conducting INTSORMIL-funded research in Africa over a 30-year period, Peterson had become familiar with the sugarcane aphid, a pest causing damage in both sugarcane and sorghum. A Botswanan student at Texas A&M University conducting dissertation research on sorghum had identified a breeding line, Tx2783, that is resistant to the sugarcane aphid. Although this pest had not previously been a problem in U.S. sorghum production, in 2013, a massive sugarcane aphid outbreak on sorghum fields in Texas and other states caused yield losses of up to 50 percent and an estimated economic loss of \$8 million in 2013 alone. Since then, the sugarcane aphid has spread to all major sorghum-producing states. Knowing that Tx2783 is resistant to the aphid, Peterson and his colleagues at Texas A&M University brought their expertise to bear in fighting it. Research conducted by these INTSORMIL-supported scientists laid the groundwork for understanding the genetics of sugarcane aphid resistance. In 2018, 19 new sorghum lines with sugarcane aphid resistance were released, 15 of which were derived from Tx2783.

High returns on USAID investment in crop research

A recent study estimated that the sorghum and millet research sponsored by USAID through INTSORMIL generated an average annual rate of return on investment of 49 percent, based on impacts in the United States and developing countries.

USAID-funded agricultural research at U.S. universities generates economic benefits for the U.S. agriculture sector.

The sorghum research CRSP, INTSORMIL, first received funding from USAID in 1979. An economic impact study found that INTSORMIL's greenbug aphid-resistant sorghum varieties saved American farmers \$389 million in 1989 alone. At that point, INTSORMIL had received a total of \$44 million (in constant 1989 dollars) in USAID support since its founding. Therefore, in a single year, the sorghum research generated nine times its total cumulative cost, and the benefits can reasonably be expected to have continued for many subsequent years.

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Innovative Research Benefits U.S. Producers and Consumers of Beans

USAID-sponsored research on beans generates innovations that benefit U.S. producers and consumers of beans. Farmers in the United States grow nearly three million acres of dry beans and related crops, such as lentils and chickpeas, in the pulse family. American consumer demand for pulse-based food products, such as hummus, has grown from \$10 million in the late 1990s to \$700-\$800 million in recent years.

USAID has long supported a bean research program at several American universities whose scientists have developed most bean varieties grown commercially in the United States. The program, originally known as the Bean/Cowpea Collaborative Research Support Program (CRSP) (1978-2012) and now known as the Feed the Future Innovation Lab for Legume Systems Research (2013 to present), is based at Michigan State University.

From the perspective of the U.S. bean industry, an important function of the bean research program is the collection of germplasm from around the world. The germplasm collection provides the bean researchers with an expanded range of genetic options for breeding beans with desired characteristics. Using this germplasm, the researchers have developed new high-yielding bean varieties with resistance to economically important bean diseases. USAID's long-term support of the bean breeding program has resulted in the development of 40 bean varieties now commercially grown in the United States, all with one or more parents from the program. Among these new varieties, the Zorro variety accounts for an estimated 35 percent of total U.S. black bean acreage, while the Zenith variety accounts for 20 percent of the acreage. These varieties are attractive to farmers because of an estimated yield gain of 10 percent over other black bean varieties.

State and national dry bean industry associations in the United States (Michigan Bean Commission, US Dry Bean Council, and American Pulse Association) composed of growers, traders, and processors are strong supporters of the USAID-sponsored bean research program because of research and specific initiatives that have contributed to the growth and future viability of the bean industry. Funding for bean research is scarce, and no other federal agency provides this level of support for public-university bean research in the United States. The USAID funding has enabled administrators of U.S. universities to make strategic faculty hires who support the dry bean industry in their regions while enhancing the international engagement of the universities.

At least 13 common bean varieties and 2 blackeye pea varieties were developed by researchers in the USAID bean program, registered as intellectual property, made available to growers, and are being commercially grown in the U.S. (beans in Michigan, Minnesota, Nebraska, North Dakota and cowpea in California).

U.S. foreign agricultural assistance stimulates export of agriculture-related services

PICS Global, Inc., is an American company that manufactures and distributes postharvest technologies targeted to smallholder farmers. The company's primary product is a low-priced grain storage bag originally developed by Purdue University and partially funded through the CRSP bean research program. USAID funds supported field research in Cameroon on weevils that destroy stored beans and laboratory research at the Purdue University campus in Indiana on hermetic plastic bags designed to kill the insects through oxygen deprivation. To design bags that were effective and yet as inexpensive as possible, the researchers developed an ultrasonic device capable of monitoring insect activity inside the sealed bag. After the technology was perfected, the university began licensing manufacturers to produce and distribute the Purdue Improved Crop Storage (PICS) bag. In 2017 PICS Global, a private company that describes itself as a social enterprise, was formed to handle the technology licensing and to provide technical and marketing services to the licensees. Currently, PICS bags are produced by seven companies, sold annually to three million farmers in 58 countries, and used to store many crops including beans, corn, sorghum, rice, and coffee.

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