

Association for International Agriculture  
and Rural Development (AIARD)

# **Food: The Whole World's Business**

Investing in International Agriculture and Food Systems  
Development for the Mutual Benefit of the United States  
and Developing Countries

A Compendium of Case Studies

Reed Hertford and Susan Schram, Editors

February, 2001

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## INTRODUCTION AND OVERVIEW

International agriculture and food systems development is the whole world's business, and we all benefit from it! In many developing countries, the majority of people make their living in agriculture and food systems and spend the largest percentage of their income on food. In the United States, we take an abundant food supply for granted. To enjoy the fruits of international agriculture, we only need to visit the local supermarket.

Behind our ready access to an abundant food supply in the United States, however, is a sophisticated system of international collaboration. This collaboration ensures that Americans continue to have access to safe, high quality food; expands trade for U.S. agricultural exports; assures our access to the latest scientific knowledge and information; solves problems across borders regarding the natural resources upon which agriculture depends; and prepares young people for working in a global economy.

This publication presents case studies highlighting successful examples of "win-win" international collaboration in agriculture and food systems development. Rather than a one-way street of "foreign assistance," these case studies show that U.S. investments in international agricultural cooperation produce key mutual benefits for both the United States and developing countries.

The underpinning of every nation's health and welfare is its food and agriculture system, a fact taken for granted in the United States because of the success of our system. The series of case studies presented herein aim to describe, in layman's language and by means of brief case study summaries, just how international collaboration in agriculture and rural development has been so successful and why expanding this investment in the future is a key strategy for assuring a safe, adequate and accessible world food supply in today's global economy.

The cases are organized into five thematic areas: 1) ensuring safe, high quality food; 2) expanding trade and developing business; 3) sharing scientific knowledge and information; 4) solving environmental problems across borders; and 5) preparing human capital for a global economy.

The win-win case studies are presented in a consistent format to facilitate comparison of objectives, approaches and outcomes. Each project case study begins with a summary of the program area, a list of participating partners, and the mutual benefits of the project. A two- to three-page narrative follows, describing the issue addressed, project activities and objectives, benefits derived for both developing countries and the U.S., and total project costs. The case study contributor is identified at the end of the narrative.

The following brief overview introduces the reader to the materials contained in each of the five sections and highlights conclusions and significant lessons learned from the case studies of each.

### **I. Ensuring Safe, High Quality Food**

The case studies in Section I illustrate how cooperation in international agriculture and food systems development protects the world from pests and diseases that have the potential of reducing farm output, curtailing exports and infecting the food we eat. The investment of U.S. taxpayers in this area

pays dividends by enabling the United States to identify potential problems before they cause serious damage and by providing access to the best tools for addressing related concerns back home.

If left unchecked, pests and diseases can quickly wreak havoc in an agricultural industry. For example, the sorghum ergot, once found only in Asia and Africa, arrived first in the Western Hemisphere through Brazil. In a mere two years, it had worked its way north and was discovered in a sorghum field in Texas. The result was to put at risk a US\$2 billion U.S. industry with annual exports of US\$800 million.

The case studies presented in this section show that successful campaigns to arrest or eliminate these diseases have two important and related characteristics: 1) they need to be well organized, and frequently include collaboration among a number of institutions and countries, and 2) they need to be comprehensive, addressing all the most vulnerable areas.

Without these characteristics, a small outbreak in a seemingly isolated area can rapidly spread and even re-infect regions earlier ridded of a disease. Therefore, individual countries spend significant political capital negotiating cooperation to produce the most appropriate partnerships. For example, one case study in this section shows that it took eight years to negotiate cooperation between Chile and Peru for eradication of the fruit fly.

In spite of substantial start-up efforts, project costs shown in these cases are surprisingly low in comparison with the values of production and consumption that are protected and saved. Most projects produced spectacular net economic benefits. The total costs of fruit fly control in Chile and Peru, for example, were only one percent of the value of increased exports by these countries in just one year! The lowest benefit cost ratios ranged from 2.0 to 4.0—still high by any standard. These case studies show that preventive "win-win" U.S. investments to ensure safe, high quality food are extremely important for international agriculture.

## **II. Expanding Trade and Developing Business**

In the United States, 20% of agricultural production is exported and most potential for U.S. market expansion is in developing countries. Within this context, investing in expanding trade and developing business is a strategic investment critical for the future of the U.S. economy. Moreover, investing in developing country agriculture helps to generate the long-term income growth those countries need to become better customers for all U.S. exports.

Section II of this compendium includes the greatest number of win-win case studies, which can be categorized into three groups. One large group deals with a variety of efforts to assist developing countries with economic transformation and transition to market economies, the markets of the future for the U.S. The second large group includes case studies describing basic initiatives to develop a particular commodity or a target group of rural inhabitants, for example, rural women. Finally, two cases recognize that successful economic transitions and economic development require high quality information and describe projects to satisfy that need.

With the collapse of communist regimes around the world, the previous economic, production, marketing and farm services systems disappeared, leaving farmers without even the most basic infrastructure support. Thus, as land became available under privatization efforts, farmers found themselves without access to production inputs, technical information and advice for beginning to pro-

duce on their own. The case studies addressing these challenges describe projects that helped develop markets, fill gaps in extension information, and provide other basic agricultural support services so that new market-based economies could begin to work in agriculture and rural areas.

The second group of cases in Section II also address general economic and business development through agriculture, but seek to achieve the development of a particular commodity or group of rural inhabitants. For example, one describes revitalizing coffee production in Haiti by improving coffee processing and marketing; another concerns linking U.S. and Egyptian agribusiness communities to accelerate the transfer of milk and sheep production technologies between the two countries.

The third group of case studies involves projects that are generating strategic information for trade and business development, information that is vital to both U.S. and developing country producers as their markets open to each other under new trade regimes (i.e., the North American Free Trade Agreement Agreement, NAFTA). One such initiative describes how new, high quality reports and strategic information on Mexican agriculture were made available in English after 400 officials of Mexico's Secretariat of Agriculture received training from the U.S. Department of Agriculture's Economic Research Service.

Costs of projects dealing with transformations to market economies are somewhat higher than for other types of projects illustrated in the compendium. This should not dampen enthusiasm for this type of project as it underscores what Professor D. Gale Johnson, a former-President of the American Economics Association, said: "We dare not underestimate what it takes to build markets and market economies." There has been a tendency on the part of U.S. citizens to take markets for granted since they have seemingly always been a part of our everyday lives.

Cases in Section II show that local rural development in developing countries results not only in economic success in those locations but also in dramatic payoffs for U.S. consumers, producers and the U.S. agribusiness community. Moreover, these cases show that direct involvement of U.S. professionals, citizens and families in international collaboration results in long-term relationships with people from other countries that expand trade and exchange, build trust and confidence, and enrich long-term relationships among international colleagues and nations.

### **III. Sharing Scientific Knowledge and Information**

Section III contains a rich array of projects that describe and bring to life a variety of agricultural research undertakings around the world, showing clearly that important benefits are generated overseas that spill into the U.S. in major streams of economic benefits. Essentially, the case studies describe four different categories of agricultural research projects:

- global research that addresses a single problem or commodity affecting many countries, usually in more than one region;
- research on specific production-reducing problems such as fungus, virus and invasive weeds, plus research on nitrogen fixation;
- post-harvest research to increase food availability by reducing production losses due to spoilage and other contaminants introduced beyond the farm gate; and
- "research on research," to improve the agricultural research process and make it more efficient.

The global research sub-category includes the work on wheat and rice of the Consultative Group on International Agricultural Research (CGIAR). It is well known that these projects launched the "green revolution" overseas as a result of the development of short-stature, disease-resistant wheat and rice varieties. Less well publicized was the fact that these same improved crop varieties (in a U.S. wheat industry worth US\$8 billion annually and a rice industry worth US\$1.3 billion) produced up to US\$13.7 billion for U.S. wheat farmers and roughly US\$1 billion for U.S. rice farmers who are growing them on a wide scale. It is noteworthy that the cost of the CGIAR effort for just these two commodities was less than US\$150 million over the years (which excludes the value of important collaboration from regional and national organizations in the public and private sectors). In addition to its work on wheat and rice, CGIAR cooperation is evident in many case studies in this compendium, some of which are led by a particular international center and others where CGIAR centers play a supporting role.

Also included in the global research sub-category are case studies from the U.S. Collaborative Research Support Programs (CRSPs) which harness land-grant university capabilities for international food and agricultural research. There are presently nine CRSPs, funded partially by the U.S. Agency for International Development (USAID), that are helping national agricultural research systems in developing countries to solve priority local problems of agricultural production and utilization. The underlying legislation for the CRSPs makes it clear that they are expected to bring benefits to both the U.S. and host developing countries, and the case studies included herein show that they have been successful in that mandate. Much of the programs' work is conducted in partnerships involving not only U.S. universities but also the CGIAR International Agricultural Research Centers, U.S. agribusiness, private voluntary organizations, USAID offices and other U.S. federal agencies such as the U.S. Department of Agriculture.

While the work of the CRSPs addresses a range of cereal crops, beans, sorghum and millet, examples of which are contained in this section of the compendium, the accomplishments of the Aquaculture Collaborative Research Support Program are also reported here, illustrating the commodity breadth of the program. Aquaculture holds promise for ensuring a worldwide expansion of the fish supply, given that the sea catch is now practically stagnant. This particular CRSP is training personnel in aquaculture techniques, developing extension strategies, improving methodologies for studies of fish growth and reproduction, and conducting innovative research regarding fish and their cultivation.

Case studies in the second category of Section III may, at first sight, appear to overlap somewhat with those in Section I. However, while the case studies in Section I deal with food contaminants affecting consumers adversely, or particular insects reducing crop and livestock production, those in Section III include research to stem virus, fungus and weed problems hampering plant and animal growth, plus cutting-edge work on biological nitrogen fixation. As in the case of the projects discussed in Section I, major worldwide cooperation has been involved in these undertakings. Ridding the world of water hyacinth by finding new biological controls is illustrative. The plant is an invasive, free-floating aquatic weed that costs the U.S. alone some US\$122 billion annually. It is also found in most of the world's tropical and subtropical regions. In most places, but certainly in the developing world, the use of herbicides and machinery to kill the pest is costly and ineffective; hence the interest in biological controls.

The third category of Section III contains only one case study: research to increase food availability by reducing post-harvest loss. It is an important example because it deals with India, where only 50% of perishable commodities (mainly fruits and vegetables) ultimately become available for

human consumption owing to the reduction in volume, quality, nutritional value or food safety occurring between the farm and the consumer. It has been estimated that the value this represents is greater than the annual value of all cars produced in India!

The final category of win-win case studies of Section III deals with research, training and information sharing to improve the quality and impact of the research process itself. One of the attractions of this work is that in many developing regions of the world, notably Latin America and the Caribbean, financing for agricultural research from the public sector has diminished sharply. Furthermore, the realignment of relative commodity prices, following the opening of foreign trade regimes, has led to the need to make major realignments in commodity research priorities, increasing demands for priority-setting skills and methodologies with which to re-orient agricultural research programs and show the way for the future.

The following conclusions and lessons can be drawn from the case studies in Section III on collaborative international agricultural research:

- Investing in international agricultural and food systems research returns high dividends: case after case illustrates that total benefits of the research exceed costs by more than most other kinds of investments. In addition, it pays these major dividends both overseas and in the U.S., almost always producing a "win-win" situation.
- International agricultural research aims to develop methods and skilled professionals who can improve on the research process itself, with a view to reducing its costs and/or increasing its impact in a global economy.
- It has expanded biological diversity.
- It requires significant cross-country cooperation.
- Through efforts to reduce post-harvest loss, it not only aims to boost production but also to save what has already been produced.

#### **IV. Solving Environmental Problems Across Borders**

This group of case studies deals with the sustainable management of land, forests and biosphere reserves, the natural resources upon which the future productivity of international agriculture and food systems depend. Environmental problems do not halt at country or international boundaries; therefore, resolving them to protect the world's precious natural resources requires collaboration among the best scientific minds.

An intriguing case study in Section IV involves an effort at land reclamation, started overseas but with important spillovers for the U.S.. There are areas both in Poland and the U.S. where, as a result of years of mine waste disposal, piles of mining wastes with potentially toxic materials have built up. One consequence is that the groundwater beneath the mines has been extensively contaminated with metals and acidity. Basic experimental work was done at two sites in Poland to rehabilitate such areas. Successful solutions to the problem were found, which include establishing herbaceous vegetative cover for the waste sites and growing metal hyper-accumulator plant varieties. The technique has provided a template for rehabilitating similar sites in Poland and around the world, including Superfund sites in the U.S.

Another case study deals with the La Amistad Biosphere Reserve, covering 2.7 million hectares in Panama and Costa Rica, that comprise the largest natural habitat in Central America, protecting much of the power and water supply of Costa Rica and Panama. Its protective buffer zone of 14,000 hectares was seriously threatened by the growth of rural communities. A combined effort of private commercial firms, U.S. universities and international NGOs, plus Costa Rican and Panamanian counterparts, helped improve agricultural technology in the buffer zone, restore degraded lands, protect forests, and establish environmental education programs for primary and secondary school students.

A third study also centers in the Central American region, where burning of the land is a generalized farming practice that has tragic consequences for human health, the environment and the economy more generally. When the land is especially dry, the effects of burning are felt locally, nationally and even internationally. In 1997, burning provoked airport closings in Tegucigalpa, Managua, San Salvador, Mexico City and the southern United States. President Clinton called the public's attention to this problem and committed resources for preventing it. In just two years' time, there was an 80% reduction in the area burned. Local benefits were obvious and the U.S. is also benefiting from reduced pollution, smog and health risks, plus improved carbon absorption as a result of forest conservation and less burning.

A fourth related case study is a project to develop and test indicators and practical guidelines for sustainable forest management, which are being distributed and used internationally. A fifth describes how achievements in Africa, Latin America and Eastern Europe by a U.S. university in the areas of land tenure reform and retention led to the establishment of a North American Program which, among its activities, reviews and advises on the effects of tenure arrangements on the long-term productivity and sustainability of agricultural lands, mineral deposits and forest resources in the U.S.

A final case study in Section IV demonstrates how international collaboration to predict climate variability helped improve the production of peanuts, rice and wheat in the Asia-Pacific Region. Being able to predict climate helps determine more optimally the timing of crop management practices (fertilizing, plowing, pesticide applications, etc.) which contributes to increasing production and farmer returns. Benefits for the U.S. lie primarily in helping improve the management of irrigation water resources, one of the most valuable inputs to production because of the competing demands for this natural resource.

Regarding the benefits of international collaboration on environmental dimensions of international agriculture and food systems development, this section shows that:

- environmental problems extend beyond country and national borders and require investments in international collaboration that can produce win-win payoffs;
- techniques for sustainable resource management can be devised overseas and first applied there, for later, highly beneficial application in the U.S.;
- dealing with environmental issues (as in the case of pest and disease problems) usually requires significant collaboration among private and public institutions in the U.S. and overseas;
- environmental problems are not just the purview of the public sector; the private sector also sees that work of this type is in its own best interest; and,
- costs tend to be somewhat higher than for many projects discussed in this section. While long-term benefits are potentially great, immediate benefits are much more difficult to detail.

## V. Preparing Human Capital for a Global Economy

Educating the future generation of youth to function capably in a global economy, assuring the global skills of university faculty, and helping citizens understand the importance of international involvement are challenges faced by today's universities in the United States and abroad. Three types of programs are addressed in this section. One area concerns university exchanges between one or more U.S. universities and one or more overseas; the second has to do with efforts that internationalize U.S. programs through individual youth and professional exchange programs; the third involves efforts to provide targeted short-term training in the U.S. in fields of strategic importance to overseas professionals.

In the first case study, two collaborating universities, one in the U.S. and one in South America, found that they faced similar problems related to increased competition for environmental resources, economic growth, demographic changes and the resulting social pressures. They formed a long-term strategic partnership, funded through a variety of separate projects, for conducting collaborative research on conservation tillage and climate change, creating a masters' degree program in environmental management, conducting comparative international studies on environmental conflict prevention, and developing distance education. Building from an original set of shared problems, they have found that they are truly "growing together." At the outset, the U.S. partner was cast in a more traditional technical assistance role. With time, however, the relationship has evolved into one of partnerships and exchanges among peers.

Other cases in Section V show the benefit of student and professional exchange programs in advancing international relations and furthering international collaboration among institutions. A Russian student exchange program advanced long-term relationships between U.S. and Russian students and faculty at their respective universities. An exchange program for Polish and U.S. extension professionals not only helped the Polish Ministry of Agriculture and Food Economy re-focus and serve the Polish agricultural sector in a private market economy, but also strengthened the international capabilities of extension personnel in 31 U.S. states and brought the benefits of U.S. international involvement to citizens at the community level. The project was especially meaningful to extension-served communities with large Polish constituencies.

Targeted short-term training is also shown to provide mutual benefits for both developing country participants and the U.S. One project in this area provided training for Chinese supermarket managers. After receiving short-term training in the U.S., Chinese participants reported starting up their own food companies or obtaining senior management posts in supermarkets and the retail food industry. The U.S. part of the win-win situation was increased trade between the U.S. and Chinese food industry, plus the establishment of new joint ventures between Chinese and U.S. food industry entrepreneurs.

In another case, South African professionals received training in agricultural business and trade development, management, marketing, policy development and agricultural technology transfer. After their participation in training, 15% of the South Africa participants were promoted in their jobs, 57% were assigned increased job responsibilities and 15% started their own businesses, some of which are sourcing inputs and products from the U.S. Over 70% indicated that the program helped them improve their job performance. Some 70% of the participants remain in contact with U.S. individuals and organizations, suggesting that the relations forged are very sustainable.

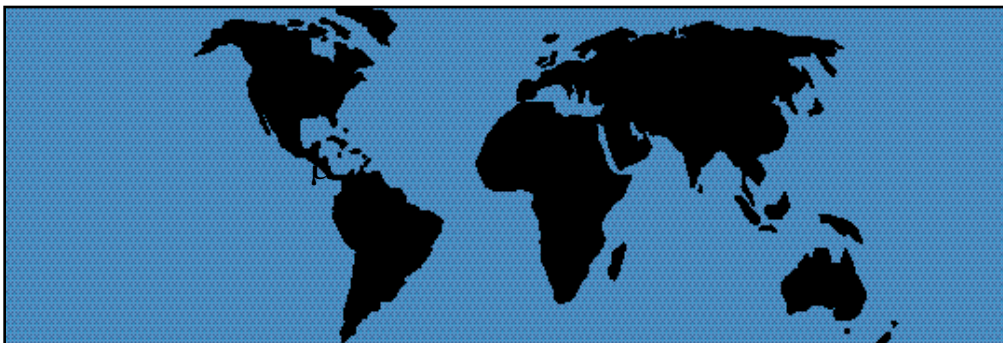
These cases show that:

- in terms of student and faculty international exchange programs, the benefits to youth and professionals of both cultures last a lifetime;
- when U.S. and foreign universities begin a program with similar conditions and circumstances, the relationship and joint efforts developed through an exchange program are more likely to prosper and succeed;
- through a long-term program, more traditional technical assistance tends to give way to true partnership among equals and peers;
- involving communities in exchange programs initiated by universities can expand international awareness and appreciation of foreign assistance programs among broad-based extension clientele;
- exchange programs among students result in their "internationalization" and produce lasting benefits and international connections; and,
- targeted, short-term training to help foreign professionals surmount a specific problem delivers sustainable results for the developing country and cements long-term relationships that have important payoffs for the United States.



# **I. Ensuring Safe, High Quality Food**

**International Agriculture and Food Systems Development: An Investment with Mutual Benefits for the U.S. and Developing Countries**  
**A Case Study Series Developed by the**  
**Association for International Agriculture and Rural Development (AIARD)**



**Improving for U.S. Consumers the Food Safety of Raw Fruits and Vegetables from Central America**

**Program Area.** Ensuring safe, high quality food

**Partners.** Central American countries, U.N. Food and Agriculture Organization (FAO), University of Arkansas and U.S. Department of Agriculture (USDA)

**Principal mutual benefits.** Improved food quality and safety of fresh fruits and vegetables produced in Central America benefit consumers in both domestic and U.S. markets

**Issue.** Contaminated imported produce has caused disease outbreaks in the U.S.

Recent outbreaks of food-borne illnesses associated with produce, including *Cyclospora* in imported raspberries, have raised concerns regarding the safety of fruits and vegetables that are not further processed to reduce or eliminate pathogens. U.S. consumers are increasingly demanding year-round access to fresh fruits and vegetables as dietary guidelines encourage greater consumption of fresh produce. U.S. fresh fruit and vegetable imports reached record levels in 1998, up nearly 15% from the previous year, totaling over US\$2.6 billion for fresh fruits and US\$2.1 billion for fresh vegetables. Over 70% of U.S. imported fresh vegetables and 50% of the fresh fruit come from Central American countries.

According to a recent General Accounting Office study, port-of-entry inspections by the Food and Drug Administration (FDA) cannot realistically ensure that unsafe fruits and vegetables will be kept out of U.S. commerce. With increasing imports of fresh produce and limited inspection resources, the only alternative is to improve the safety and quality of imported fresh fruits and vegetables at the source. Disease outbreaks from imported food can damage the reputation of both U.S. and foreign producers. With the relatively short shelf-life of fresh produce, lost markets, even if relatively brief, can have a serious impact on producer income.

**Project objectives and activities.** The project identifies training needs and provides training to local instructors with a view to developing a skilled workforce that can facilitate the safe production, harvesting, handling, storage and transport of raw fruits and vegetables from Mexico and Central America. For the month of April 1999 alone, FDA import detentions of fresh fruits and vegetables from Central America totaled over 85 shipments for reasons including filth, improper pesticide usage and microbiological contamination. This resulted in significant lost income for exporters. The overall goal is to improve the quality and safety of fresh produce for domestic and international markets, and to reduce the amounts of fresh produce impounded due to safety and sanitary problems.

The first phase of the project was a training needs assessment workshop held in Guatemala City in December 1998. Results of this workshop formed the basis of the regional training course held in May-June 1999 in Costa Rica. The course provided expertise and training to professionals from the government, academic and private sectors on methods to ensure the quality and safety of fresh fruits and vegetables throughout the production chain. FAO is working with USDA-Foreign Agricultural Service-ICD and the University of Arkansas, as well as a number of other groups, to develop and implement training in this area, including the private produce sector, government agencies (Environmental Protection Agency, FDA and USDA) and regional organizations, including the Inter-American Institute for Cooperation on Agriculture (IICA), the Pan American Health Organization (PAHO) and the International Regional Organization for Agricultural Health (OIRSA).

National-level training will follow the regional activities as trainers prepared under the project transfer information/skills to individuals directly involved in the handling of fresh fruits and vegetables, including growers, packing house staff, transporters, brokers, buyers, and government food control agencies. This local training will be tailored to the needs and specific commodities of individual exporting countries.

**Developing countries' benefits.** Fruit and vegetable exports from Central America total over US\$4 billion annually. This has been one of the brightest export industries in the region, with revenues more than doubling in a decade. Import detentions by the U.S. can result in major revenue losses for individual exporters; lost markets due to food safety and sanitary problems can result in significant lost income for the region. Consumers in the targeted countries also benefit as local producers and handlers use good agricultural and manufacturing practices, pesticide residue analysis and similar technical capabilities to improve the quality and safety of local produce.

**U.S. benefits.** According to a 1994 study of the Council on Agricultural Science and Technology (CAST), some 6.5 million to 33 million illnesses and up to 9,000 deaths annually are associated with contaminated foods. Hospital costs and lost productivity costs resulting from food-borne illnesses are likely to exceed US\$10 billion per year. Food product recalls due to life-threatening bacteria have increased from 79 reports in 1988 to nearly 400 in 1995. With rising consumption of fresh fruits and vegetables, a growing portion of which is imported, efforts to improve the food safety of imported produce can only serve to reduce the costs of food-borne illnesses.

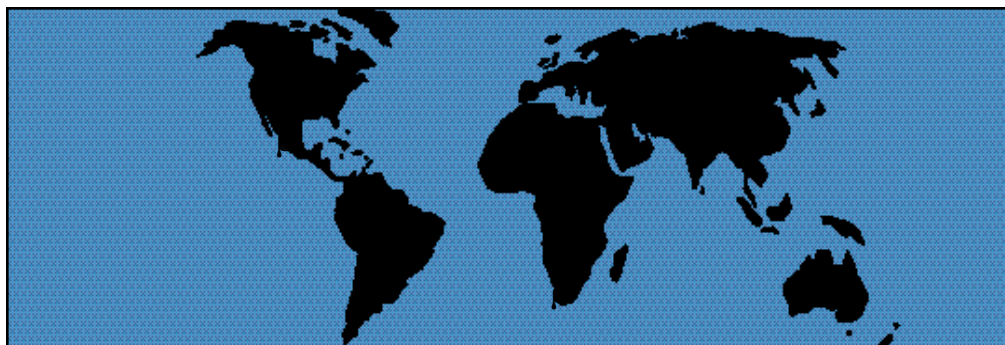
In addition to the obvious benefits of safer foods for U.S. consumers, domestic producers also stand to benefit. Domestic strawberry producers were initially reported to be the source of the *Cyclospora*-related illnesses in 1996 that later were epidemiologically attributed to imported raspberries. Nevertheless, lost strawberry sales by domestic producers (primarily in California) were estimated at higher than US\$40 million as a result.

**Project costs.** Total project costs from all sources will likely total around US\$250,000, excluding resources in local training provided by the countries of the region. This is less than 0.01% of the value of Central American fresh fruit and vegetable imports into the U.S., a minuscule investment in light of the major costs to U.S. consumers resulting from food-borne diseases.

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## Sorghum Ergot Alert in the Americas

**Program Area.** Ensuring safe, high quality food

**Partners.** Agricultural Research Service/USDA; Brazilian National Agricultural Research Enterprise (EMBRAPA), Brazil; Grains Crops Research Institute, Potchefstroom, South Africa; Institute of Agricultural Research (IAR), Nazareth, Ethiopia; Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), Mexico; International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); Institut des Sciences Agronomiques du Rwanda (ISAR), Rwanda; Institute of Microbiology of the Czech Academy of Sciences, Prague, Czech Republic; INSTSORMIL CRSP; U.S. National Grain Sorghum Producers Association (NGSP); Texas A&M University; and the University of Zimbabwe.

**Principal mutual benefits.** Effective management and mitigation of the threat of the disease in ergot endemic areas

**Issue.** Sorghum ergot, once found only in Asian and African countries, has a propensity for rapid, uncontrollable spread, which recently took the sorghum industry of the Americas by surprise. First identified in Brazil in 1995, it spread to Argentina, Bolivia, Paraguay and Uruguay by late 1996. By the first quarter of 1997, ergot was in the Dominican Republic, Haiti, Jamaica, Mexico and Puerto Rico. By late March 1997, it was spotted

in a sorghum field just north of the Rio Grande River near Progresso, Texas. By the end of that year, the disease had spread throughout the sorghum-growing areas of the U.S.; producers were stunned by the swiftness of the spread of this disease.

Ergot causes crop losses by reducing the quantity and quality of seed, predisposing seeds to disease, and making harvesting and threshing difficult. Since the presence of ergot increases disease transmission and toxicity risks, food safety concerns in international trade can bring down the exports of sorghum-producing countries. U.S. exports are near the US\$800 million mark at present; it produces 40% of the world's seed and earns over US\$435 million annually from its sales. About 90% of the sorghum area in South and Central America is planted with sorghum hybrids, the seed of which is produced, for the most part, by U.S.-based companies.

Sorghum is the world's fifth most important cereal crop and about 90% of the area cultivated in sorghum is in developing countries, where sorghum is a basic food for millions of poor people. In the U.S., it is used chiefly as a feed grain—and the second most important one—with production valued at over US\$2 billion annually. About three quarters of the crop is grown in three states: Kansas, Nebraska and Texas.

**Project objectives and activities.** It is unlikely that ergot can be eliminated: it is in the Americas to stay. However, it can be managed and its consequences diminished. The project's objective is to reduce losses caused by ergot to 1% of crop production within five years. (Before this project was launched, U.S. losses were estimated to have been US\$51 million annually, or almost 3% of the value of the crop.)

In this connection, the community of agricultural researchers engaged in sorghum improvement programs initiated a public awareness campaign, facilitating the exchange of available information about the disease with different audiences, generating specific biological information about the pathogen in the Americas, designing ergot management practices, and contributing to the development of regulatory policies for international trade.

This public awareness campaign has had the effect, among others, of stemming a tendency to panic among sorghum farmers in the Americas who are alarmed by the disease. ICRISAT, one of the international agricultural research centers of the Consultative Group on International Agricultural Research (CGIAR), brought prior experience with sorghum ergot in Ethiopia, India, Rwanda and Zimbabwe to bear in this vanguard effort. A video describing the impact of sorghum ergot and provisions for its control was developed by USDA and ICRISAT scientists and shown to key policymakers in the Americas. In addition, a methodology was designed which enables researchers, including scientists in the U.S., to screen sorghum varieties for resistance to ergot.

Just as the information generated in Africa and Asia has benefited the Americas, research in the Americas will benefit countries throughout the world.

In February 1999, an international team of ergot researchers—one each from ICRISAT, South Africa and Zimbabwe, previously associated with ICRISAT—received the Outstanding Achievement Award of the U.S. National Grain Sorghum Producers Board and the Sorghum Improvement Conference of North America for their contributions to the sorghum industry worldwide.

**Developing country benefits.** The chief benefits for developing countries, mainly in the Western Hemisphere, include: the availability of research information on the biology and control of sorghum ergot, the availability of screening methodologies and locally adaptable and high yielding resistant varieties, rapid access to research information and ergot-resistant lines, training, the greater capacity of all developing country scientists to conduct research on sorghum ergot, and reduced losses due to rejection in the seed and grain trade as well as by the animal feed industry.

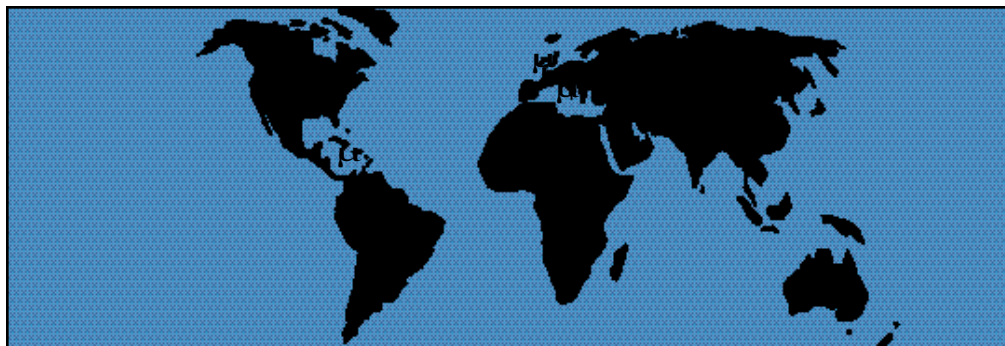
**U.S. benefits.** Inefficient ergot management methods could produce a three-fold increase in seed production costs for producers due to the need to increase the use of fungicides to control the disease. This would threaten the competitiveness of the U.S. in world markets and cut very substantially into current exports, valued at about US\$800 million per year. A conservative estimate of U.S. benefits from all sources places benefits at US\$30 million per year, which represents the estimated difference between the value of crop production losses before the project and the value with losses representing only 1% of production.

**Project costs.** Most project costs were incurred by ICRISAT, USDA, INTSORMIL and Texas A&M University. Costs for just under two years incurred by all donors/project partners are estimated to total only slightly over US\$175,000—an extremely small amount when compared to the conservative estimate of annual benefits to the U.S. alone.

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## Saving the Livestock Industries of the Caribbean and the U.S. by Eradicating the Tropical Bont Tick

**Program Area.** Ensuring safe, high quality food; animal disease control

**Partners.** Caribbean countries and Belgium, the European Union, U.N. Food and Agriculture Organization (FAO), Holland, Germany, the Inter-American Institute for Cooperation on Agriculture (IICA), the International Fund for Agricultural Development (IFAD), Italy, the United Kingdom and the U.S. Department of Agriculture (USDA)

**Principal mutual benefits.** Eradication of the tropical bont tick in Caribbean countries will foster increased livestock production in this livestock-deficit region of the world and prevent the spread of the tick to mainland countries where losses could run to hundreds of millions of dollars annually.

**Issue.** A tick, spread by a bird, that kills livestock and damages hides and skins.

The tropical bont tick (*Amblyomma variegatum*)—first introduced into the Americas from Africa in the 19th century— infects wild and domestic animals, especially cattle, sheep and goats in the Caribbean region, with heartwater, a fatal disease. Tick bites are severe, producing septic wounds and abscesses that damage hides and skins. The tick also increases the prevalence of an acute bacterial skin disease. These fatal and detrimental effects of

the tick largely explain why Caribbean countries must import annually US\$100 million of livestock products to meet local demand, including that of the tourist industry.

The tick is also a threat to Florida and to Central and South American countries because it is spread by the cattle egret, which has a wide-ranging migratory pattern. USDA estimated in 1993 that the spread of the tick to mainland countries could produce losses of over US\$700 million annually.

**Project objectives and activities.** In 1986, eradication was shown to be feasible by FAO, IICA, the U.S. Agency for International Development (USAID) and USDA, and a project was developed to eradicate the tropical bont tick and heartwater disease from all infested Caribbean islands. If effective, the campaign would also eliminate the threat of the tick from all of the Western Hemisphere.

Islands and surrounding mainland areas were classified into three risk levels. High risk areas, those containing established populations of the tick, included Anguilla, Antigua, Barbados, Dominica, Montserrat, St.Kitts and Nevis, St. Lucia, and the five islands of Guadeloupe. Activities commenced in Anguilla, St. Kitts and Nevis in 1995, moved on to Montserrat and St. Lucia in 1996, and then to Antigua and Barbados in 1997. In these countries, program activities began with the

training of technical personnel responsible for the project, the dissemination of informational materials, an animal census and disease survey, and the purchasing of equipment and supplies. Eradication was then conducted with acaricide treatments of all livestock by their owners. Finally, national project staff perform follow-up surveillance until tick eradication is confirmed. To date, St. Kitts and Nevis, Montserrat and St. Lucia are in the final stages of eradication; Antigua is ahead of schedule.

The principal activities in medium- and low-risk areas have been public information and awareness campaigns, surveillance programs, training for surveillance personnel, and effective quarantine systems.

A Program Council (APC), acting as a Board of Directors, was constituted in 1994 by representatives of participating countries, international organizations and donors. Implementation falls to the Caribbean Community (CARICOM), FAO and IICA, which are responsible for the Project's Regional Coordinating Unit (RCU), composed of a program manager, a research and training officer, a veterinary research officer, and an extension and communications official.

**Developing country benefits.** Highest returns from the eradication program were estimated for medium-risk areas. Using a 6% discount rate and conservative assumptions, benefits were placed at 4.2 times costs. Benefits amounting to 2.3 times costs will be generated in the high-risk areas.

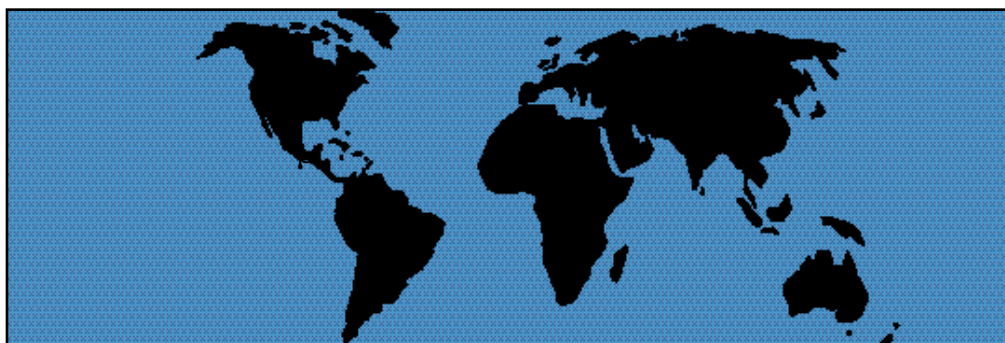
**U.S. benefits.** If the tick is not eradicated and migrates to Venezuela, the Greater Antilles and, most importantly, the U.S. mainland, losses could run to US\$762 million annually. This figure, dominated by U.S. losses, approximates the benefits to the U.S. to result from tick eradication.

**Project costs.** The project is to accomplish its aims in six years, at a total cost of US\$20 million. About US\$15 million of this amount is contributed by countries of the region for their national projects, with US\$7 million coming directly from local farmers and livestock producers. Another US\$5 million is contributed by donors to finance the RCU and the travel costs associated with APC meetings. Using a 6% discount rate, total costs come in at US\$12.3 million. This is a minuscule sum of money when compared to the mutual benefits resulting from the eradication of the tropical bont tick.

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## Reducing Chemical Residues on Snow Peas

**Program Area.** Ensuring safe, high quality food

**Partners.** Del Valle University, National Institute of Agricultural Technology (ICTA) and the Ministry of Agriculture in Guatemala; the Integrated Pest Management (IPM) Collaborative Support Program (CRSP) (with inputs mainly from Purdue University and Ohio State University, in this instance, but managed by Virginia Technical University), and the U.S. Department of Agriculture (Agricultural Research Service (ARS) and Foreign Agricultural Service (FAS))

**Principal mutual benefits.** U.S. consumers benefited from the availability of a US\$40 million flow of snow peas free from the health hazards of chemical residues. Some 20,000 Guatemalan producers have secured this market and their livelihood through continued exports of US\$40 million of snow peas to the U.S.

**Issue.** Reducing chemical residues on snow peas.

Over the past 15 years, non-traditional agricultural exports from Central America to the U.S. have increased about 10 times, with three quarters of these exports currently comprising fruits and vegetables. Three countries—Costa Rica, Guatemala and Honduras—account for 90%. Costa Rica's non-traditional agricultural exports are dependent on a single commodity, namely pineapples. Though representing a smaller share of Central America's non-traditional agricultural exports,

Guatemala's agricultural exports are, by contrast, highly diversified. In the Central American region, Costa Rica and Guatemala are considered the most competitive, but with potential still remaining for an expansion of non-traditional agricultural exports.

Exploiting that potential requires addressing non-economic constraints, notably U.S. food safety standards related to phytosanitary conditions and contamination from disallowed chemicals. Between 1984 and 1994, over 3,000 non-traditional agricultural export shipments from Guatemala worth US\$18 million were detained or rejected at U.S. ports.

This situation is exemplified by the case of the snow pea, a temperate climate crop cultivated in Guatemala's central highland districts by 20,000 small producers, each with less than 0.5 hectares in snow pea production. (These producers are thought to support a total population of over 100,000 people.) Insect and disease infestations have led these farmers to rely excessively on chemical control measures. When a leaf miner outbreak occurred in 1995, chemical controls resulted in a USDA Plant Protection Quarantine (PPQ) being imposed on all Guatemalan snow pea imports at U.S. ports of entry. (In its adult stage, the leaf miner looks like a fly. It lays eggs at the base of the plant, the leaf miners emerge from the eggs, then make their way to the pea pods, where they feed by boring small brown-stained tunnels through the snow peas.) Lost exports by



Guatemalan snow pea producers in 1996 alone were valued conservatively at US\$6 million.

**Project objectives and activities.** Against this background, Del Valle University, ICTA and the Ministry of Agriculture in Guatemala; Purdue and Ohio State Universities in the U.S., as members of the IPM CRSP which is managed by Virginia Tech University; and USDA's ARS and FAS joined forces to help get the quarantine lifted and to develop longer-term solutions to the excessive reliance on chemical control by Guatemalan non-traditional agricultural export producers.

First, efforts focused on the immediate problem of the PPQ. It was scientifically proven that the Guatemalan leaf miner was not a species exotic to the U.S. and thus not a threat to U.S. producers. The partners also tested several strategies to reduce chemical residues on snow peas and to enhance product quality. These proved successful, and the PPQ was lifted just 13 months after it was imposed. Annual shipments of snow peas from Guatemala to the U.S. resumed.

Efforts then turned to developing strategies to reduce reliance on chemicals more generally. Nine field test sites were established in representative production areas, with control plots being managed by local producers and IPM plots being managed by CRSP agronomists and field technicians. Few producers were acquainted with integrated pest management strategies, as most relied on agrochemical distributors for their pest management information.

Leaf miners were found to be the major pest problem in snow peas. Weekly samples of leaf miners were taken to determine adult insect pressures and necessary pesticide applications. The earlier research which resulted in the lifting of the PPQ in U.S. ports assisted greatly with the design of this later phase of the research, involving a reduced number of applications of Environmental Protection Agency-approved agrochemicals and the use of sticky traps to reduce adult insect leaf miner pressure. Other measures were also incorporated into the IPM test plots to reduce adult leaf miner reproductive capacities.

Results? It was found that the number of pesticide applications could be reduced by two thirds, from

an average of 10.4 to 3.7 applications. Introduction of the practice of using fewer applications resulted in marketable snow pea yields that are almost 25% higher, improved product quality (as measured by marketable production at the shipping point grading station), lower production costs, and improved returns to producers and their families. Project partners were also instrumental in getting growers and exporters in Guatemala to institute effective pre-inspections to ensure that snow peas exported to the U.S. are free from pests and pesticide residues at their embarkation points. At present, 40% of the exported volume of snow peas passes through this pilot pre-inspection program, and all farmers of this product are using the best cultural practices recommended by the project.

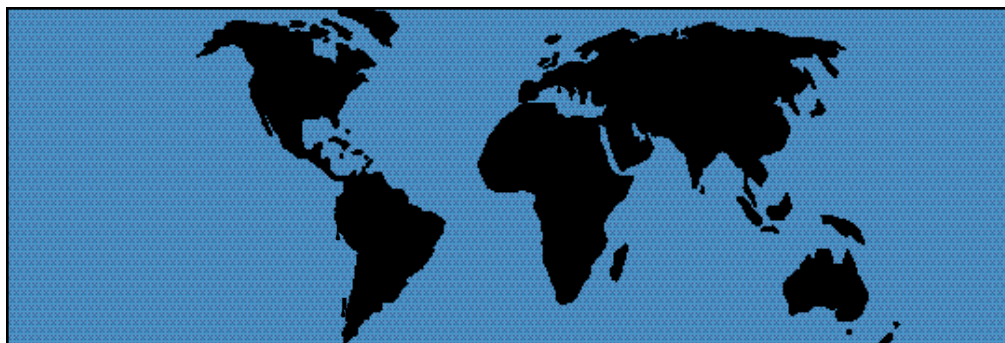
**Shared mutual benefits.** U.S. consumers benefited from the project's sustaining a US\$40 million flow of snow peas that would not threaten their health with chemical residues. Because the kind of leaf miner found in Guatemala is prevalent in the U.S., research and protocols developed in Guatemala will find applications in this country for bean and pea crops for fresh produce markets. Guatemalan producers –including 20,000 who support a total population of over 100,000– have secured their livelihoods through the continued annual sales of US\$40 million of snow peas as non-traditional agricultural exports. Moreover, the strong partnerships that developed between U.S. and Guatemalan professionals have spun off additional joint ventures on brambles, broccoli and sugar snaps, further benefiting the local population and U.S. consumers.

**Project costs.** About US\$50,000 of core funding from the IPM CRSP supported the project, which was matched by US\$25,000 of cost sharing on the part of U.S. institutional partners and US\$20,000 by Guatemalan partners. In short, one year of snow pea exports from Guatemala to the U.S. is worth several hundred times the cost of the project.

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### **Fruit Fly Eradication: The Binational Campaign of Chile and Peru**

**Program Area.** Ensuring safe, high quality food

**Partners.** Servicio Agrícola y Ganadero (SAG), Chile; Servicio Nacional de Sanidad Agraria (SENASA), Peru; Inter-American Institute for Cooperation on Agriculture (IICA), Costa Rica, Chile and Peru; and the International Agency for Atomic Energy (IAEA), Austria

**Principal mutual benefits.** The annual value of Chilean and Peruvian fruit exports will be increased significantly with the eradication of the fruit fly and a year-round supply of fruit will be assured to the U.S., which is the two countries' largest export market.

**Issue.** Chile (in 1963) and Peru (in 1957) launched campaigns to eradicate the fruit fly, which was seriously threatening fruit production and fruit exports because of plant quarantine restrictions in many countries. The fly's disastrous effects begin when it lays eggs on mature fruit; the resulting larvae enter the fruit and ruin its contents before re-emerging as mature fruit flies, leaving holes that are penetrated by other contaminants (fungi in particular) which further destroy the fruit.

By 1990, the Chilean campaign—relying heavily on chemical treatment—successfully eliminated all outbreaks of the fruit fly, except in the extreme northern Region I of Arica (state-level entities in Chile are called "regions"). This was because effective barriers did not exist at the Chile-Peru border as the Peruvian campaign had lacked conti-

nuity and the fruit fly continued to be a reasonably widespread pest. As a result, the plant quarantine services of many countries would not accept Chilean fruit because of the continued presence of the fruit fly in that country.

With the credibility and support of IICA, conversations were held for eight years (1981-89) between Chilean and Peruvian authorities in an attempt to resolve this problem and eliminate the fly from the border areas of the two countries. These conversations were unproductive at the outset, largely because of the history of conflicts and tensions between the two countries (including the "Pacific War"). In addition, Peruvian fruit production in the Department of Tacna (in Peru, states are called "departments") at its border with Chile was not economically significant, as Tacna was chiefly used as a transshipment point for fruit produced in the interior of the country.

The stalemate was broken when it was suggested that a binational project employing the "sterile insect technique" (SIT) to eliminate the fruit fly in Arica and Tacna could strengthen ongoing eradication efforts. Peru's sterile fruit fly production plant at La Molina had a surplus capacity that could be brought on stream by the project, replacing the chemical control of fruit flies—costly and environmentally unsound—with a biological control that effectively curtails fly reproduction. This proposal was accepted by Chile because of its long-time concern about the intensive use of chemical pest controls.

**Objectives and activities.** When the project was finally agreed to, three objectives were set: elimination of the fruit fly from the binational border area, approval of "fruit fly free status" for Chile, and the launching of an ambitious fruit fly campaign in selected valleys on the western coast of Peru that offer the greatest promise for fruit production and exports.

Project activities were launched in 1991, utilizing integrated pest management (IPM) techniques. First, the quarantine area was defined to include Chile's Region I and Peru's Tacna and Moquegua Departments, the latter being added so the binational project would overlap with a part of Peru's national fruit fly eradication program. Second, reliable detection methodologies were agreed to and implemented, involving the establishment of a network of traps and sampling techniques. Third, sterile fruit flies were produced, initially at the La Molina center and later in Chile, after Chile built a modern facility near the site of the binational project. Since then, all project sterile fruit flies have been produced in Chile. Together with the distribution of the sterile flies from airplanes, this is the most tedious, demanding and costly aspect of the project. Fourth, quarantine regulations for the Peruvian-Chilean border were agreed to, in part because of the large volume of trade in fruit between the two countries.

Although to date only one of the three project objectives has been achieved (Chile has been declared fruit fly free), good progress is being made with regard to the other two. During the 1991-1998 period, the project had to be renewed on an annual basis. When it was recognized that the binational effort would need to continue if the gains achieved in eradication were to be sustained, an open-ended extension for an indefinite period of time was signed in October 1999.

**Benefits for Chile and Peru.** Most importantly, on December 14, 1995, Chile was declared fruit fly free, an advantage estimated to have increased producers' returns by at least US\$500 million annually, representing about 40% of the average annual value of Chilean fruit production since 1991. Fly populations in Peru's Tacna Region have been reduced to what is technically termed the "suppression level." An Inter-American Development Bank/Peruvian mission estimated

that the country's export returns should increase by US\$100 million once the fly has been eliminated completely from Tacna and the western coastal area. This represents an almost 80% gain in the 1991-98 average annual value of Peruvian horticultural exports!

Major advances have also been made in upgrading the skills of human capital in both countries to control the fruit fly; these professionals are now equipped to control other diseases that may arise in the future. In sum, Chile and Peru are in a position to resolve speedily international sanitary issues that in the past could have taken years to overcome. Finally, new partners have been attracted to join and finance the project, for example, the IAAE, as well as private organizations that want to enter into production in Chile or Peru by reason of their efforts to control the fruit fly.

The project's positive results have moved Chile to establish a similar binational program with Argentina. It has also served as a model for collaboration among other countries of the Andean region.

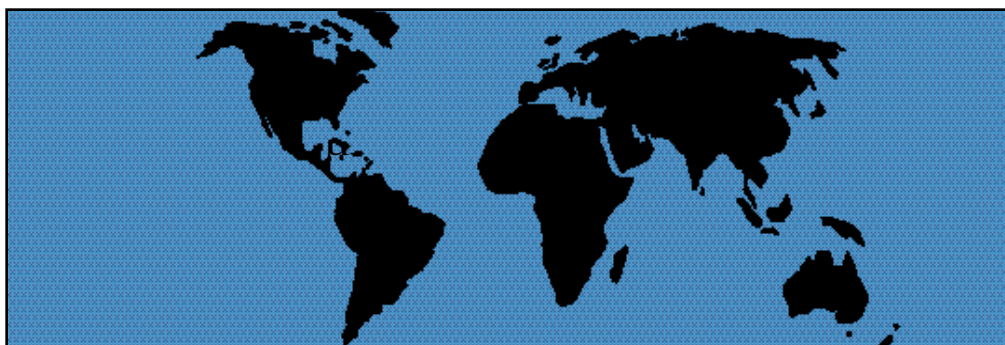
**U.S. benefits.** U.S. consumers, the principal buyers of Chilean and Peruvian fruit, receive major benefits (represented by an additional US\$600 million in U.S. imports) because they are able to buy fresh fruit year round. Moreover, USDA quarantine inspection costs are reduced because pre-inspection stations are mounted in originating countries, once high levels of pest control have been achieved.

**Costs.** No more than US\$5 million in total was contributed to the project by the governments of Chile and Peru, the IAAE, and IICA during the eight-year period (1991-99). This represents about one percent of the value of estimated export gains for just one year.

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### **Preventing Screwworms from Re-invading the Livestock Industry in the Americas**

**Program Area.** Ensuring safe, high quality food; animal disease control

**Partners.** U.N. Food and Agriculture Organization (FAO) and the Cuban Institute of Veterinary Medicine

**Principal mutual benefits.** Preventing a re-invasion of screwworms in the livestock industry of the Americas will make it unnecessary to mount another eradication campaign; the earlier 1960s campaign that successfully eliminated the parasite from seven countries (200 million hectares) in the Western Hemisphere cost US\$500 million.

**Issue.** Preventing economic loss caused by a livestock parasite

The screwworm, a major current and potential problem of the livestock industry in the Americas, is a parasite that affects humans and animals. It is caused by the larvae of a fly (*Cochliomyia hominivorax*) which invades and infects the wounds of warm-blooded animals. Mating only once, the female lays one or more batches of up to 300 eggs at the edge of any wound or skin abrasion, however small. Within 24 hours the larvae develop and burrow into the living flesh, creating large, deep, open wounds which attract further egg-laying females and frequently lead to the animal's death.

As late as the 1960s, New World Screwworms (NWS) blighted livestock from central U.S. to northern Chile, including the Caribbean. An ambitious eradication campaign was launched that successfully eliminated the NWS from Belize, El Salvador, Guatemala, Honduras, Mexico, Panama and the U.S., on the mainland. However, in the Caribbean, the NWS continued to be a major problem affecting wild and domesticated animals. In October 1995, it was first reported in Cuba. Because the parasite can easily re-invade areas from which it has been eradicated, its presence anywhere in the region represents a threat to other parts of the hemisphere. Cubans had been treating the parasite manually, using local remedies of doubtful effectiveness; more effective is the periodic use of insecticides in topical or bath applications.

FAO sent an EMPRES (Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases) evaluation mission to Cuba when the NWS was first reported there. That mission concluded that the problem was severe and probably worsening as a result of the scarcity of insecticides in the country and Cuba's difficulties in buying ingredients to produce insecticides locally. It was also judged likely that a more severe outbreak of the pest in Cuba could result in its expansion into disease-free countries.

FAO estimated that in Cuba alone, the pest was causing economic losses (conservatively calculat-

ed) amounting to around US\$36 million annually, not including the value of the weight lost by infected animals, the additional manpower needed to control the pest, livestock hides destroyed, and decreased milk production. Given the magnitude of loss, FAO and Cuba concluded that a campaign to control the pest, followed by a NWS eradication program, would be fully justified.

**Project objectives and activities.** The project, implemented over a 24-month period, commenced in Cuba with the adoption of the modest objectives of surveying the geographical distribution and seasonality of the disease, and establishing effective systems to control and monitor it.

In support of these objectives, the following project activities were agreed to by FAO and Cuban authorities: assessment of the economic and production losses caused directly by NWS; training of Cuban professionals in methods to survey, monitor and control the parasite, as well as raising awareness about the disease and its control among rural populations; evaluation of appropriate control methods for local conditions; design of a control strategy; reduction of the risk of the disease spreading beyond Cuba (mainly through more effective controls in animal trade); and development of a follow-on eradication project, based on the experience of the control campaign and including identification of potential donors for the follow-on phase.

FAO agreed to provide 29 person-weeks of short-term technical assistance, involving a NWS control and monitoring expert, an expert in screw-worm breeding in high-security laboratories, an economist, and a communications specialist. This technical assistance was to be provided in three missions to Cuba during the project period. In addition, the national coordinator was sent to Costa Rica and Mexico to familiarize himself with their control and eradication programs, and 750 Cuban professionals were financed to attend training courses offered at Cuba's Institute of Veterinary Medicine. Cuba agreed to add technical personnel to manage the statistical information produced by this initial project.

**Developing country benefits.** This project has served primarily to position Cuba to be able to launch a full-scale NWS eradication campaign.

This first-phase control project demonstrated that the parasite can be completely eradicated from the country in a matter of four years, at a total cost of US\$65 million, using the Sterile Insect Technique. This involves releasing sterile flies into the environment that produce infertile eggs, arresting the development of larvae that create tissue damage in animals. The benefits of eradication have been estimated at about four times the cost of the eradication effort.

Other specific benefits of the control program include establishment of a communications system for small farmers in the country which involved them in the survey, monitoring and control of NWS. This included distribution of 182,000 NWS treatment kits and the development of mechanisms to prevent infestations of NWS-free areas.

**Benefits in the Americas.** The earlier eradication campaign in the Americas launched in the 1960s covered over 200 million hectares in seven countries, including the U.S., at a total cost of US\$500 million. Total economic benefits were estimated to be six times this, or US\$3 billion. Should Cuba not eradicate the NWS and the disease again invade the same countries with equal intensity, the benefits foregone in the Americas could be as high as US\$3 billion, which represents a measure of the real cost of inaction. To assess accurately the benefits foregone, they are multiplied by the estimated probability of parasite re-invasion in the formerly affected area and countries, which would appear to be very substantial.

**Project cost.** The cost to FAO of the project was US\$353,000.

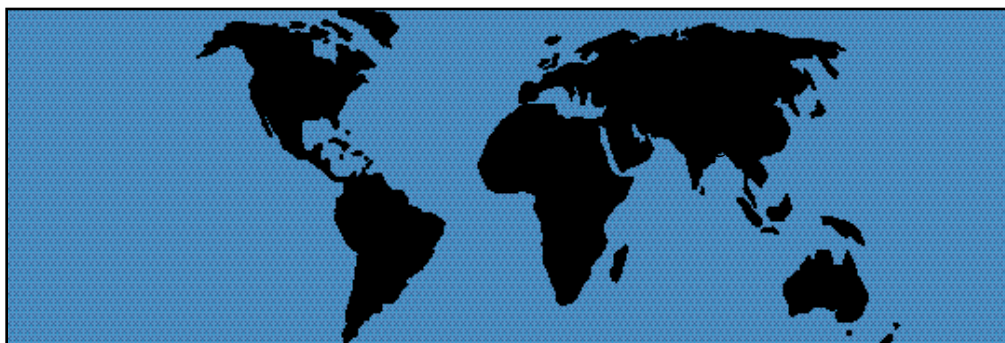
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## **II. Expanding Trade and Developing Business**

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## Promoting Private Agribusiness in Bangladesh

**Program Area.** Expanding trade and developing business

### Partners

**Bangladesh** Ministry of Agriculture, private farmers, input dealers and food processors.

**U.S.** U.S. Agency for International Development (USAID), International Fertilizer Development Center (IFDC) with RONCO Consulting Corporation, and Winrock International.

**Principal mutual benefits.** Formerly dependent on massive U.S. food aid, Bangladesh has achieved self-sufficiency in rice, the principal staple. Policy reforms, coupled with technical assistance and credit programs, have begun to open the economy to agri-entrepreneurs. U.S. agribusiness exports (fertilizers, poultry, processing equipment) to Bangladesh have increased dramatically.

**Issue.** Build confidence that market-driven agribusiness can serve Bangladesh

At independence in 1971, Bangladesh faced severe problems. One of the world's poorest and most densely populated countries (130 million people live in an area about the size of Wisconsin), it depended heavily on foreign aid for critical food imports. Though most of its people were farmers,

an inefficient government marketing system, an ineffective government-run inputs supply enterprise, and an inconsistent maze of public policies thwarted adoption of technology and open, competitive activities that could improve productivity, incomes and food security. During the 1980s and early 1990s, IFDC led efforts at all levels of the fertilizer distribution chain to show that the private commercial sector could do a better job of meeting farmer needs. The government stopped its subsidies and let the private sector distribute fertilizer. Building on that success, the Ministry of Agriculture invited IFDC to help promote a private agribusiness sector to increase value-added production.

**Project objectives and activities.** The Agro-based Industries and Technology Development Project (ATDP) is a unique partnership of public, private commercial and non-governmental organizations, the goal of which is to increase productive business and employment in agriculture and the rural sector of Bangladesh. The five-year project, which ended in July 2000, aimed to:

- strengthen the technical and financial capacity of agribusiness enterprises so they can increase agricultural inputs, production, processing and marketing;
- forge linkages among agro-enterprises and partners who can support them; and

- promote efforts to create a policy environment that will encourage the expansion of private commercial sector activities.

The project worked in eight sub-sectors (including the dairy, poultry, fruit and vegetables industries) and reaches clients through eight field offices. To promote business ties, ATDP helped Bangladesh firms locate suppliers and markets overseas. The project had links with the U.S.-Bangladesh Business Council and USAID's Global Technology Network.

**Developing country benefits.** With the collaboration of the agricultural extension service and a local non-governmental organization, the project promoted the widespread use of a new fertilizer technique (hand-placing of urea super granules in rice fields) that significantly increases production and farmer returns while reducing fertilizer consumption. Project-advocated policy reforms adopted by the government have reduced tariff and other barriers and created a more attractive environment for agribusiness.

As a result of improved technology, policy reform and hands-on technical and business assistance, Bangladeshi farmers began to export potatoes in 1999. In addition, some enterprises are producing frozen french fries. Shrimp exports to the U.S. and to the European community are growing rapidly, and poultry production is expected to double in 1999 alone. As a result of these and numerous other successes, both the government and the

expanding agribusiness sector are gaining confidence in free market forces.

**U.S. benefits.** Improving agribusiness in a nation once described as "a basket case" has made Bangladesh less reliant on foreign aid for food security, producing budget savings for the U.S. government. At the same time, U.S. exports to Bangladesh continue through private commercial channels and Bangladesh is now purchasing U.S. commodities and equipment with its own resources, opening possibilities for a growing number of business ties. For example, commercial agro-exports, mainly fertilizers, from the U.S. increased from US\$6.8 million in 1997 to US\$20.6 million in 1998. In just the first half of 1999, over US\$19 million of such U.S. exports were destined for Bangladesh.

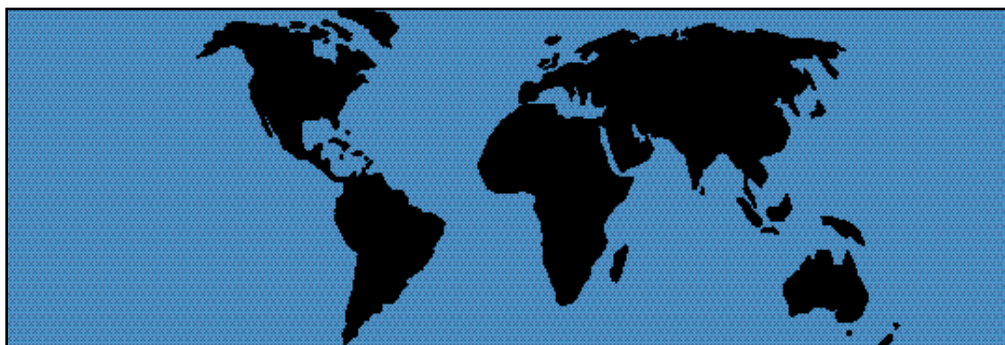
**Project costs.** In addition to the US\$10 million provided by USAID through the ATDP project, the Bangladesh Ministry of Agriculture has made available from its own resources a US\$26 million agribusiness credit fund and US\$4 million in technical assistance and other items from regular budget resources.

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## Establishing an African Seed Trade Association

**Program Area.** Expanding trade and developing business

### Partners

**U.S.** American Seed Trade Association (ASTA), U.S. Department of Agriculture (USDA)

**Overseas.** International Seed Trade Federation (FIS), The Seed Company of Malawi, and the Malawi Ministry of Agriculture and Irrigation

**Primary mutual benefits.** Creating a viable African Seed Trade Association will foster development of a modern, competitive regional seed industry throughout Africa and encourage private sector growth. As African countries receive information on U.S. biotechnology, seed technology and seed regulatory systems in a free, competitive market, this will translate into increased U.S. seed exports to that region.

**Issue.** In 60% of African countries, the seed industry is controlled by state monopolies. Despite decades of donor assistance for agricultural development, these countries lag far behind the rest of the world in seed sector development. Most have not taken the necessary steps toward global integration of their seed sector, especially in terms of agricultural research, seed regulation and commerce.

Although government control of seed production and distribution has declined in many countries, a viable commercial market has not yet filled the gap. The private sector, both indigenous and multinational, has much to offer in terms of technical expertise, technology and monetary resources. However, it is over-regulated and has suppressed participants in seed sector development schemes, due primarily to a limited understanding of the private sector's potential contribution to seed sector and agricultural development, as well as of the synergy that can exist between public and private institutions and organizations.

The African Seed Trade Association, the first initiative of its kind to organize and empower the private seed sector in Africa, held its first organizational meeting on April 8-10, 1999 in Lilongwe, Malawi. Representatives of national seed trade associations and enterprises from 16 African countries, as well as representatives of international organizations, trade associations and NGOs, attended. Participants voted to create the African Seed Trade Association (AFSTA), which will determine the location of its permanent secretariat and adopt its charter at a later date.

**Developing country benefits.** With a successful organization of the African seed sector, seed producers worldwide can work together to build a commercial sector that can develop viable systems for agricultural technology transfer. Donor and seed industry support will enable such an organization to eventually administer technical assis-

tance and agribusiness management skills, to association members with the purpose of improving their commercial viability. A strong association will enable the African seed industry to work with government representatives to develop seed regulatory systems and intellectual property protection mechanisms that promote private seed commerce not only at the national and regional levels, but throughout Africa. It can also forge closer ties with national and regional agricultural research institutes in order to improve the transfer of improved seed varieties to African farmers. Finally, a strong African Seed Trade Association can collect and provide market information to its membership to assist them in their market development pursuits.

**U.S. benefits.** Successful implementation of this project will provide a cadre of public and private sector individuals in each African country with information on U.S. biotechnology, seed technology and seed regulatory systems in a free, competitive market. Over the next five years, this could translate into well over a 5% increase in U.S. seed exports to combined target countries. It would also be beneficial for trade in commodities produced with biotechnology-derived seed products,

currently including cotton, corn, soybeans and some vegetables.

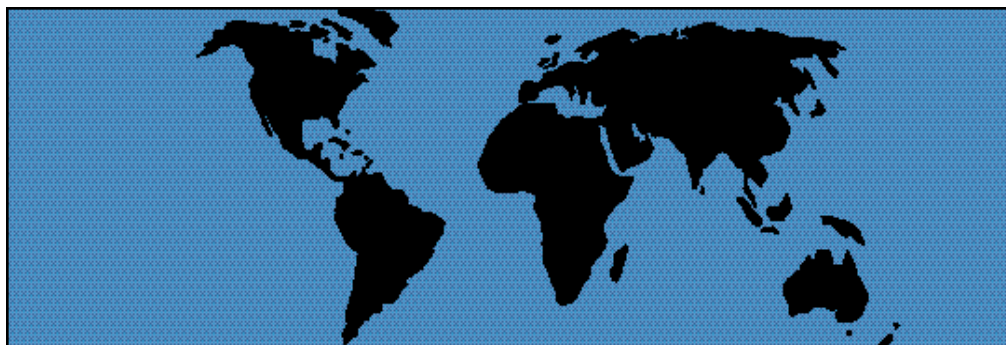
The project will also promote regional integration and harmonization of seed policies and regulations supportive of U.S. seed trade in target countries/regions. Seed associations, open to public and private seed company membership, serve to lobby and influence governments, foster the exchange of information and, generally, ease barriers for an effective transfer of improved varieties.

**Project costs.** The cost of the initial AFSTA meeting was US\$65,000, which was contributed by ASTA, the Seed Company of Malawi and the Malawi Ministry of Agriculture. However, the association plans to be financially self-sufficient in the near future.

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### **Trade Links in Egypt: More Than Cows and Sheep**

**Program Area.** Expanding trade and developing business

**Partners.** Agricultural Cooperative Development International/Volunteers Overseas Cooperative Assistance (ACDI/VOCA) and the U.S. Agency for International Development (USAID)

**Project objectives.** Known as "AgLink," this project links U.S. and Egyptian agribusiness for technology transfer, trade development and increased Egyptian exports

**Principal mutual benefits.** AgLink impact data show a 37% increase in Egyptian client milk production and an almost 29% increase in meat production since the project was launched in 1997. AgLink has facilitated trade linkages with a potential value of over US\$30 million for U.S. businesses. These linkages form the structure for Egypt's future sustainable growth in international trade and export.

**Issue.** Egyptian livestock and dairy products are not competitive in the world market due to deficiencies in quality, quantity and marketing. Technology transfer raises quality, efficiency and production, which will result in the placement of more and better products on domestic and world markets.

**Project activities.** After two years of operation, AgLink has expanded its client base to 67; in addition, 18 new clients will participate in AgLink's new Lamb Export Development Sector. These clients receive a variety of services including onsite expert consultations, workshops, demonstrations, seminars and training courses. Outreach activities extend linkage opportunities exponentially.

Clients participate in exchange travel programs to the U.S. where they gain access to new technology and trade opportunities, visit farms, and attend conferences and courses. A recent visit to Egypt by a representative of the Farmer's Commodities Corporation resulted in the visit of 18 Egyptian grain traders to the U.S. to attend training on risk management and hedging. Another group will attend the U.S. Dairy Expo in the fall.

Egyptian client needs represent trade opportunities for U.S. businesses (suppliers of equipment, live animals, veterinary care products and feed nutrients, etc.). The Egyptian market holds tremendous potential as it has been growing at over 5% each year for the past several years and privatization is increasing.

To enhance this growth, AgLink operates a trade inquiry system, encourages exchanges between private U.S. and Egyptian companies, and works individually to bring potential buyers and sellers

together. AgLink consultants work directly with clients to improve Egyptian product quality and management skills, including facilitating trade and export linkages.

**Main benefits for Egypt.** Recent project impact data show a 37% increase in AgLink client milk production and an almost 29% increase in meat production since the project was launched in 1997. This dramatic increase is the result of the implementation of over 1,800 technology recommendations to Egyptian farms and firms.

These statistics represent a significant contribution to the personal income of Egyptian farmers and firm clients as well as to GNP. As the spread effect of technology transfer introduced and promoted by AgLink takes hold, impact will begin to reach smaller farmers. Thus, the use of improved practices and technology will be a viable means of alleviating poverty in Egypt. As Egypt moves to expand export development, these improvements will be benchmarks for success.

**Main benefits for the U.S.** To date, AgLink has facilitated trade linkages with a potential value

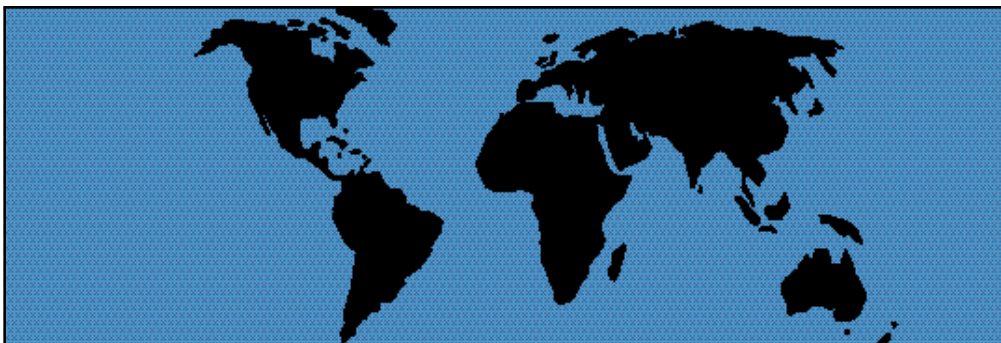
of over US\$30 million for U.S. businesses. Excellent trade opportunities exist in Egypt as AgLink continues to open avenues for trade exchange for U.S. and Egyptian agribusiness. These linkages form the structure for Egypt's future sustainable growth in international trade and export.

**Total cost.** US\$9.1 million. Recently, AgLink implemented "cost sharing" with clients as an exit strategy for project completion in 2001. AgLink expects to share 10% of program costs with clients and vendors in 1999 and, by project end, cost sharing will cover 30% of program costs.

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**Development and Implementation of Plant Variety Protection (PVP) Legislation in Morocco**

**Program Area.** Expanding trade and developing business

**Overseas partners**

- Direction de la Protection de Vegetaux, de Controles Techniques et de la Repression des Fraudes (DPVCTRF) (the division of the Moroccan Ministry of Agriculture that regulates plant importation and exportation); Moroccan Agribusiness Project (MAP)/ Development Alternatives International (DAI)

**US Partners**

- Agricultural Biotechnology Support Project (ABSP), Michigan State University; the U.S. Agency for International Development (USAID)

**Primary mutual benefits.** This project opened new markets for U.S. private sector companies. The Moroccan market was previously closed to such companies because the country lacked national intellectual property protection, specifically plant variety protection (PVP). For its part, Morocco gained the ability to access new improved crop varieties for local consumption and export.

**Issue.** Enhancing trade opportunities through plant variety protection

Agriculture plays a key role in Morocco's economy, employing about 40% of the labor force and contributing about 18% of Morocco's gross domestic product. Morocco actively trades fresh and processed agricultural products in European markets. In order for it to compete in international markets with other exporting countries, it needs access to practical biotechnology applications that can quickly introduce selected traits in order to resolve production problems and accelerate large-scale propagation of disease-free plants.

Until recently, breeding for the purpose of improving crop varieties was primarily the domain of the Moroccan public sector. Through the Moroccan Agribusiness Project, USAID became aware that the private agricultural sector was being denied access to varieties improved by U.S. companies because of a lack of national intellectual property protection, specifically plant variety protection (PVP). The Morocco private sector had developed improved crop varieties (e.g., citrus) that it could not protect. In addition, its horticultural sector was paying a high cost because it was denied access to new plant varieties and genetic materials, for example, strawberries, peaches and other tree fruit, date palm and flowers.

## **Objectives**

- To promote Moroccan/US agribusiness partnerships
- To develop national policies promoting investment in agriculture and agribusiness

## **Project activities**

- DAI/MAP promotion of US-Moroccan joint ventures
- DAI/USAID work with the private sector and the Moroccan government to develop plant variety protection legislation
- ABSP, DAI and USAID-organized workshops in Morocco to discuss the implementation of plant variety protection legislation
- ABSP training for Moroccan DVPCTRF staff regarding the establishment and operation of a plant variety protection office

**Total project costs.** ABSP operated with a US\$200,000 budget from USAID/Morocco; DVPCTRF covered local administrative and workshop costs.

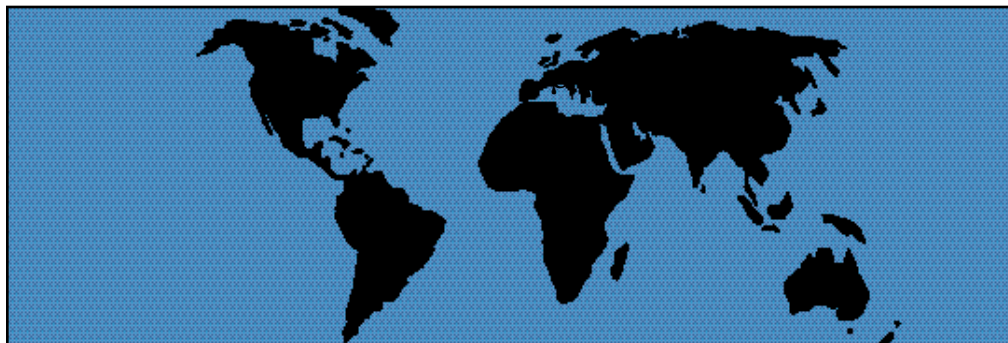
**Benefits to developing countries.** Morocco gained the ability to access new improved crop varieties for local consumption and export.

**Benefits to the U.S.** The project opened potential new markets for producers in the U.S.. Economic benefits will become more quantifiable when policy changes have been in effect for a longer time period.

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### **The U.S./Eastern Europe Market Information Project**

**Program Area.** Expanding trade and developing business

**Partners.** Economic Research Service (ERS)/ U.S. Department of Agriculture (USDA), the ministries of agriculture and the agricultural economic research institutes of Bulgaria, Czech Republic, Poland, Romania and Slovakia.

**Mutual benefits.** East European institutions are now producing more timely and accurate market information, both in English and in the native languages of the participating countries. The information helps policy makers and agribusiness in both Eastern Europe and the U.S. make better informed market decisions.

**Issue.** Upgrading capabilities in transitional economies for data collection and analysis

ERS received funds from the SEED Act (Support for Emerging European Democracies) and the USDA's Emerging Markets Program to develop institutions in transitional economies so as to equip them to collect, analyze and disseminate the economic information necessary for the functioning of market economies.

**Project activities and objectives.** From 1991 to 1998, ERS organized technical assistance for commodity market analysis in several Central and East European countries: Bulgaria, Czech Republic, Poland, Romania and Slovakia. These

efforts were funded partially through the SEED Act and partially through USDA's Emerging Markets Program. Counterpart institutions were the ministries of agriculture and the agricultural economic research institutes of those countries.

The ERS program had two principal objectives. The first was to help counterpart institutions build a program for publishing regular commodity market reports on major markets in the country, providing an analysis of the current situation in commodity markets and short-term forecasts of supply, demand and prices. ERS provided training in the fundamentals of economic analysis and taught counterparts how to present the results in readable format. Counterparts were also helped to identify and reach their target audience.

The second objective of the ERS program was to provide training in short-term policy analysis, with the aim of providing objective analysis of the economic impacts of alternative policies and programs proposed by high-level officials.

**Developing country benefits.** ERS trained over 100 East European analysts in the fundamentals of economic analysis and forecasting. Many of these counterpart personnel have gone on to train others, and many have been promoted to important policy positions. As a result of this training, they have helped their ministries implement policies that are more supportive of free markets.

Counterpart institutions in Central Europe are publishing regularly scheduled reports providing analysis and short-term forecasts for key commodity markets in those countries. These reports provide the fundamental market information that farmers and agribusinesses need to make appropriate decisions on production, purchasing, marketing and foreign trade.

**U.S. benefits.** These projects benefited the USDA and the U.S. agribusiness community in several ways:

- USDA analysts now have access to better information on the Central European market. This is an important benefit because, as USDA was downsized, it is not able to devote resources to collecting detailed economic information from these countries.
- USDA now receives better reports from the embassies in the region as a result of their interaction with ERS counterparts.
- Many of the analysts trained through these programs have been promoted to high-level policymaking positions in their governments and are using their training to make more enlightened policy decisions.

- East European analysts trained through these programs are also contributing to analysis produced by the Organization for Economic Cooperation and Development (OECD), which is an important source of information for policy makers in all OECD countries.
- U.S. agribusiness has more accurate information on which to base investment and trade decisions.

**Costs.** Project costs totaled US\$6.85 million, with the following contributions being made by project host countries:

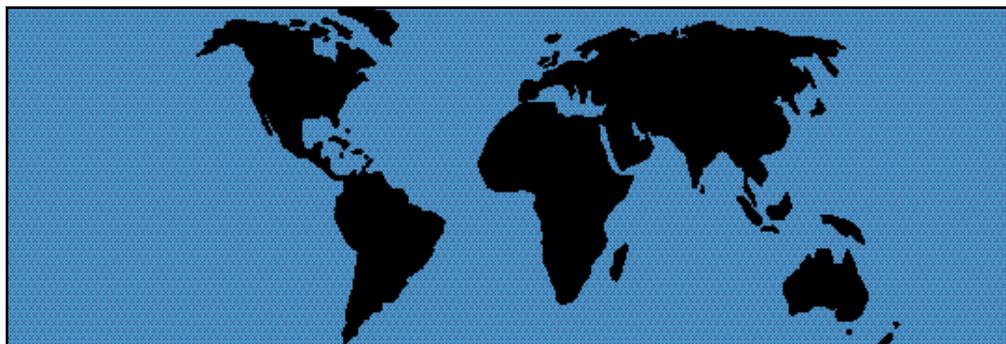
Poland	US\$3.0 million
Czech and Slovak Republics	US\$0.35 million
Romania	US\$1.50 million
Bulgaria	US\$2.00 million

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## Developing a Seed Industry in the Republic of Georgia

**Program Area.** Expanding trade and developing business

### Partners

**U.S.** Agricultural Cooperative Development International/Volunteers Overseas Cooperative Assistance (ACDI/VOCA), the U.S. Agency for International Development (USAID), the U.S. Department of Agriculture (USDA)

**Developing country.** Republic of Georgia

**Principal mutual benefit.** This project provides the technical expertise needed to develop a seed industry in the Republic of Georgia and encourages agribusiness expansion through rural credit activities, while developing potentially lucrative business relationships with U.S. agriculture and machinery producers.

**Issue.** The Republic of Georgia has negligible domestic seed production and opportunities for producers to receive credit for agricultural production. In addition, there is little free market infrastructure to assist in the development of either the seed industry or credit institutions.

**Project objectives and activities.** The Seed Enterprise Enhancement and Development (SEED) project focuses on two complementary areas of agricultural development. First, the project

stimulates agricultural production by fostering the development of a domestic seed industry in the Republic of Georgia, with emphasis on maize, wheat, sunflower and potato seed. Secondly, the project uses capital through a localized credit cooperative framework, enhancing local farmers' ability to take advantage of new investment opportunities and to receive returns on those investments.

**Developing country benefits.** Members of the farming and agribusiness community in the Republic of Georgia are witnessing the advantages of having a reliable domestic seed market and reliable access to credit. This is allowing local farmers and producers to begin expanding from local or subsistence farming to larger-scale operations, which can lead to their becoming regional producers, as well as trading partners with other countries. The project is also developing the food and employment market in this otherwise rural and underdeveloped former Soviet Republic. Finally, grassroots economic expansion and access to credit for food production are increasing pro-market, pro-democratic opinion in a region that has seen a great deal of instability and conflict in the last decade.

**U.S. benefits.** This project develops business relationships between agriculture and machinery producers in the U.S. and the Republic of Georgia, and is developing a potentially lucrative trading

partner for the U.S. Seed varieties from major U.S. seed manufacturers, including Monsanto and Pioneer, are currently being tested for soil, climate and growth potential.

**Funding/project costs (including cost sharing)**

USAID technical assistance	US\$3 million
USDA monetized funds	US\$637,000
ACDI/VOCA matching of volunteer resources (through the Farmer-to-Farmer project)	US\$500,000

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### **Developing the Dairy Industry in Moldova and Ukraine**

**Program Area.** Expanding trade and developing business

**Partners.** Small, private U.S. project engineering and investment companies; three dairies in Moldova and Ukraine; World Bank Rural Finance Corporation (RFC); U.S. Agency for International Development (USAID); Citizens Network for Foreign Affairs (CNFA)

**Principal mutual benefits.** This project resuscitated a moribund dairy in a depressed Moldovan city through an infusion of U. S. technology, technical assistance and training. Developing country benefits included increased employment, improved product quality and the introduction of new products. The U.S. company benefited from equipment exports, sale of consulting services and new market intelligence. The project's success and sustainability sparked the company to replicate the model in two other dairies: one in Moldova and one in the Ukraine.

**Issue.** Increasing and providing a reliable supply of raw material (milk) to local dairies and upgrading dairy processing capabilities.

Following the near collapse of Moldova's dairy sector in the years immediately following its 1991 independence, dairies struggled to meet a rising consumer demand. The biggest problem was a lack of raw materials for further processing.

Moldova also lacked an organized milk collection system, which was complicated by the fact that most dairy cows are owned by inefficient, small-scale farmers.

**Project objectives and activities.** The project objective was to improve the operation of a local dairy and its milk suppliers by installing modern U.S. dairy processing and packaging equipment; providing a credit and technical assistance program for dairy suppliers to improve quality and production; developing an efficient distribution system for milk products; introducing new products; and providing a comprehensive technical and managerial training program to improve production, storage and processing.

The first set of activities involved designing product packaging and shipping all equipment from the U.S. to Moldova. U.S. consultants were sent to establish new manufacturing processes and to train a Moldovan quality control manager. Workers were trained in business management, marketing, accounting and processing technology to equip them with the skills necessary to improve plant efficiency and product quality. Yogurt, a new product, was introduced at the dairy; the shelf life of milk was increased from 36 hours to 8 days.

Next, a distribution network was established and refrigerated units were installed in stores. Demand grew steadily, requiring the dairy to stop

adding new stores until a greater raw milk supply could be secured. Although the volume of milk received per day increased from three tons of milk to 30 tons during the first six months of operation, product demand could not be met.

In order to meet the growing demand, the last major set of activities included a farm support program to work with private farmers on dairy herd management and proper sanitary methods. Two teams of dairy specialists were sent to Moldova through the CNFA Agribusiness Volunteer Program to identify problems and assist milk producers in developing plans to improve the quality and quantity of milk supplied to the dairy. Milk collection stations—complete with equipment and supplies including antibiotics, feed and refrigerated storage tanks—were established in local villages near the dairy to preserve and collect the growing milk supply of private farmers. The World Bank Rural Finance Corporation (RFC) established credit unions in these villages, providing short and medium-term credit to milk producers for purchasing additional cows and/or dairy supplies and equipment.

USAID funding helped build critical upstream and downstream linkages in the dairy sector through a training and technical assistance program for dairy employees and private farmers, value-added processing, new product introduction, packaging equipment, and an environmental mitigation program at the dairy.

**Developing country benefits.** The local dairy has set a standard for quality dairy products in the Moldovan market. The dairy received a partner-investor that brought new technology and working capital to the struggling dairy. Workers' wages increased by 20%, the number of employees and hours worked increased, salaries were paid on a timely basis, workers received training in new processes and quality control, and community pride bloomed in a newly renovated, privately run

enterprise. Locally produced, nationally recognized quality branded dairy products in western style packaging became available in Moldova. Dairy farmers delivering to the milk collection stations are paid in cash on a regular basis, which is beginning to improve liquidity in the region.

The project developed a dairy that continues as one of the strongest, most profitable companies in the region. This dairy became a pilot and model project for future developments. Its success led the same company to invest in two additional dairies, another in Moldova and one in Ukraine, where it is instituting the same dairy upgrades and farm programs to reach private milk producers.

**U.S. benefits.** Over US\$2 million worth of U.S. modern dairy packaging, processing, storage and delivery equipment is being used in Moldova, and these exports will continue to grow as expansion occurs. U.S. dairy consultants provide ongoing technical training to farmers in dairy husbandry, nutrition, and sanitary milking and milk storage methods.

### Project costs

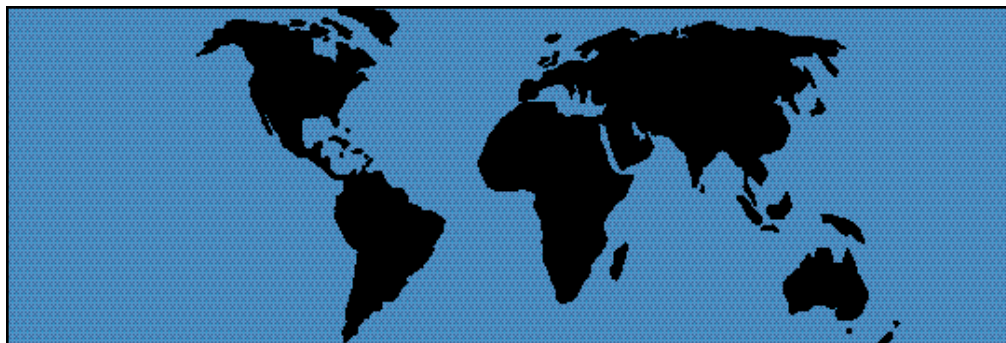
Total planned investment:

USAID	US\$ 1.7 million
U.S. private sector company	US\$12.7 million
Local Ukraine/Moldova dairies (cash or in kind)	US\$ 4.6 million
Total	US\$19.0 million

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### **Russian-American Farm Privatization Project (RAFPP)**

**Program Area.** Expanding trade and developing business

**Partners**

**U.S.** Farm families from Texas and Wisconsin, Michigan State University, Ohio State University, and the University of California at Davis

**Russia** The Ministry of Agriculture, the Department of Agriculture of Volkov Raion, St. Petersburg State Agrarian University, Shushary Academy of Agribusiness Management

**Principal mutual benefits.** For the Russians, viable private, self-managed farming with major improvements in economic and social livelihood. For the U.S., expanded markets and trade opportunities as a result of creating a platform for reciprocity and cooperation through personal contacts.

**Issue.** To begin moving Russian agriculture from a collective, state system to privately owned and managed farm enterprises.

Former U.S. Secretary of Agriculture Edward Madigan and the then mayor of St. Petersburg, Anatoly Sobchek, agreed in 1991 to implement a project to assist the farm privatization process near the historic city of St. Petersburg.

**Project objectives and activities.** The project sought to develop a focal point for farm privatiza-

tion in Russia through a research and demonstration farm in an important rural area where it could be reasonably expected that Russian farm families would take the initiative to develop their own private farms, with mentoring from U.S. farm families. The site selected for the demonstration farm was Volkov Raion, which lies 75 miles east of St. Petersburg. The city of Volkov Raion contributed 850 hectares of a former state farm to the project; the Department of Agriculture of Volkov Raion selected 23 families to participate and gave each roughly 150 acres on which to establish a private farm.

U.S. farm families were enlisted for 18- to 30-month stays at the research and demonstration farm; two families (husbands and wives) spent most time there. They offered demonstrations on crop and livestock production systems suited to the small scale of the Russian units, and were available to local farmers for consultation on agricultural and management issues. The U.S. farm families also offered courses in a variety of areas and some U.S. individuals conducted adaptive research on crops and livestock of relevance to the Volkov Raion area.

Faculty members and staff from Michigan State and Ohio State Universities, and the University of California at Davis, helped upgrade the capabilities of the St. Petersburg State Agrarian University and the Shushary Academy of Agribusiness Management to backstop, support and extend

relevant farming information to project families. Five years after it was launched, the project also assisted in developing a formal information delivery system that mirrors many aspects of the U.S. State Cooperative Extension System.

**Developing country benefits.** Twenty of the original 23 Russian families successfully developed productive farms that provide them today with livelihoods that are economically and socially more rewarding than their work on the earlier collective, state-run farms. The RAFPP has worked with the new extension system to contact roughly 1,000 additional families, some of whom have taken responsibility for managing their own farm units.

**U.S. benefits.** While difficult to quantify at present, as the agricultural sector begins to develop with the project, doors will open for U.S. agribusiness to provide farmers with improved seed and animals, farm equipment and more productive technology. The local Russian population became familiar with the variety and quality of U.S. farm and non-farm products, and individual contacts were promoted between Russian and U.S. business operators, which resulted in greater demand for

U.S. commodities by the population in and around St. Petersburg. As a result of the strong bonding that developed between the Russians and the visiting U.S. families, a platform was created that U.S. agribusiness is building on to enhance its trade and to open markets in Russia.

**Project costs.** The total cost of the seven-year project was US\$2.4 million, which was covered with funds from the USDA Foreign Agricultural Service. This covered the costs of travel and the local expenses of the U.S. families, acquisition of some farm supplies and equipment for the demonstration farm, and the cost of participation of faculty from the Land-Grant Universities.

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### **The KrediFanm Program: Investing in Rural Haitian Women**

**Program Area.** Expanding trade and developing business

**Partners.** Inter-American Institute for Cooperation on Agriculture (IICA) in Haiti; U.N. Fund for Population Activities (UNFPA) in Haiti; AgriFuture Foundation, Washington, D.C.; Kellogg Foundation; and the Assistance to Civil Society Project (ASOSYE) - U.S. Agency for International Development (USAID)/Haiti.

**Principal mutual benefits.** Increased revenues earned by poor rural Haitian women in their traditional economic roles are resulting in the development of a new formal economy that offers commercial trade and business opportunities for the U.S.

**Issue.** More than 65% of the Haitian population is rural and dependent on the agricultural economy, which went into stagnation and steady decline in the late 1950s, a trend which continues to this day. The result is overcrowded cities, illegal emigration, conflicts and local tensions. The immediate causes of this decline are overpopulation, fragmentation of landholdings, over-exploitation of lands resulting in serious environmental deterioration, and ever-declining agricultural yields. This situation has obliged rural dwellers to sell key factors of production simply to survive: fruit trees, trees for charcoal, tools, seeds, livestock, and (finally) the land itself, to finance a permanent migration. To halt and reverse this process, capital and other production inputs must be injected at the level of the individual household.

Traditionally, Haitian women have been responsible for marketing the output of their households; men are responsible for production. With the income earned through the sale of her household's agricultural production, a woman supplies her family with all their purchased necessities. Any additional income goes to medical care, education, and (ultimately) investment in animals, seeds, land or other production inputs.

Because women are the business persons of Haitian society and are most familiar with financial transactions, rural credit interventions directed at women have been much more successful than those directed at men. Recognizing this expertise in Haitian rural women, IICA was able to identify the most appropriate place to make additional capital available to the rural economy. As a result of KrediFanm, women are reporting not only increased school attendance by their children, but also expanded marketing activities, new micro-enterprises, and the purchase of livestock (the traditional savings bank of rural villages).

**Objectives and activities.** The program capitalizes revolving credit funds at the community level with a methodology specifically suited to the rural milieu, ensuring equitable management of the funds by women's groups, including loan distribution and repayment. Each community fund begins with capital of about US\$5,000, which is managed by between 40 and 60 women, and loans are provided at 2% monthly interest. A portion of the interest payments cover the charges of a local

agent; the rest is reinvested in the fund itself. About US\$90,000 were invested in 29 funds over a period of two years. With over 7,000 loans taken out and repaid, this capital increased to over US\$130,000 in two years; the loan repayment rate was fully 100%! Financial management is the responsibility of each KrediFam group, with project personnel only providing oversight, advice and training on an "as needed" basis.

In early 1999, Kellogg funding allowed six more KrediFam groups to be added to the program. Older KrediFam groups took on the responsibility of training and monitoring these newer groups, which have been as successful as their predecessors. KrediFam women, now numbering almost 2,000, are extremely proud of themselves and the program and have developed a striking solidarity. This spirit led to the establishment of the KrediFam Foundation, which unites the now 35 KrediFam groups and manages the capital, currently valued at more than US\$145,000. The KrediFam Foundation was established in September 1999, led by an executive committee elected by the KrediFam women. It is currently in the process of developing an aggressive fund-raising campaign. The KrediFam Foundation also plays an educational and advocacy role at the national level relative to the rights and concerns of rural women.

In addition to project efforts related to the credit funds, each community received reproductive health training from a resident health team, addressing not only reproductive health and family planning, but also sexually transmitted diseases, preventive health care, general nutrition and hygiene, family budget planning and women's civil rights.

Only donor's limitations to expanding the capital base and technical assistance have prevented more than 5,000 waiting women to be incorporated into the project. In early 1998, in an attempt to incorporate all these women at the local level, 29 groups initiated and capitalized their own revolving credit funds with their own contributions. These "self-generated funds" are distinct from the donor/project funds. They are used primarily to finance loans to other women under the same terms of the KrediFam program, and to finance collective investment schemes ranging from marketing to land purchases for collective agricultural production. By late 1998, these funds totaled US\$14,140; just eight months later that sum had burgeoned to

US\$49,000.

**Benefits to Haiti.** Haitian women play a crucial economic role in their society. Their marketing circuit ensures that garden produce is sold, that goods move in and out of cities and regional markets, and that profits are reinvested in household production. Providing these women with credit has been one of the most sound investments in the rural economy, one that is helping pull many rural people out of grinding poverty.

**U.S. benefits.** On a small-scale, the KrediFam program has provided access to seed capital that certain women are developing into veritable enterprises. One woman now trades regularly with Florida and the U.S.; several women have opened small restaurants; and all of the KrediFam groups have invested their own funds in productive local economic ventures. A larger and more vibrant formal economy will transform Haiti into a solid trading partner with the U.S. and even a partner in new business investments.

The collective financial management of the KrediFam funds is based on equity and transparency, key elements for a viable business culture and the basis of a genuine democracy. Haitian women's business acumen and understanding of democratic principles suggest an untapped potential for a profound transformation of the Haitian economy and polity, one that could prove more substantial than what has been achieved by men since the 1986 fall of the Duvalier regime, or even since the entry of U.S. and United Nations troops in 1994.

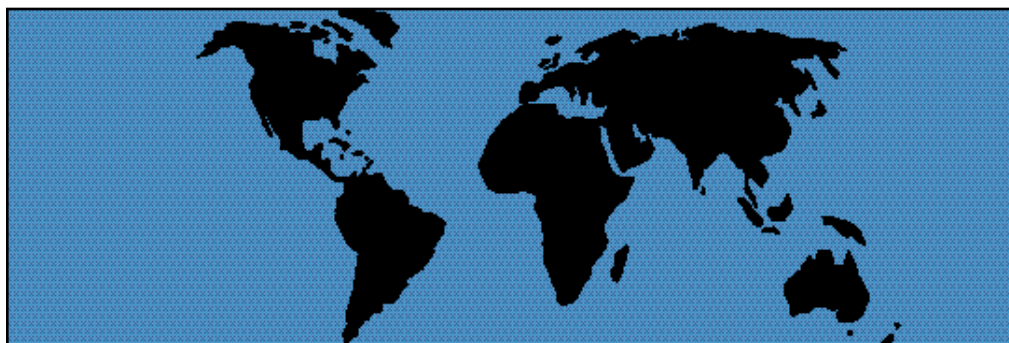
**Costs.** Donors contributed about US\$480,000 in the two-year start-up period. Although KrediFam and "self-generated" funds currently total only about US\$200,000, the start-up activities are expected to yield a virtual explosion in the value of the local funds in the years ahead, based on progress recorded to date.

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## The U.S. – Mexico Emerging Markets Project

**Program Area.** Expanding trade and developing business

### Partners

**Mexico:** the Center for Agricultural Statistics (CEA) and the Agency for Agricultural Sector Studies (DGESA), both of the Secretariat of Agriculture and Rural Development (SAGAR).

**U.S.:** Economic Research Service (ERS), National Agricultural Statistics Service (NASS) and Agricultural Marketing Service (AMS), all of the U.S. Department of Agriculture (USDA).

**Principal mutual benefits.** This project has enhanced SAGAR's capacity to provide Mexican farmers and consumers with data on and analysis of the situation and outlook for the commodities most important to Mexico's farm sector. U.S. farmers and agribusiness gain from the project through greater access to high quality information on Mexican agriculture, which allows them to compete effectively in Mexican agricultural commodity markets.

**Issue.** As barriers to agricultural trade dissolve in the post-North American Free Trade Agreement (NAFTA) era, it is increasingly important for the U.S. and Mexico to understand each other's agriculture. Both governments are relinquishing control of their domestic agriculture at the same time

as trade barriers are coming down, further increasing farmers' need for information on international market conditions. In the 1996 Farm Bill, the U.S. Congress authorized the Foreign Agricultural Service (FAS) to fund projects that facilitate U.S. agricultural exports. To respond to the need for better information on Mexican agriculture, FAS selected the Economic Research Service (ERS) to manage a three-year project which began in 1996 to strengthen Mexico's agricultural information system.

**Project activities and objectives.** The project's main objectives are to supply Mexican and U.S. farmers with the statistics, forecasts and analyses they need for adjusting and adapting to changes in the post-NAFTA farm economy, and to provide U.S. agribusinesses with high quality information on Mexican agriculture so they can compete effectively in Mexican markets.

To achieve project objectives, activities are conducted in three areas. The first is commodity reporting, by which publications and other results are produced to inform a wide audience in the U.S. and Mexico on the status of and outlook for Mexico's most important commodities. This includes training of SAGAR analysts by the USDA.

The second activity is the collection and dissemination of basic data on agricultural commodities,

with a view to improving the quality of information available. Mexican field technicians learn to conduct yield surveys for corn, beans, sorghum, avocados and other important commodities; they also receive training in remote sensing and geographic referenced information systems that, among other things, facilitate data collection on areas planted in particular crops.

Finally, the project contributes to strengthening SAGAR's capabilities to conduct impartial and economically sound analyses of strategic issues that face North American agriculture in the post-NAFTA era—for example, how to eliminate transportation bottlenecks impeding agricultural trade between Mexico and the U.S..

**Developing country benefits.** Over 40 Mexican SAGAR professionals with commodity reporting responsibilities have received training from USDA. As a result, nine SAGAR report series (for apples, beef, corn, edible dry beans, poultry, sorghum, swine, wheat and dairy products) were initiated, with over 10,000 copies distributed to users in Mexico. Reports were also posted on the SAGAR website in both Spanish and English, so as to increase their access to U.S. users. The accuracy of SAGAR's short-term production forecasts was improved as a result of the USDA training received by 300 Mexican field technicians in techniques for conducting sound yield surveys. USDA training in remote sensing and geographic referenced information systems improved estimates of the areas planted and harvested for key Mexican commodities.

**U.S. benefits.** Enhancement of SAGAR's website—by posting information in English and

expanding the data available—greatly increased its use by producers and others in the U.S. The project-launched report series are increasingly being presented directly to U.S. agribusiness representatives, and they are becoming a key source of information. For example, a CEA representative introduced the project-launched grain reports at an FAS-sponsored meeting on the grain exporting process, held in Laredo, Texas. The analysis and discussion of transportation bottlenecks that impede U.S.-Mexican agricultural trade were instrumental in facilitating access by U.S. producers to Mexican markets. Under the same area of project activity, the AMS/USDA and SAGAR reviewed Mexico's vegetable marketing system to determine if increasing urbanization in Mexico was channeling retail sales away from traditional markets to U.S.-style retail outlets. Results are valuable to a range of U.S. producers and sellers attempting to move vegetables into Mexican markets.

**Project costs.** The FAS/USDA Emerging Markets Office contributed US\$2.2 million for this three-year project, covering the cost of U.S. training, equipment and travel by Mexican counterparts to the U.S.. In addition, SAGAR has made major contributions of staff time, printing, office facilities, and travel within Mexico.

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## Building Grain Marketing Infrastructure in Bulgaria

**Program Area.** Expanding trade and developing business

### Partners

**U.S.** Agricultural Cooperative Development International/Volunteers Overseas Cooperative Assistance (ACDI/VOCA), U.S. Agency for International Development (USAID), U.S. Department of Agriculture (USDA)

**Developing country:** Bulgaria's Ministry of Agriculture, Forestry and Agrarian Reform and its private sector

**Principal mutual benefits.** By developing a grain warehouse and commodity marketing program in Bulgaria, this project promotes development of commodity marketing and trading and advances the Bulgarian agriculture sector while facilitating trade between the U.S. and Bulgaria.

**Issue.** Grain industry system needed in emerging market countries

Farmers in emerging market countries face numerous problems stemming from a lack of readily available, safe and secure storage facilities for agricultural commodities. Western farmers, traders, banks and businesses take for granted the availability of reliable storage facilities that issue secure warehouse receipts, which allow the holder

to borrow against stored grain and also facilitate the sale, disposition and transfer of the commodities received.

**Project objectives and activities.** The Grain Industry Development Program in Bulgaria is establishing a warehouse receipts system that will provide farmers with flexible options for selling and financing their crops. The program will energize the agricultural economy and lay the groundwork for commodity exchanges and international trade.

In 1997, six Bulgarians participated in an ACDI/VOCA symposium held in Poland on warehouse receipts. Later, ACDI/VOCA, the Bulgarian Ministry of Agriculture, Forestry and Agrarian Reform, USDA, USAID and the private sector joined forces to create such a system in Bulgaria. Goals included establishing a reliable marketing information system, forming a national grain and feed association, and helping to draft a grain marketing law to implement reforms and a warehouse receipt program.

Throughout 1998, a series of ACDI/VOCA and USDA experts advised the government on the policies and regulations that needed to be in place to support a grain industry system. On 27 July 1998, the Bulgarian Parliament passed the Storage and Trade in Grain Act, legalizing the system. ACDI/VOCA also piloted a project to test the poli-

cies and regulations in real world conditions; full implementation was targeted for the 1999 harvest.

Providing a legal foundation was only the beginning. No one was sure that banks would provide loans using grain, let alone warehouse receipts, as collateral. Three warehouses were selected for the project-sponsored demonstration and education project, which was launched by the U.S. ambassador on 15 September 1998. ACDI/VOCA worked one-on-one with the warehouse owners, bankers and producers at the three selected sites to educate them on the importance of the system and to help them realistically evaluate risk.

The first success occurred on 27 October 1998 when Eurobank issued the first two loans using grain as collateral; more loans were made in the following months. ACDI/VOCA is working with USDA to have 500 metric tons of storage space licensed.

**Emerging market country benefits.** Farmers have new options available to them relative to when they can sell their crops, which will allow them to take advantage of more advantageous prices. Negotiable warehouse receipt instruments enable farmers to borrow from banks using the receipts as collateral, creating a new cash resource. With secured collateral, banks consider loans to

farmers as being less risky. Uniform grade standards for grain and other products promote domestic and international grain marketing.

**U.S. benefits.** A licensed grain storage and commodity marketing program is the foundation for international grain marketing, and uniform grade standards for grain and other products further promote international trade. The Grain Industry Development Program will foster growth in the agricultural sector. Economists predict that agriculture could be one of the biggest growth areas for Bulgaria over the next 10 years. As Bulgarians reap the benefits of a vibrant economy and prosperity, they will import more goods and services from the U.S..

**Project funding.** Project funding comes from USAID's Central and Eastern Europe II grant, which has provided US\$4 million for activities in Bulgaria.

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### **Establishing a Private Product Distribution System in the Ukraine**

**Program Area.** Expanding trade and developing business

**Partners**

**Developing country.** Private input distributors from the Western Newly Independent States (WNIS)

**U.S.** An American crop protection chemical company; U.S. Agency for International Development (USAID); Citizens Network for Foreign Affairs (CNFA)

**Principal mutual benefits.** Enhancing the Ukrainian agricultural farm input supply sector through the introduction of U.S. technology, sales and exports.

**Issue.** Establishing a competitive and sustainable private product distribution system

Since its independence, Ukraine's agricultural producers have had to rely on an inefficiently run state distribution system. Small chemical businesses struggled to establish a position in the marketplace with minimal assets and ill-defined credit histories. With funding from USAID and other sources, an American chemical company is expanding its operations to include 15 small-scale private input distributors. By partnering with the

U.S. chemical company, these businesses are able to benefit from a development contract between USAID/CNFA and the American crop protection chemical company.

**Project objectives and activities.** Initially, the objective of this partnership was to strengthen and expand the distribution network of 15 private distributors, who are now becoming the basis of a competitive, private sector input distribution system in the transition from the state-dominated distribution system. The crop protection company supplies herbicides, insecticides and fungicides to the distributors, who in turn supply these products to farmers. Training in business management, product use, and storage and safe disposal is provided both to distributors and to farmers.

In the first stages of the project, US\$5.7 million of credit was made available to the 15 distributors, with more than half of that going to farmers. Over 1,000 individuals (including farmers, agronomists and farm managers) received training in agricultural and financial management practices. In addition, 43 distribution managers received training at three U.S.-based training/consultation sessions held in 1997 and 1998. Forty demonstration sites were established for the field demonstrations that were an integral part of the training.

Not only has the project attained its original targets, it has exceeded many of them. For example,

the company has surpassed the goal of creating 15 jobs by creating 30, four by the company itself and 26 by its WNIS distributors. In 1998 the company was able to expand the number of distributors from 15 to 30, with 22 partners in the Ukraine, six in Belarus and two in Moldova.

**Developing country benefits.** The project has made otherwise rare western technology and services readily available to private farmers and others. With the use of the chemical company's technology, farm revenues increased by over 60% and there was a marked improvement in yields and crop quality. The agricultural sector receives training, modern equipment, technical assistance, agricultural inputs and the know-how of U.S. companies and agribusiness experts. Since the project began, farm revenues from 507,000 hectares treated with the company's products have grown to over US\$108 million.

**U.S. benefits.** In developing the distribution of farm input supply in the private sector, the compa-

ny is opening a market for U.S. goods and services for itself and for other U.S. companies. Encouraging private farmers and distributors erodes state power and expands the distribution system.

### **Project costs**

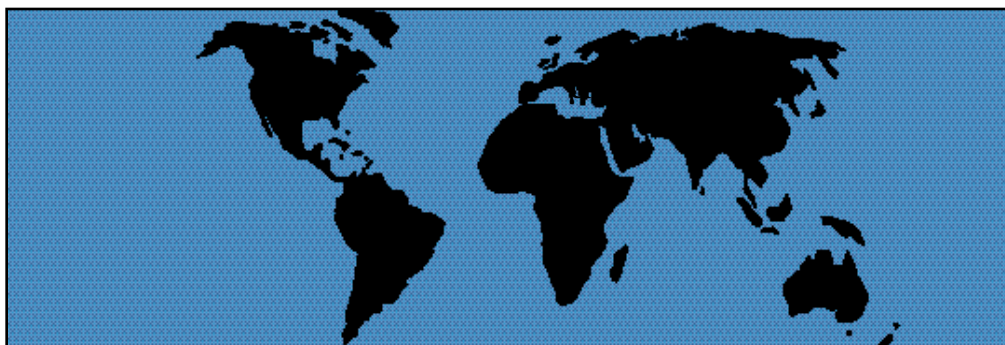
#### **Investments**

USAID	US\$ 499,162
Private US company	4,782,912
Ukrainian distributors	5,540,000
	US\$10,822,074

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**Establishing a Private Distribution Network  
for Agricultural Inputs in Albania**

**Program Area.** Expanding trade and developing business

**Partners**

**Albania** A host of private input distributors and the trade association they formed

**U.S.** U.S. Agency for International Development (USAID), the International Fertilizer Development Center (IFDC) and Mississippi State University

**Principal mutual benefits.** Albanian farmers have improved access to a reliable and competitive supply of modern inputs. An effective trade association is established that serves as a model for others. The Albanian market is opened to US\$10 million in U.S. fertilizer and seed exports. Food security and economic growth are improved in an unstable, troubled region.

**Issue.** Establishing a competitive and viable private sector network for the distribution of agricultural inputs

With the collapse of the communist regime in the early 1990s, Albania was at ground zero for development. Previous agricultural and delivery systems disintegrated; credit disappeared. Because the private sector had not existed for over two gen-

erations, other entities did not step in to fill the voids. Land was distributed to 400,000 farmers, but they had no access to inputs or technical information and advice.

Auctioning U.S.-supplied fertilizer to begin the process, IFDC identified and nurtured entrepreneurs and helped form a trade association that enabled dealers to obtain credit, purchase fertilizer and other agricultural inputs in bulk, and market cooperatively as a group. Farmers now have a reliable supply of competitively priced inputs and benefit from private sector extension services which provide sorely needed technical advice. The program demonstrated that the market can be made to work again, even after a long period of neglect.

**Project objectives and activities.** Since 1992, USAID has supported IFDC efforts to establish a working private sector distribution system for agricultural inputs in Albania. The project, which ended in December 1999, provided technical and business assistance to over 200 emerging input dealers and subsequently to hundreds more agribusinesses engaged in a range of food production and processing activities. In a credit-starved nation, project staff helped dealers obtain over US\$20 million in loans to import fertilizer, now for a total of 75,000 metric tons annually at present. The dealers are now able to self-finance 75% of their business, which was worth US\$23 million in 1999.

The project implemented an aggressive media, marketing and field demonstration campaign, as a result of which nearly all farmers are now using improved seeds and fertilizer. Significant improvements were made in the agricultural information statistics unit, the soil and other laboratories, and the local seed industry. The trade association became totally sustainable in early 1999, fostering the development of seven other agricultural trade associations. A new USAID-funded project awarded to IFDC will assist the new associations achieve similar results and boost agribusiness growth by providing hands-on technical and marketing advice.

**Developing country benefits.** Crop production grew and the input supply and production systems were able to withstand the 1997 collapse of the government and the inflow of Kosovan refugees in 1999. Over 400 new agribusinesses, each employing 10 new workers on average, were established. Farmers now benefit from a reliable supply of inputs and technical information, the trade associations are effectively lobbying for policy reform, and new markets are opening up.

**U.S. benefits.** The policy reforms and technical assistance helped open Albania for U.S. business

which, in recent years, has earned over US\$10 million in fertilizer and seed exports. Thus, at a much reduced cost, the U.S. was able to support food security without having to make large food shipments to a troubled country in a strategic and unstable region. The success of the input dealer trade association is serving as a model for others in Albania and the region.

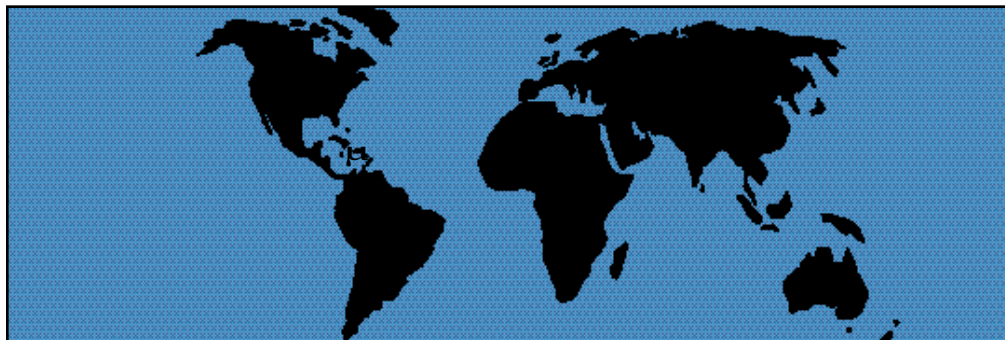
**Project costs.** USAID provided US\$8.6 million in grant funding. In addition to raising commercial credit, Albanian fertilizer dealers and other project clients provided significant counterpart resources. For example, in 1998, association members invested US\$9 million of their own resources and contributed US\$400,000 in dues, service fees and in-kind costs. Thus, matching funds in just one year exceeded the total value of the project grant from the U.S.

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### **The Haitian Coffee Revitalization Project**

**Program Area.** Expanding trade and developing business

**Partners.** Inter-American Institute for Cooperation on Agriculture (IICA) in Haiti; U.S. Agency for International Development (USAID) in Haiti; the Haitian Ministry of Agriculture, Natural Resources and Rural Development (MARNDR); and the Inter-American Development Bank (IADB).

**Principal mutual benefits.** Increased gourmet-quality coffee production in rural Haiti boosts coffee farmers' incomes, reverses environmental degradation, increases Haiti's exports to the U.S., and provides U.S. consumers with a prized coffee.

**Issue.** Coffee has long been the principal export crop of Haiti, providing more than 75% of export revenues until the 1950s. Over the last 20 years, however, coffee production fell sharply, from 400,000 sacks (120 pounds per sack) in the early 1980s to less than 100,000 in 1999. Coffee is produced on small hillside plots along with fruit trees and other food crops by about 327,600 peasant farmers; more than 50% of Haiti's tree cover is related to coffee production. Because coffee prices have been falling relative to food crop prices, more and more farmers have replaced their coffee with annual crops, setting in motion a downward spiral of environmental deterioration, over-exploitation of fragile lands, and rural-urban migration.

Coffee passes through a series of marketing intermediaries before it is exported. As a result, much of the price paid by final consumers does not reach the farmers, reinforcing the negative impact on producers of the relative decline in coffee prices. Since the 1980s, a pound of red beans has brought twice as much as a pound of coffee.

In collaboration with USAID, IICA launched the "Coffee Revitalization Project" in 1990 to boost coffee production. By 1993, however, it had become clear that improved market incentives would be required to achieve this objective.

**Objectives and activities.** The Coffee Revitalization Project fostered two changes in traditional export relationships. The first was to introduce washed coffee processing, as washed coffee is usually sold as gourmet quality and brings a higher price than "natural" or traditional coffees. The second was to promote farmer-managed exports, whereby farmers' organizations replaced the traditional intermediaries in export marketing, thus boosting farmers' returns.

Project activities consisted of establishing and providing training for local coffee farmer organizations directly responsible for production, marketing, and export sales. This was crucial to the long-term viability and sustainability of the entire activity, which is based on democratic and equitable principles of operation, transparency and

efficiency, characteristics that run counter to traditional rural Haitian society. The 22 local farmer associations were federated into the Federation de Caféières Natives (FACN) which, since 1998, has operated independently to produce, process and export coffee. FACN sells Haitian Bleu™, a special blend of Haitian coffee, to selected regional U.S. coffee retailers. Sales to these buyers have been made under a five-year contract at an exceptional price of US\$2.00/lb, representing a 67% premium over the normal price of US\$1.20/lb for Central American gourmet coffees. It is not surprising that the production of FACN Haitian Bleu™ soared from 66,000 pounds in 1994 to more than 145,000 in just four years.

The project also provided new coffee root stock (new varieties of coffee trees), helped organize local nurseries, and provided training in better cultivation techniques. It also invested in local, artisanal wet mills for washed coffee processing, trained local producers in improved production and processing techniques, and initiated and developed the marketing relationship with U.S. gourmet coffee roasters and retailers.

Direct farmer participation in the project and the democratic principles governing its operations have had a significant positive impact at the local level on Haiti's larger democratization process.

**Benefits to Haiti.** More than 65% of the Haitian population is rural and over 325,000 producers depend on coffee production for the well-being of their families. Coffee revenues are a primary source of capital for reinvesting in agricultural inputs and appropriate technology that result in higher yields, as well as for investing in children's education and medical care. This encourages farmers to continue farming, reducing the emigration of poverty-stricken rural dwellers to the cities and overseas. Coffee cultivation is also one of the few viable and efficient means of reversing environmental degradation in the country and, thus, of preserving downstream, lowland agricultural production. At the national level, increased and higher value coffee production augments national export earnings and improves the balance of trade.

Because of these important benefits, the Haitian government obtained an IDB loan in 1998 to expand the Coffee Revitalization Project. From 1998 to 1999, IICA successfully implemented this enlarged program in two new areas of the country.

**U.S. benefits.** The U.S. is the primary market for the FACN's Haitian Bleu™ coffee, which is distributed by six retailers covering as many different areas in the U.S. The value to U.S. consumers of this premium coffee is a principal U.S. benefit. In addition, the increased revenues of the rural poor improve the economic conditions that cause so many Haitians to emigrate to other countries, and acquisition of democratic principles at the grass-roots level contributes significantly to bringing about stability in this country that lies at the doorstep of the U.S.

**Cost.** Since 1990, about US\$7.2 million has been provided by USAID for the project. Haitian government financing (US\$656,700 through an IADB loan) constitutes the project's principal source of funding at this time.

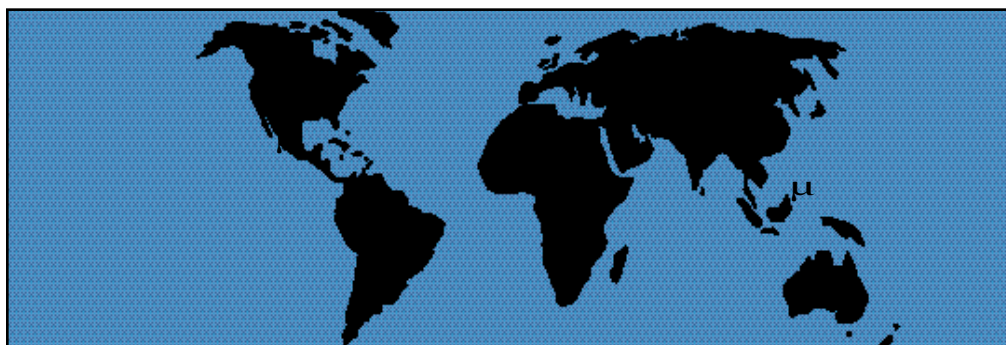
Although a complete assessment of all project benefits since 1990 is unavailable (and would be difficult to obtain given the wide range of activities supported, i.e., training, democratization, root stock improvement, nursery development), we do know that the two new regions just added to the project include 3,000 coffee producers and that at least 200,000 lbs of additional exports are expected to be produced annually, valued at US\$400,000 at today's prices. Because this one-year figure for production is close to the value of the IADB loan, it appears that the project will be highly beneficial into the future.

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### **III. Sharing Scientific Knowledge and Information**

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### **Dramatic Spillovers to the U.S. from CGIAR Research**

**Program Area.** Sharing scientific knowledge and information.

**Partners.** Two centers of the Consultative Group on International Agricultural Research (CGIAR) [the International Maize and Wheat Improvement Center (CIMMYT - Mexico) and the International Rice Research Institute (IRRI - Philippines)]; and the states of California, Minnesota, Montana, North Dakota, Oklahoma, South Dakota, Texas.

**Principal mutual benefits.** Marked increases in yields and production stability through development of short-stature, disease-resistant wheat and rice varieties.

**Issues.** The CGIAR is a worldwide network of 16 international agricultural research centers that began working in 1960 to reduce hunger in developing countries. Although CGIAR's financing results from a true partnership of over 40 donors, in recent years 12% of the total annual budget has been contributed by the U.S. Other large donors include: European countries (35%) the World Bank (15%) and Japan (11%).

Millions of people have escaped starvation through the work of the centers that work on wheat (CIMMYT in Mexico) and rice (IRRI in the Philippines).

Nobel Laureate Norman Borlaug began his work on wheat in the 1940s under a Rockefeller

Foundation program in Mexico. A yield ceiling was soon reached, however, because the plants could not hold up larger heads of grain without falling over. Semi-dwarf wheat plants, involving crosses of a sturdy, short-stemmed Japanese variety with U.S. varieties, were being introduced in Washington State by a USDA wheat breeder. Borlaug tried crossing the semi-dwarfs with disease-resistant Mexican varieties, and produced strains of sturdy wheat that could remain erect when fertilized and irrigated. Yields were two to three times those of the unimproved wheats. In the 1960s and 1970s, these semi-dwarfs spread throughout the developing world. Owing to CIMMYT's research in Mexico, they and their offspring are now grown by millions of farmers, including U.S. wheat farmers.

In 1966, IRRI scientists introduced a new rice variety they called IR-8, which has been dubbed the "miracle rice" by the news media. It resulted from crossing a disease-resistant, Indonesian variety with a short-statured Chinese variety that spends more energy producing grain than straw. Farmer yields improved four and five times, and years of lost crops were reduced dramatically. Since its release, IR-8 has evolved into IR-26, IR-36 and IR-56, in response to research efforts to thwart the tungro virus, the grassy stunt virus, and varieties of brown planthoppers. Without continued investments and significant "maintenance research," IRRI's initial success would have come to a bitter end.

**U.S. benefits and costs.** Wheat production in the U.S. generates almost US\$8 billion annually and accounts for about 12% of world wheat output. In 1993, rice generated US\$1.3 billion for the U.S. economy; moreover, U.S. exports account for almost 20% of all rice traded internationally. Together, the land planted in these two crops annually accounts for almost 25% of all U.S. cropland.

By the early 1990s, about one fifth of all U.S. wheat was sown to varieties having CIMMYT ancestry. In 1993, virtually all the California spring wheat crop was grown with CIMMYT varieties or with CIMMYT-based ancestors. About one tenth of the acreages in other regions —the northern plains states (Minnesota, North Dakota, South Dakota and Montana), the central plains (Oklahoma and Texas) and the southern plains (Colorado, Iowa, Kansas and Nebraska)— was sown to varieties with CIMMYT ancestry. In the case of rice, about 75% of total U.S. rice acreage is sown to varieties with IRRI ancestry, and IRRI rice varieties have been used primarily as parent stock for developing medium- and long-grain, semi-dwarf rice varieties in California, Arkansas, Louisiana, Mississippi, Missouri and Texas.

A research team at the International Food Policy Research Institute (IFPRI) recently tracked the development and use of improved, higher-yielding varieties of rice and wheat from IRRI, CIMMYT and U.S. breeders, over the 1970-93 period. It was concluded that the gains to U.S. farmers from CIMMYT wheat were between US\$3.4 and US\$13.7 billion and that the gains from IRRI rice varieties were as high as US\$1.0 billion. These large sums provide a sharp contrast to the US\$71 million in U.S. financing for CIMMYT's wheat improvement activities and its US\$63 million for

IRRI rice research. In the case of wheat, a US\$0.02 investment in wheat research produced US\$100 of wheat production in the U.S. and a benefit-to-cost ratio as high as 190:1. In the case of rice, the benefit-to-cost ratio was estimated at 17:1. Few investments—even in today's new high technology industries— show these levels of return.

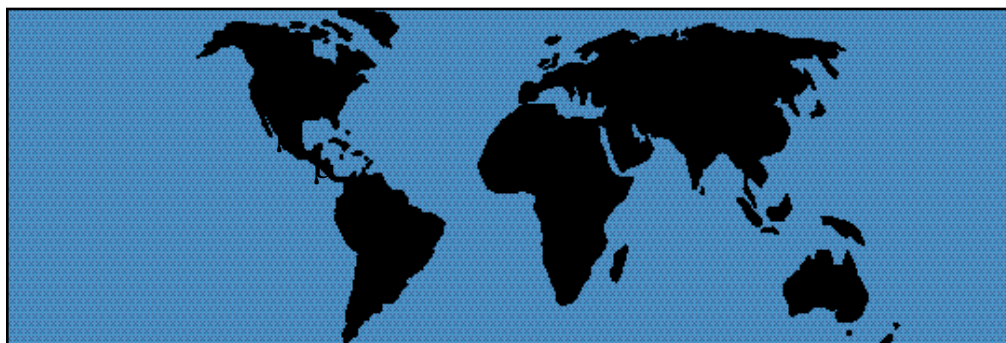
**Developing country benefits.** The CGIAR centers do not generally provide "finished seeds" to developing countries but rather parent stock from which locally suited varieties are obtained. In developing countries the rates of return to agricultural research at the local level, even when CGIAR research is taken into account, have consistently proven to be high. In settings as varied as Australia, Bangladesh, Bolivia, Brazil, India, Japan, Malaysia, Mexico, Pakistan, Peru, Philippines and South Africa, rates of return estimated for wheat and rice research have generally fallen in the range of 30% per year.

**Project costs.** From 1970 to the mid-1990s, U.S. investments in CIMMYT's wheat research and IRRI's rice research amounted to US\$134 million, a small sum when compared to the benefits of the research and the importance of wheat and rice to just the U.S. economy.

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### Diversifying Maize Varieties

**Program Area.** Sharing scientific knowledge and information

**Partners.** Two dozen firms from the U.S. private sector, three dozen U.S. federal and state research organizations, and 12 Latin American countries

**Principal mutual benefits.** Enhancement of U.S. and Latin American maize varieties through the introduction of exotic germplasm to broaden the varietal base.

**Issue.** Expanding the ancestry of U.S. maize varieties to broaden their genetic base

In the U.S., maize is the major crop, planted on 75 million acres (almost one quarter of all cropland) and accounting for half of world production. Beginning in the early 1960s, however, warnings were issued about the genetic vulnerability of U.S. maize, resulting from its very narrow genetic base and the sale by private firms of closely related hybrids. It was therefore thought prudent to develop alternate breeding populations from diverse exotic sources to prevent possible production breakdowns resulting from unfavorable climate, pests and diseases, and market developments. This would require the involvement of Latin American countries, since they are principal centers of origin of the crop and possess most of the exotic germplasm.

**Project objectives and activities.** The objective of the enhancement effort was to provide the corn industry with materials developed from exotic germplasm, with the ultimate aim of improving and broadening the varietal base of the maize grown by U.S. farmers.

The first step was the LAMP project (Latin American Maize Project), which involved 12 Latin American countries and the U.S. Through it, over 12,000 different varieties (thought to represent 74% of all maize races) were ultimately collected in these countries and evaluated for their agronomic productivity (grain yield), disease and insect resistance (i.e., to corn root worm, stalk rots and ear molds) and value-added characteristics (percent oil, protein, and starch).

The second step was more complicated. Because the principal source of U.S. seed is the private commercial seed industry, competitive forces made it unlikely that any one company would support a varietal enhancement effort that incorporated LAMP accessions. To foster coordination and collaboration among private firms, USDA's Agricultural Research Service (ARS) and Land-Grant Universities joined the effort. Ultimately, the American Seed Trade Association pledged in-kind support and lobbied Congress for permanent base funding for ARS and the universities, which commenced in 1995. This consortium launched enhancement efforts under the U.S. Germplasm

Enhancement of Maize Project (GEM). Led by a Technical Steering Committee (TSG) composed of 11 cooperators, it meets four times a year to discuss policies, protocols, and project results. The TSG also oversees enhancement-related activities—for example, publication of a newsletter, data management, and sponsorship of field days—and specific activities of GEM cooperators, of which there are almost two dozen from the private sector and three dozen from the public sector.

An example of how the project works can be illustrated by the concern, expressed early in the project's life, for developing resistance to corn borer leaf. Almost 700 accessions from Peru were evaluated and 11 resistant varieties were identified, all of which grow in coastal valleys along Peru's northern coast. Breeding crosses of the resistant accessions with U.S. Corn Belt lines produced new varieties that are resistant to the pest. Crosses made to resist other pests and diseases have not only protected the U.S. maize crop, but also reduced the need to apply agricultural chemicals (pesticides), thus reducing environmental degradation.

**Developing country benefits.** Like U.S. farmers, some maize producers overseas have benefited from the enhancement project, although probably not as yet to the extent of their contributions of exotic germplasm. Their seed industries are less well developed and farmers typically reuse the seed they produce from previous crops for several years.

**U.S. benefits.** The two projects described herein were designed primarily to benefit the U.S. maize industry, through collaboration with Latin

American countries possessing exotic germplasm that could be bred with existing U.S. maize varieties to expand their genetic base. Although that objective has been largely reached, GEM is an ongoing project and the U.S. seed industry will continue to use the exotic accessions made available through LAMP and GEM to improve agronomic productivity, pest and disease resistance, and valued-added characteristics of U.S. maize production.

**Project costs.** Since its inception in 1995, the GEM Project has been provided with US\$500,000 annually by the Congress, as well as further benefits from annual in-kind support from the seed industry, estimated at US\$450,000. The total cost of the LAMP Project is estimated at US\$3 million. These are minuscule amounts of money when contrasted with a value-added improvement to the grain, worth (say) only US\$0.10 per bushel, that would increase the value of maize production by US\$800 million! Because of the importance of maize production to the U.S. and the world, even small improvements produce truly extraordinary economic benefits.

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**Combating *Striga* and Improving Cereal Yields Through Collaborative International Research**

**Program Area.** Sharing scientific knowledge and information

**Partners**

**Developing countries** Ethiopia, Kenya, Mali, Niger, Senegal, Sudan.

**U.S. states** Indiana, Virginia

**Institutional partners**

*Overseas*

- Ethiopian Agricultural Research Organization (Ethiopia)
- Universität Hohenheim (Stuttgart, Germany)
- Institut Nigerien de Recherche Agronomique (Niger)
- Institut de Economie Rurale (Mali)
- Agricultural Research Corporation (Sudan)
- International Center for Research in the Semi-Arid Tropics (ICRISAT)
- International Maize and Wheat Improvement Center (CIMMYT)

*U.S.*

- Purdue University
- U.S. Department of Agriculture, Agricultural Research Service, Animal & Plant Health Inspection Service (USDA/ARS/APHIS)
- University of Virginia at Charlottesville
- NGOs: World Vision International; SG 2000

**Principal mutual benefits.** International collaborative research brings together leading scientists to address problems that affect agriculture and food systems worldwide. This particular research is part of the Sorghum/Millet (INTSORMIL) Collaborative Research Support Program (CRSP), which addresses the control of *Striga* species through the breeding of sorghum lines with resistance to pests and environmental stress. The objective of this research is to boost and stabilize yields of sorghum, millet and other cereals in tropical Africa, Asia and in selected U.S. states.

**Issue, objectives and activities.** Witchweeds (*Striga* spp.) are an economically important parasitic weed of sorghum, millets and other cereals, especially in tropical Africa and Asia. In Africa, *Striga* is one of the greatest biological constraints on food production—a more serious problem than insects, birds or plant diseases. It has also been a problem in some counties in North and South Carolina.

This parasitic weed reduces the yields of cereals such as millets and sorghum, which are a dietary staple for 500 million people in Africa and Asia. Cereal yield losses from *Striga* in Africa average 40%; in some countries such as Ethiopia and Sudan, losses of 65% to 100% are common in heavily infested fields. Sorghum losses due to this parasitic weed have been estimated at 845,000 metric tons per year in sub-Saharan Africa alone.



Control methods available to date have been costly and beyond the means of sorghum farmers in developing countries.

The purpose of this research is to achieve a better understanding of the biological interactions between *Striga* and its hosts, and to devise control strategies based on host-plant resistance, partly through biotechnology. Project activities have included providing training to developing country collaborators in research methods, breeding approaches and the use of integrated *Striga* control methods. Project efforts have also included testing, demonstrating and distributing to farmers (in cooperation with various public and private organizations, including NGOs) elite *Striga*-resistant cultivars in areas where *Striga* is endemic. The adoption and use of these control strategies have been evaluated in cooperation with agricultural economists.

**Benefits to developing countries.** A large collection of *Striga*-resistant germplasm is being shared with collaborating agricultural research scientists in developing countries who are breeding local lines of sorghum that are resistant to pests and environmental stress. For example, in 1996-97 in Mali, the *Striga*-resistant, food-quality sorghum variety *Seguitana cinzana* provided 600 to 800 kilos per hectare more grain than the non-resistant variety evaluated at Cinzana Agricultural Research Station trials—a 33% increase in grain yield when grown with an improved cropping system consisting of manure and ridge tillage. In another example, Ethiopian researchers worked with the NGO SG 2000 to encourage farmers to adopt *Striga*-resistant lines of sorghum developed

by collaborative INTSORMIL research. The resistance of these improved sorghum lines to *Striga* resulted in such high yields and lack of parasitism that farmers are saving the grain for themselves in order to plant larger areas next season.

**U.S. benefits.** The U.S. relies on African countries for sources of sorghum germplasm to improve American varieties. By collaborating with scientists in these countries to control this parasitic weed that decreases their sorghum yields, American scientists continue to build strong research bonds upon which the U.S. sorghum industry depends. In 1998 alone, the value of U.S. grain sorghum exports was approximately US\$532 million; almost five million metric tons were exported that year.

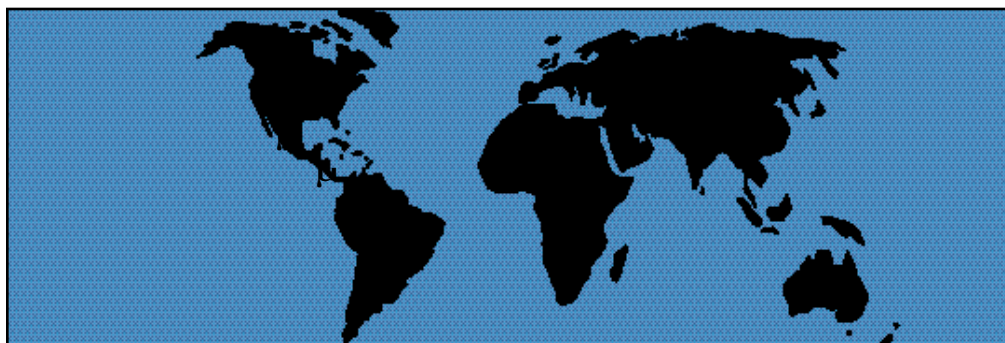
#### **Project costs (1979-99)**

Total donor (USAID) costs	US\$1,256,000
Cost sharing	
Cost sharing by U.S. institutions	344,320
Cost sharing by foreign institutions	280,000
Total cost	US\$1,880,320

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**Protecting Sorghum from Greenbug through International Collaborative Research**

**Program Area.** Sharing scientific knowledge and information

**Partners**

**Developing Countries** Russia, China and countries in the Western Hemisphere

**U.S. states** Texas, Kansas, Nebraska

**Principal mutual benefits.** International collaborative research brings together leading scientists to address problems that affect agriculture and food systems worldwide. This particular research effort is part of the International Sorghum/Millet (INTSORMIL) Collaborative Research Support Program (CRSP), which aims to reduce damage to sorghum from greenbug in the Western Hemisphere. Alleviating the impact of the greenbug requires studying it in its centers of origin outside the U.S., and cross-country collaborative research is the only way to do this. In the U.S. in 1998 alone, the value of grain sorghum exports was approximately US\$532 million, with approximately five million metric tons exported.

**Issue.** Reducing greenbug damage to sorghum production

Greenbug causes major damage to sorghum plants in the developmental stage. The insect sucks juices from the sorghum plant and releases a toxic substance in the process, killing plant tissue.

The greenbug originated in the Mediterranean region and is currently present in several African countries (Botswana, Egypt, Sudan), Central and South America, and the U.S.. All U.S. production of sorghum is from hybrids, grown either dryland or irrigated. Total damage to sorghum caused by the greenbug has been placed at almost US\$250 million annually. The crop is used for export (188 million bushels were exported in 1998) and as animal feed: two thirds of the cattle in the Southwest and one third of the cattle in the Midwest are fed sorghum.

**Project objective and activities.** The immediate objective of this collaborative research is to reduce damage by greenbug. Over the long-term, this requires more information and data on the biology and genetics of the interaction between sorghum plants with greenbug. This project is helping to develop, evaluate and deploy greenbug-resistant sorghum; assess density/damage relationships; determine mechanisms and causes of resistance; identify the role of insect-resistant sorghums in integrated pest management; and apply molecular biology to increase resistance durability through an understanding of the genetic relationship between insects and resistant plants.

**Developing country benefits.** Research techniques developed and successfully used in the U.S. by entomologists, plant breeders and molecular biologists are being transferred to developing

countries for developing insect-resistant lines of sorghum and integrated pest management strategies to minimize economic damage. The success of interdisciplinary, cooperative research on greenbug in the U.S. serves as a model to developing countries for strengthening their agricultural research capabilities to combat greenbug and other insect pests before they become a more serious economic liability.

The experience gained by graduate students, and the principles and techniques they learn while doing marker-assisted selection research to develop greenbug-resistant sorghum in the U.S., will be put to use in their countries when they return home. For example, a Ph.D. student from Mali is learning plant breeding and molecular biology techniques through the research he is engaged in on sorghum resistance to greenbug. After completing his doctoral studies, he will be developing disease-resistant lines of sorghum in Mali.

**U.S. benefits.** Greenbug-resistant sorghum hybrids decrease dependence on chemicals for pest

control and are key components of an integrated pest management strategy for sorghum production. The economic gains to the U.S. resulting from changes in production and consumption of agricultural commodities through adoption of greenbug-resistant (Biotype E) sorghum developed by the INTSORMIL CRSP have been estimated at US\$113 million per year.

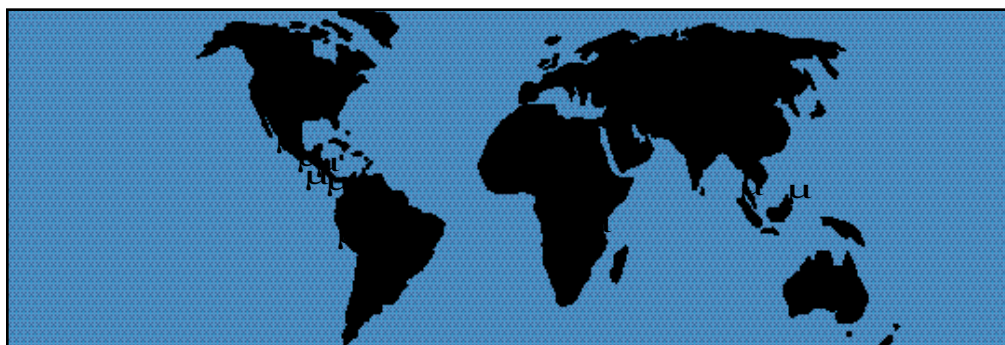
#### **Project costs (1979-1999)**

Total donor (USAID) costs	US\$1,562,100
Cost sharing by U.S. institutions	390,500
Total cost	US\$1,952,600

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**Developing Pond Dynamics/Aquaculture Technologies  
for Global Returns**

**Program Area.** Sharing scientific knowledge and information

University of Delaware; University of Georgia  
University of Hawaii; University of Nebraska;  
University of Oklahoma; University of Texas

**Partners**

**Developing countries:** Honduras, Guatemala, Kenya, Mexico, Nicaragua, Panama, Peru, Philippines and Thailand

**U.S. states:** Alabama, Arizona, Arkansas, California, Delaware, Florida, Georgia, Hawaii, Illinois, Michigan, Nebraska, Ohio, Oklahoma, Oregon and Texas

**Formal overseas institutional partners.** Asian Institute of Technology, Thailand; Central Luzon State University, Philippines; Department of Fisheries, Ministry of Natural Resources, Kenya; Instituto de Investigaciones de la Amazonia Peruana, Peru; Escuela Agricola Panamericana, Zamorano, Honduras; Universidad Juárez Autónoma de Tabasco, Villahermosa, Mexico; and Universidad Nacional de la Amazonia Peruana, Peru

**U.S. institutional partners.** Auburn University; Harbor Branch Oceanographic Institute; Ohio State University; Oregon State University; Southern Illinois University at Carbondale; The University of Michigan; U.S. Department of Agriculture (USDA); University of Arizona; University of Arkansas at Pine Bluff; University of California, Davis;

**Principal mutual benefits.** The Pond Dynamics/Aquaculture Collaborative Research Support Program (P/D/A/CRSP) contributes to optimizing the efficiency of aquaculture systems both in the US and internationally, minimizing the negative environmental impacts of fish culture, developing economical and culturally-appropriate aquaculture development strategies, and disseminating international scientific and technical information worldwide.

**Issue.** The ability of the world fishery industry to meet the growing global demand for fish is seriously threatened.

World fish production from all sources is nearly 100 million tons annually, a level that approximates (and for some fishery resources exceeds) maximum sustainable yield. Aquaculture is a primary means of achieving significant future increases in the world fish supply, an important protein source in the world. The Pond Dynamics/Aquaculture Collaborative Research Support Program conducts research that contributes significantly to removing major constraints to aquaculture development, thereby promoting economic growth and increasing food security.

**Project objectives and activities.** By enhancing and developing sustainable aquaculture systems, the PD/A CRSP aims to improve long-term food supplies and human nutrition, especially for the rural poor, including women and children. The CRSP mission is to raise small farmers' incomes, increase consumers' welfare through an enhancement of fish farm activity, improve the well-being of the rural poor, and conserve or enhance the natural resource base.

The PD/A CRSP was awarded a five-year grant in August 1996 to serve as a basis for improving the sustainability of aquaculture production systems. The building blocks are production systems research and capacity building via research support.

#### **Developing country benefits.**

- Training of over 2,400 farmers, scientists and agency personnel from 42 countries in fish production, sampling techniques, computer use, economics and marketing
- Development of an extension strategy in Rwanda that enabled 3,000 fish farmers (many of them women) to quadruple their ponds' productivity in four years
- Development of a computer model for studying the dynamics of organic matter and nitrogen in integrated agriculture-aquaculture systems. The findings help farmers choose best practices for optimal production with minimal negative ecological effects
- POND© computer software developed by CRSP researchers was used in a geographic

information system (GIS) to assess aquaculture potential in Africa and Latin America, in collaboration with FAO.

**US benefits.** The U.S. tilapia industry is the fastest growing sector of U.S. aquaculture. U.S. output in 1996, 1997 and 1998 was 15, 17 and an estimated 21 millions tons, respectively. Successful tilapia farming requires the stocking of ponds with only male tilapia. The technology of choice for sex-reversal of tilapia fry is use of a steroid. A prime example of how CRSP research contributes to the U.S. aquaculture community is a new CRSP-developed technology which reduces worker exposure to hormones, minimizes environmental impact, and promises to be more economical than earlier technologies involving steroid-containing feed. Laboratory results have been successful, and the technology is being tested under farm conditions. In addition, PD/A CRSP researchers have contributed significantly to getting FDA approval for the new steroid-immersion technology.

**Program costs.** Program costs from 1982 to the present are US\$27 million from USAID. U.S. and host country institutions provided US\$11.3 million in matching funds.

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**Breeding Beans for Drought Resistance Yields Mutual Economic Benefits for Mexico and Michigan**

**Program Area.** Sharing scientific knowledge and information

**Partners**

**U.S.:** Bean/Cowpea Collaborative Research Support Program (CRSP), Crop and Soil Sciences Department, Michigan State University;

**Mexico:** Instituto Nacional de Investigaciones Forestales y Agropecuarias (INIFAP)

**Principal mutual benefits.** Mexico is the second leading producer of beans worldwide after Brazil; Michigan is the leading producer of navy and black beans in the U.S. Drought conditions seriously constrain rainfed production in Mexico and Michigan. The germplasm developed as a result of international scientific collaboration to breed drought-resistant beans (within the framework of the Bean/Cowpea Collaborative Research Support Program) has benefited both countries.

**Issue.** Drought is a major constraint to bean production worldwide, second in importance only to pests and diseases. Developing new drought-resistant bean varieties through breeding is the only sustainable long-term solution to this problem. Breeding for resistance to drought is complicated by many factors, for example, the type of drought, widely varying moisture conditions in

bean production regions, the presence of root pathogens, inadequate genetic variability to identify drought-resistant varieties, and problems involving screening methodologies.

**Objectives and activities.** With over one million hectares of beans planted under limited rainfall, Mexico is an ideal location to study drought, evaluate germplasm and test control strategies. Work undertaken by the Bean/Cowpea CRSP and the national bean program of Mexico, led by INIFAP, focused on the evaluation and selection of local bean germplasm under drought stress and its use as parental material for varietal improvement.

During the development of the new bean varieties, testing was conducted for yield and performance in experimental station test plots and then in growers' fields. In the latter trials, the yields of the variety Pinto Villa, developed through CRSP/INIFAP collaboration, outperformed local varieties by 72%. Based on these data, the new variety was multiplied, distributed and adopted by producers – first, in Chihuahua state and ultimately throughout Mexico's semi-arid highlands. The rapid adoption of Pinto Villa in the semi-arid highlands was accelerated by three successive years of severe drought in the region.

**Benefits to the developing country.** In the semi-arid highlands of Mexico, over 350,000 hectares, or 80% of the acreage planted to pinto

beans, are now planted to the drought-tolerant Pinto Villa variety. As a result, Pinto Villa provides consumers with one of the cheapest beans available in Mexican supermarkets. Pinto beans are now 46% cheaper than black beans in the marketplace.

**Benefits to the U.S.** The germplasm developed through the Bean/Cowpea CRSP has also benefited the U.S., where periodic drought can dramatically reduce yields and economic returns to bean growers. Over 90% of bean production in Michigan (the leading producer of navy and black beans in the U.S.) is grown under rainfed conditions. Annual bean production fluctuates considerably as a consequence of erratic rainfall patterns.

Based on research from the Bean/Cowpea CRSP program in Mexico, the line T3016-2 was identified as top-yielding among the 181 lines grown in seven drought-stressed environments in Mexico and Michigan. When T3016-2 was used as a parent in the Michigan State University breeding program, new black and navy beans were developed that outperformed standard varieties under drought stress by over 165%. This research is being extended to assist bean producers in the semi-arid production areas of the Western U.S. where water availability for irrigation and escalating water costs are restricting production.

**Project costs.** Since 1986, the obligation of the Bean/Cowpea CRSP to work on drought has been under US\$2 million. In Mexico, the resulting

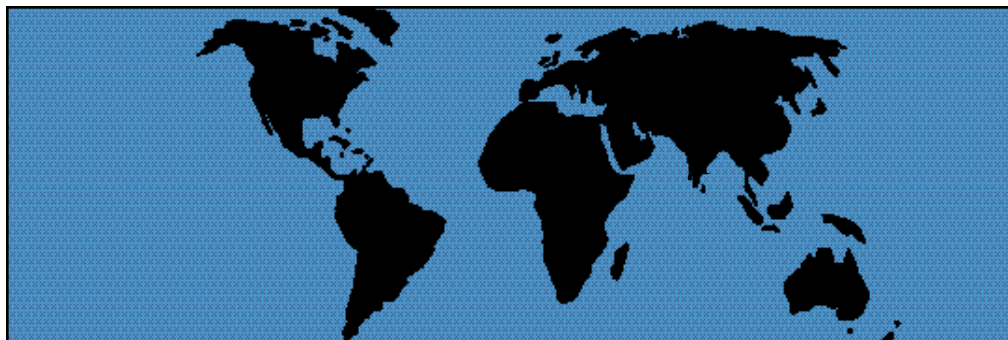
research has sustained an industry with an estimated annual farm gate value of US\$390 million. In terms of importance to food security, Mexico has the highest bean consumption in Latin America, over 15 kilos per capita annually.

In Michigan, commercial dry bean yields peaked at an all time high in 1999, with a 13.5% increase over the last record high in 1991. In general, most estimates attribute 50% of the improved performance to the improved variety and the other 50% to improved management, including better disease, insect and weed control. The farm gate value of the 1999 bean crop in Michigan was US\$150 million; the comparable value in 1991 was US\$132 million. Taking varietal improvement to represent half of the US\$18 million increase between the two years leads to the conclusion that the economic benefit of varietal improvement was around US\$9 million for 1991-99 in just the U.S. Similar yield gains have been reported in other states of the U.S. as a direct result of CRSP research.

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### Reducing Food Loss in India

**Program Area.** Sharing scientific knowledge and information

**Partners.** University of California at Davis (UCDavis); U.S. Agency for International Development (USAID); Punjab Agricultural University (PAU)

**Principal mutual benefits.** As a result of this project, the Punjab Horticulture Post-Harvest Technology Center has become a model that can be replicated in other parts of India to reduce serious food losses, improve food quality and support expanded exports of horticultural products. In terms of benefits to the U.S., over the next three years the Center plans to buy more than US\$500,000 of scientific equipment, services, instruments, and reference materials from U.S.-based post-harvest technology vendors. In addition, improvements in India's food safety should increase the supply and variety of exotic fruits and vegetables available for U.S. consumption.

**Issue.** Reducing post-harvest food loss

In India, only 50 of every 100 lbs of perishable commodities produced (mainly fruits and vegetables) become available for human consumption, due to reductions in volume, quality, nutritional value, or food safety problems arising between the farm and the points of final consumption. In value terms, this 50% loss rate is truly astounding; it is

greater than the annual value of all automobiles manufactured in the country!

Knowledgeable observers claim that these losses are due to under investment in three areas: professional expertise, appropriate infrastructure and post-harvest technologies.

**Project objectives and activities.** UCDavis decided it had comparative advantages for facilitating improvements in the first of these three areas. In May 1997, it was provided modest financing by USAID to offer a short course at Punjab Agricultural University (PAU) on post-harvest problems and technologies for Indian researchers and private sector professionals. During the event, local state government officials expressed interest in developing a new post-harvest technology center cooperatively with producers, the government, PAU and UCDavis. Subsequently, UCDavis personnel spent several months in the Punjab, helping assess the demand for such a center, outlining its work program, and making suggestions as to how the center could best be managed.

In mid-1998, the Punjab Horticulture Post-Harvest Technology Center was officially established with the purpose of conducting research and transferring technology, mainly through educational programs, to an industry urgently in need of improvement. In support of this mission, the Center incor-



porated several innovative features. First, it is administered by a Board of Directors comprised of private sector, government and university representatives (including representatives from UCDavis). Second, although located on the PAU campus, it is a semi-autonomous entity that is only "associated" with the University. Finally, it receives over US\$1.0 million annually from both government and private sector organizations through a new kind of public-private partnership, although major funding comes from the Punjab Agricultural Marketing Board (which oversees the marketing of perishable commodities in the Punjab). It is noteworthy that USAID financing is no longer being provided.

**Developing country benefits.** As the Punjab Horticulture Post-Harvest Technology Center is still in its infancy, having been established only in the middle of last year, solid outcomes cannot yet be claimed. However, the fact that the Center has attracted substantial funding and has a strong Board of Directors made up of representatives from different sectors of the economy indicates that it is off to a promising start. Continuing contact with UCDavis over the coming years (most recently with a visit to UCDavis by the Center's Director and his senior associate) should help establish and maintain the pace for the Center's accomplishments, as well as the importance of their impact. Some observers fully anticipate that the Center will become a model replicated in other regions of India for reducing food loss, improving food quality and supporting expanded exports of horticultural products.

**U.S. benefits.** Over the next three years, the Center plans to buy more than US\$500,000 of sci-

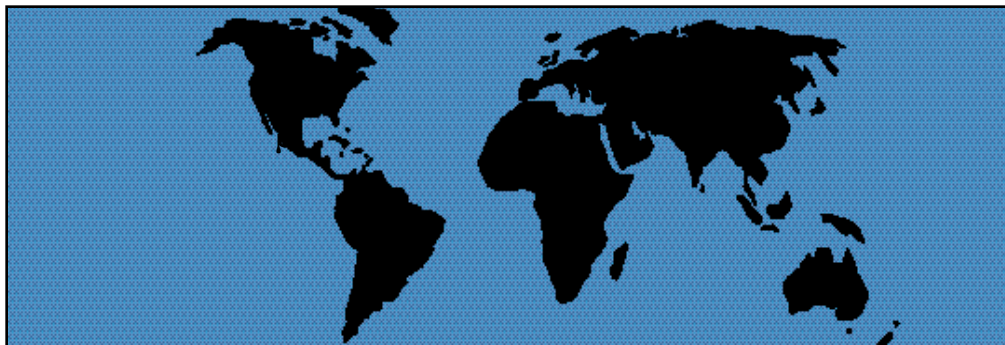
entific equipment, services, instruments and reference materials from U.S.-based post-harvest technology vendors. Exceptional case studies of post-harvest technology have been developed by faculty who have visited India. The opportunities for scientists from UCDavis to see and study new and challenging problems in their areas of interest, and to interact with Indian scientists, have produced platforms from which new research will be launched and international cooperation sustained into the future. Moreover, India's improvements in food safety resulting from the efforts of the Center should increase the supply of exotic fruits and vegetables for U.S. consumption.

**Project costs.** With their annual contribution of US\$1.0 million to the Center, the Indians are the principal contributors. The other significant project cost incurred to date was the USAID "seed grant" of US\$90,000 to fund partially the activities leading up to the establishment of the Center. Future travel and time commitments by UCDavis faculty and students will be absorbed by the University. Thus, if the project meets its objective of reducing the present rate of food loss in India, benefits will clearly outweigh costs.

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## Stemming the Resurgence of the Irish Potato Famine Fungus

**Program Area.** Sharing scientific knowledge and information

### Partners

**Developing countries** Mexico, Poland, Russia

**U.S. states** New York

**Institutions** Cornell University; Plant Breeding and Acclimatization Institute Radzikow, Poland; Russian Research Institute of Plant Industry; Vavilov Institute for Research, St. Petersburg, Russia; PICTIPAPA, Mexico; International Potato Center (CIP); Consultative Group on International Agricultural Research (CGIAR)

**Principal mutual benefits.** The release of new late blight-resistant varieties significantly reduces the use of fungicides and controls the resurgence worldwide of the Irish potato famine fungus in developing countries and the U.S.

**Issue.** Crop loss caused by potato late blight fungus

During the last 10 years, new aggressive strains of the potato late blight fungus have spread from their ancestral home in Toluca, Mexico to all major potato-producing areas in the world. The new strains are resistant to the commonly applied systemic fungicide "Metalxyl" and can cause loss-

es of up to 40% in developing nations. The estimated annual cost of late blight in developing countries is US\$3.25 billion. Control of the disease through resistant varieties could increase the value of potato production by as much as 50% in developing countries. The environmental cost of the use of fungicides is also of concern, including health risks as a result of exposure to and misuse of fungicides.

While comprehensive economic data are not available on losses in the U.S. and Canada, severe losses have occurred to individual producers. In the mid-1990s, late blight was especially severe in the northeastern United States and in the Columbia Basin in Washington and Oregon states.

**Project objective and activities.** In order to reduce the problem of potato late blight, this project is working in Mexico, Poland, Russia and the U.S. to: 1) investigate the fungus in its ancestral home and at Cornell University; 2) breed for resistance; and 3) train scientists, students and growers in integrated pest management. Valuable germplasm, rescued at the Vavilov Institute in St. Petersburg, Russia, is being shared among project partners.

**Benefits to developing countries.** Economic benefits derive from increased yields resulting from the planting of high quality, disease resistant potatoes. This project is based at Cornell

University and focuses only on Eastern Europe and Mexico; no final economic impact data are available. However, the Cornell program collaborates closely with the Global Initiative on Late Blight (GILB), which is coordinated by the International Potato Center (CIP).

Internal rates of return from research conducted by CIP over the past 15 years in cooperation with national agricultural research systems in Eastern Africa have been estimated at 91% annually. Net benefits to farmers totaled approximately US\$10 million in 1993 and more than US\$60 million during the past decade. Investments totaled approximately US\$5.6 million over 15 years. This surpasses the profitability of many development projects and compares favorably with other documented success stories in international agricultural research.

**U.S. benefits.** The release of new late blight resistant varieties significantly reduces the use of fungicides in the U.S., allowing its growers to be more competitive. Private sector companies, including McDonalds, McCain, Frito Lay, Monsanto and Zeneca are keen on making use of the best control methods available to combat this fungus. The National Potato Council also considers the use of integrated pest management a high priority.

**Project costs.** This six-year project has an annual budget of approximately US\$400,000. These funds are raised through a diverse group of private

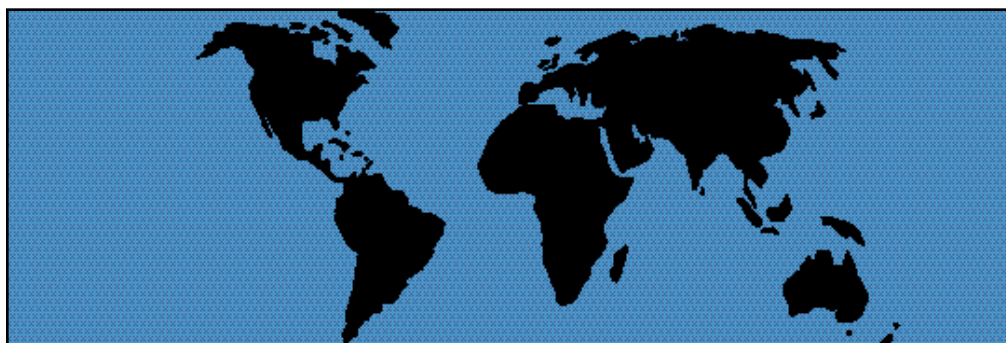
and public sector donors, including the USDA Foreign Agriculture Service; Wallace Genetic Foundation, Civilian Research Development Foundation; Nature Mark-Monsanto; Frito Lay; McCain Foods; Rohm and Haas; Zeneca; USDA/Integrated Pest Management Fund; USDA/Agricultural Research Service; Cornell University Hatch Funds; and PULSAR. Several additional donors wish to remain anonymous.

**Cost sharing.** Several Cornell faculty are participating in this effort. Their time is supported by the University's College of Agriculture and Life Sciences at an estimated cost of US\$800,000 to US\$1 million. PICTIPAPA in Mexico supports the project with a grant from PULSAR (a private concern); their investment to date has been US\$1.5 million. Several scientists in Poland are also participating, with their salaries being paid by their base institutions.

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### **Analogous Zones Approach Hastens Technology Adoption in Russia**

**Program Area.** Sharing scientific knowledge and information

**Partners**

**Canada** Natural Sciences and Engineering Research Council, Manitoba Pool Elevators, Uniroyal Chemical, Yellowquill Farms, and Zeneca Seeds

**Russia** AgEvo, Dow Agro Sciences, Kurgan State Agricultural Academy, Omsk State Agrarian University, Siberian Agricultural Research Institute, and the Siberian Branch of the Oilseed Crops Institute

**U.S.** USDA Agricultural Research Service; Global Livestock CRSP; Gore/Step Commission Subcommittee on Agricultural Research, Education and Extension; Gustafson; Hennings Seed Company; University of Idaho; University of Maryland, College Park; U.S. Canola Council; and the World Soil Resources/U.S. Department of Agriculture (USDA)

**Principal mutual benefits.** This approach significantly reduces the time it takes to adapt and apply technologies available in one part of the world to other regions.

**Issue.** The development of new agricultural technologies is time consuming —on average around

12 years from first identification of a research problem to the application of resulting technologies. Shortening this time period reduces investment costs and extends the stream of benefits.

This project identified areas with similar climates, soils, moisture and temperature (growing habitats) so that a technology developed to fit one area could rapidly move into the other "analogous zone," sparing the latter time and the full costs of development.

**Project objectives and activities.** Russia's livestock industry has been protein deficit for years and also in need of edible oils. The USDA Economic Research Service reports that animal productivity in the former Soviet Union was roughly half U.S. levels, and that animal production declined further since its breakup. Low protein content in livestock feed has been identified as the primary factor. In 1997 Russia imported 760,000 tons of vegetable oil at a cost of US\$453 million. Several oil crops could meet both needs, but the climate seemed unsuitable. Canola, a modified rape variety developed in Canada to meet its animal protein and edible oil needs, showed promise. Would it transfer to Russia, specifically to the Omsk Region?

To identify the analogous zones in the two countries, soil and climatic data from World Soil Resources of USDA's Natural Resources

Conservation Service and the United Nations Food and Agriculture Organization (FAO) were consolidated in a single data set called the Biological Resources Analysis Support System (BRASS). Using BRASS data, Northeastern Alberta, Northwestern Saskatchewan and areas in Montana and Wyoming were found to be analogues of Omsk, Russia, by reason of similar latitudes, soil subclass classifications, soil temperature regimes, soil moisture regimes, average monthly air temperatures, and average monthly rainfall.

Ten U.S. varieties and two Russian varieties of canola were then evaluated in three Russian sites. Yields obtained with similar cultural and management practices in two Omsk sites were found to be comparable to those obtained in the analogous zones of the U.S. and Canada. The third Russian site produced lower yields, apparently due to a severe drought. These experiments are being repeated to verify the first round of results and additional experiments are being undertaken in Southwestern Siberia, where a highly promising outcome has already been obtained.

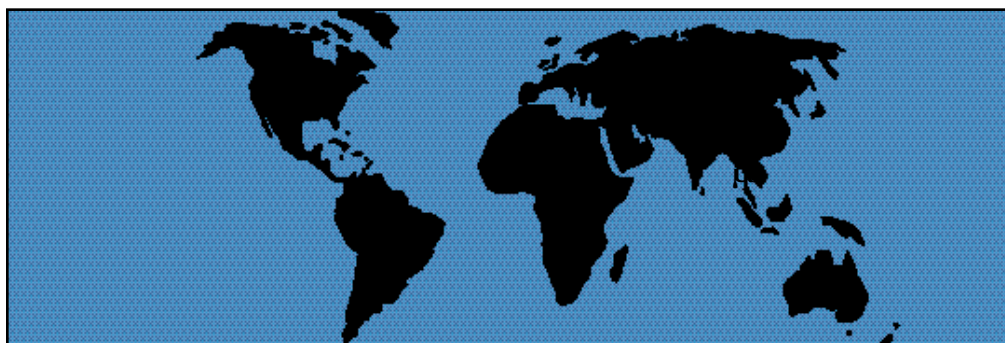
**Mutual benefits.** Russia benefits by having a new technology (specifically, a new crop variety and related management practices) quickly available for its livestock industry, one that responds to the industry's need for additional sources of oils and protein for animal feed. The U.S. and Canada benefit from larger markets for sales of their seeds, inputs and related equipment.

**Project costs.** Although the project has been under way for three years, and many people and organizations have provided financial and in-kind support, total costs are estimated to be in the range of merely US\$150,000.

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**Biological Nitrogen-Fixation Technology Improves Yields and Incomes for Thai Bean Farmers**

**Program Area.** Sharing scientific knowledge and information

**Partners.** Departments of Agriculture and Extension of the Kingdom of Thailand; University of Hawaii; U.S. Agency for International Development (USAID)

**Principal mutual benefits.** Higher incomes for Thai farmers, increasing their demand for U.S. exports, plus sale of U.S. agricultural equipment and supplies valued at US\$750,000.

**Issue.** In the Kingdom of Thailand, grain legumes (mung bean, peanuts and soybeans) rank second just after rice in terms of their importance to producers and consumers. The demand for these crops has been expanding at over 10% yearly since 1980. However, local supply could not keep pace and legume imports skyrocketed from 16,000 to 1,064,000 metric tons. Closing this widening demand-supply gap had to be done in a way that would hold down production costs and raise yields substantially since opportunities for expanding the land area under grain legumes was limited and yields ranging between 900 and 1,200 k/ha were low.

One prospect for achieving higher yields while minimizing production costs was to increase the availability of nitrogen to the plants through a

process termed biological nitrogen fixation (BNF). Through BNF, legume plants, working in cooperation with a soil bacterium, are able to capture nitrogen from the air and convert it into plant energy, precluding the need for manufactured nitrogen fertilizers. In modern agriculture, farmers inoculate their legume crops with selected strains of the bacterium that are highly efficient in capturing atmospheric nitrogen for the plant. The seeds are painted or coated with material containing the bacterium. Legume inoculants are manufactured under rigorous quality standards and support high enough populations of the bacterium to ensure that farmers apply many millions of cells to each seed just before the seed is planted.

**Project activities and objectives.** When it got under way in 1982, the project aimed to improve farmers' access to BNF technology through research and by improving the strains and manufacturing processes of bacterium used to inoculate grain legumes. To begin with, the principal Thai scientists received training and conducted research in the U.S. through programs financed by USAID. The research helped identify superior strains of inoculants for prevailing Thai agro-ecosystems; tested the suitability of Thai raw materials for the manufacture of inoculants; and calibrated inoculant application rates and application methods for Thai field conditions. A USAID loan to the Thai government resulted in development of a modern inoculant production facility in the Thai

Department of Agriculture (DOA), designed by U.S. experts. The DOA and University of Hawaii established a resource center for BNF technology which provided needed technical expertise, genetic resources and professional training for agricultural specialists from Thailand and nearby countries. Furthermore, agricultural extension agents that received training from the BNF Center offered field demonstrations to Thai farmers on BNF methods and benefits.

Once the project proved successful, the Thai private sector joined in the production and distribution of inoculants, producing a "takeoff" in the spread and use of BNF technology for grain legumes.

**Developing country and U.S. benefits.** Thai farmers increased their use of inoculants from 28,000 bags in 1980 (200 grams per bag) to 1.1 million bags in 1993. Inoculant penetration of the potential inoculant market for soybeans reached 51% by 1990. Gross returns to farmers from the additional output attributable to the use of the new technology were estimated at US\$121 million over the project period. The use of inoculants resulted

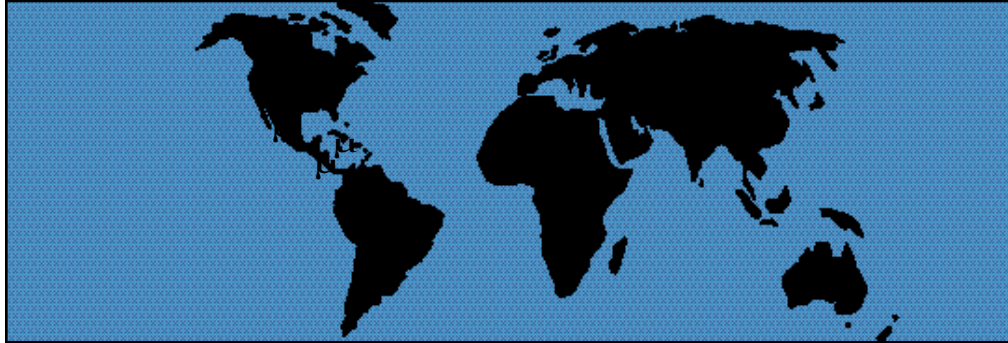
in a saving of 143,828 metric tons of urea, valued at US\$25.9 million. Adding these two amounts and subtracting the estimated cost of inoculants yields a rough estimate of project benefits of about US\$140 million over the 1982-93 period. The resulting rise in Thai farmer incomes increased the demand for U.S. exports, as well as farmers' demand for agricultural equipment and supplies from the U.S., valued at over US\$750,000 annually.

**Project costs.** Project costs amount to about US\$2.6 million over the 1983-94 period, with US\$1.2 million of this originating in a USAID loan and USAID grants.

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**Investments in Agricultural Research in Latin America and the Caribbean Pay Handsome Dividends**

**Program Area.** Sharing scientific knowledge and information

**Principal Partners.** Inter-American Development Bank (IADB), Inter-American Institute for Cooperation on Agriculture (IICA), International Center for Tropical Agriculture (CIAT), International Food Policy Research Institute (IFPRI), subregional agricultural research programs (including the so-called "PROCI's"), and the national agricultural research institutes of Latin American and the Caribbean

**Principal mutual benefits.** As a result of this project to upgrade technologies for planning and evaluating agricultural research, public and private sector investors in Latin America and the Caribbean have tools for better orienting their research so as to optimize investment returns. This has made investments by all partners, including the U.S., more efficient, effective and profitable. Priority setting and evaluation technologies developed through this project are being adapted for use in U.S. agricultural research programs.

**Issue.** Significant economic reforms were put in place in Latin America and the Caribbean (LAC) in the 1990s, two of which have had profound consequences for agriculture. One was the reduction in public expenditures, the size of government and the activities of the public sector. The other was

the opening of the region resulting from the liberalization of its international trade regimes.

These reforms had an important impact on government-financed national agricultural research institutes, historically the backbone of agricultural research and technology generation efforts in LAC. First, the financing available for their operations was cut quite markedly as of the late 1980s, although they are still principal beneficiaries of the US\$1.0 billion LAC spends on agricultural technology generation annually. Second, the reduction (and sometimes the elimination) of tariffs and subsidies on agricultural commodities, which traditionally enjoyed some form of protection, realigned relative prices. For example, horticultural crops are now much more attractive to farmers and basic grains have become distinctly less attractive. Coffee and sugar are no longer LAC's major agricultural export commodities; maize, wheat and other basic grains are being increasingly imported; and horticultural crops (fruits and vegetables, in particular) now rank first as exported agricultural commodities.

Not surprisingly, commodity price realignments have raised major questions at government-funded agricultural research institutes regarding their commodity priorities. Where should they invest? At the same time, reduced budgets have led governments to press researchers not only to redefine their priorities, but to define them more sharply



then ever before and to monitor, evaluate and carefully assess results in order to ensure efficiency and effectiveness.

The upshot has been a sharp rise in the demand for priority-setting and evaluation skills and methodologies which can orient agricultural research programs and "show the way." This case study deals with a unique project which was extraordinarily successful in responding to this need.

**Objectives and activities.** In 1995, IICA and the IADB executed a cooperative agreement for the project "Strengthening Capacities and Applications to Prioritize Agricultural Research in Latin America and the Caribbean," to be led technically by IFPRI, a member the Consultative Group for International Agricultural Research (CGIAR). Partners included CIAT, the national agricultural research institutes in LAC, and sub-regional agricultural research programs such as the Caribbean Agricultural Research and Development Institute (CARDI). The aim of the three-year undertaking was to accelerate the development of much needed priority-setting and evaluation skills and methodologies which could orient agricultural research programs and "show the way."

The project produced a user-friendly Windows software program called DREAM, which is capable of assessing investment returns on agricultural research projects; basic data were assembled to facilitate applications of this program. Some 58 technicians from throughout the region, mainly staff from the national institutes, were trained in agricultural research priority-setting and evaluation techniques. In addition, *ex-ante* assessments of agricultural technology generation efforts, involving two or more countries addressing shared problems, were performed for the Andean and Caribbean subregions. Research projects assessed included those to rid the Andean Region of a potato pest, to produce new rice varieties for LAC, and to increase vegetable production for local and tourist markets in the Caribbean. Finally, a package of eight documents, constituting a methodological textbook for assessing and evaluating agricultural technology development projects, was published and made available.

**Benefits to LAC countries.** Most of the countries in the region now have trained personnel, methodologies and instruments for producing and analyzing information which should optimize investment returns to agricultural research. Over-investments in one area of research or under-investments in another are much less likely to occur, increasing the efficiency and effectiveness of both public and private sector investments. Furthermore, it has been repeatedly demonstrated that few investments have returns that are higher than those that can be generated through agricultural research. For instance, the project found that new varieties of rice for LAC that would reduce production costs by just 18% could produce a total net return over the following 15-year period of around US\$161 million.

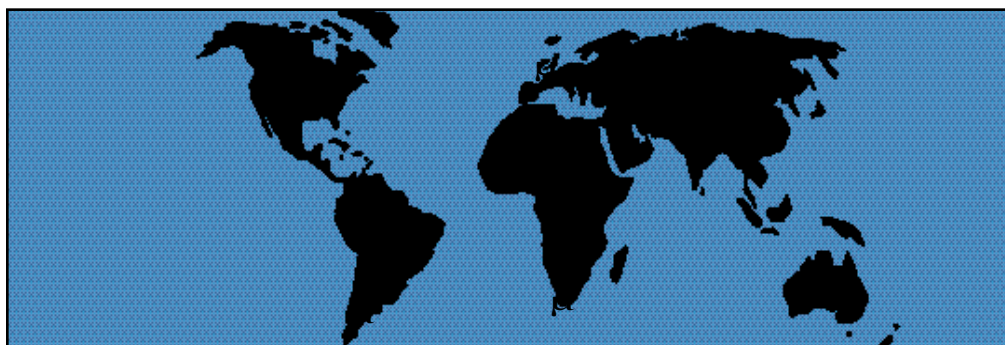
Furthermore, the methodologies, instruments and data made available through this unique project should help sharpen the division of labor between the public and private sectors, and show how "win-win" synergies can be exploited through joint ventures and shared programs involving both sectors or two or more countries.

**U.S. benefits.** The U.S. government makes major investments in the CGIAR, IADB, the Land-Grant System of Universities and State Experiment Stations, the World Bank, USAID, and USDA, which, in turn, invest in agricultural research in LAC. The U.S. private commercial sector is also a major player in the region. The data, methods and instruments made available by the IADB-IFPRI-IICA project are helping them to make their investments more efficient and productive, and are providing a valuable common language between them and their collaborators in LAC.

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**Biological Control of Invasive Species:  
The Case of Water Hyacinth**

**Program Area.** Sharing scientific knowledge and information

**Partners.** U.S. Department of Agriculture's Agricultural Research Service (ARS), South American Biological Control Laboratory in Hurlingham, Argentina, and ARS Aquatic Plant Control Research Unit in Fort Lauderdale, Florida); South African Plant Protection Research Institute; CABI Bioscience in the United Kingdom

**Principal mutual benefits.** Discovery of new natural enemies to combat the water hyacinth, which is among the top 10 noxious weeds worldwide, which cannot be controlled with herbicides and mechanical harvesting, particularly in developing countries.

**Issue.** Although the U.S. Department of Agriculture (USDA) has long worked to exclude and manage invasive pests, the globalization of trade and travel has resulted in an unprecedented introduction of foreign plants and animals. The damage caused by invasive pests in the U.S. alone is estimated at US\$122 billion annually, including the costs of control, lost resources and damage to property.

Since 1881, biological control—the deliberate use of one living organism to control another—has been used as a tool to stem the spread of intro-

duced pests. When properly conducted, biological control works because it uses carefully selected and tested natural enemies (i.e., insects, mites or pathogens) against the target pest.

Water hyacinth is a free-floating perennial herb with lush leaves and blue-to-lavender flowers. It is also the worst floating aquatic weed in many tropical and subtropical parts of the Americas, Asia, Australia and Africa. It provides a good illustration of the use of biological control against harmful invasive species.

The plant used to be held in check by natural enemies, such as insects and microbes in the Amazon that stress the plant and control expansion of its mat. Over time, however, water hyacinth escaped into other waters lacking these natural enemies when tourists and visitors took them home as attractive ornamentals. Out of reach of its natural enemies, the water hyacinth wreaked havoc. The plants grow about three feet as they float on the water's surface, with their stems intertwining in extremely dense mats. In Africa the plant now infests every major river and nearly every major freshwater lake. In the U.S., it flourishes in hundreds of bodies of water in Hawaii and California and throughout the South, from Texas to the Carolinas.

At worst, this plant can be considered a killer. In the Sepik area of Papua New Guinea, for example,

it is blamed for contributing to the starvation of indigenous people. According to Australian scientists K.L.S. Harley, M.H. Julien and A.D. Wright, people "could not access subsistence gardens and hunting areas, catch fish, or travel to market to sell and buy produce" because of the presence of dense water hyacinth mats.

Water hyacinth also damage water quality by blocking sunlight and oxygen and slowing the water's flow. Capable of doubling its height within a couple of weeks, it grows faster than any other plant. By choking out other vegetation, it makes an area unusable to plants and animals that live in or depend on the water, and is capable of eradicating fish spawning grounds. In some parts of the world, the mats form habitats for disease-carrying mosquitoes, as well as for snail species that are intermediate hosts for schistosomiasis, among the world's worst parasitic diseases.

Uncontrolled water hyacinth robs water from potential drinking and irrigation supplies. The mats can block boat travel, and chunks of mat can break free to clog downstream pump stations that supply water for drinking, irrigation and hydro-power. Chemicals and mechanical removal, formerly the primary weapons against the weed, are costly, often ineffective and not environmentally friendly.

**Project objectives and activities.** Today, increased cooperation by governments and scientists around the world is turning up new natural enemies to help combat this invasive weed. The more unique and specific natural enemies that scientists can find and evaluate, the more likely they can deploy new biological control agents suited to the weed's various growth stages, climates and growing conditions.

In April 1999, scientists from ARS, South Africa's Plant Protection Research Institute, and CABI Bioscience in the United Kingdom conducted a joint exploration near Iquitos, Peru, a region thought to be the world's richest source of natural enemies of water hyacinth. The team searched 180 km of the upper Amazon River and the Ucayali and Marathon Rivers that converge to form the Amazon, collecting hundreds of natural enemies and plant samples at 30 sites over seven days.

Among the natural enemies and plant samples collected were new species of *Thrypticus*, a tiny

Amazonian fly that attacks water hyacinth. Immature flies feed inside the weed's petioles, the tiny stalks that attach leaves to stems, and the flies' tunneling may enable microbes to enter and further weaken or kill the plants.

This newly discovered fly has, for the first time, been reared in large numbers. "These flies –plus other new species scientists discovered in the upper Amazon basin– could become the first new insects imported to attack water hyacinth in about 25 years," said Floyd P. Horn, Administrator of USDA's Agricultural Research Service. "Biological control with insects and other natural enemies, such as fungi, is essential for a long-term solution. Today's primary weapons –herbicides and mechanical removal– can be costly and often ineffective."

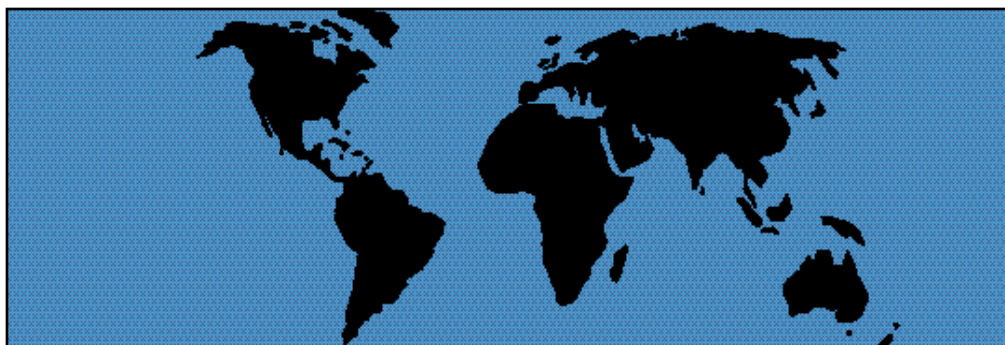
In December 1999, Cordo's research team at SABCL released several hundred adult *Thrypticus* water hyacinth petiole mining flies on water hyacinth plants in a six-foot square cage outside its Buenos Aires laboratory. The flies mated and large numbers of their adult offspring began appearing in January. Cordo said, "*Thrypticus* might be ready to import in two or three years" for testing in an ARS quarantine laboratory in Florida.

**Shared mutual benefits.** A more diverse crew of natural enemies should increase the effectiveness of efforts to combat water hyacinth by the U.S. and other countries. Currently known natural enemies are being deployed in the U.S. and more than 20 other countries, including Australia, Cuba, Egypt, Honduras, Indonesia, Malaysia, Mexico, Panama, South Africa, Thailand, Vietnam and Zimbabwe. Of those natural enemies, two South American weevils (*Neochetina bruchi* and *N. eichhorniae*) and the water hyacinth borer (*Sameodes albiguttalis*) were first released in the United States as a result of ARS efforts.

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### **Development of Virus-Resistant Potatoes in Mexico**

**Program Area.** Sharing scientific knowledge and information

**Partners.** Lead project partners were the Monsanto Company (U.S.) and the Center for Research and Advanced Studies (CINVESTAV) in Mexico. Other project partners included Cornell University, Washington State University, International Service for the Acquisition of Agri-biotech Applications (ISAAA), Mexican National Institute for Agricultural, Livestock and Forestry Research (INIFAP), Mexican National Service for Seed Inspection and Certification (SNICS), and the Rockefeller Foundation.

**Principal mutual benefits.** Significant potato production increases in Mexico, an improved regulatory framework for the transfer of biotechnology, and greater public awareness and understanding of the benefits of agri-biotechnology research. The latter, in particular, favors expanded future export sales by U.S. private firms to Mexico.

**Issue.** Potato is considered a horticultural crop in Mexico and as such it ranks second in importance after tomatoes in area harvested, accounting for almost 3% of the value of total crop production. In the central and southern states of the country, they are grown principally by small-scale producers (farming five hectares of land or less), accounting for one eighth of the total value of potato production. In northern regions, potatoes are produced primarily by large-scale farmers.

Viral diseases of potatoes, transmitted mainly by infected seed materials, adversely affect the crop's yield and quality. The economic impact of such diseases is estimated by knowledgeable observers to be about 30% of the crop annually. Despite recent advances in chemicals for a variety of crop protection purposes, plant viruses are unaffected by chemical treatments (which is somewhat analogous to the case of human viruses that are not generally susceptible to available antibiotics).

While the use of certified, pathogen-free seed materials can reduce the presence of infected potato varieties, certified seed is often beyond the reach of farmers either because their farms are isolated from input markets, or because certified seed costs exceed their financial resources. As a consequence, over three quarters of the land area devoted to potato production in Mexico is not planted with certified seed. Producers either save some of their potato production for seed or buy seed materials from nearby producers; both practices increase, of course, the prevalence and spread of viruses.

**Objectives and activities.** Three viruses designated as virus X, virus Y and potato leaf roll virus were targeted. The plan was to insert genetic resistance to these viruses in three widely grown potato varieties (Alpha white potato, Rosita red potato and Norteña white potato) grown by Mexican producers of most farm-size classes. The

project also sought to develop a regulatory framework to establish risk assessment measures and to exchange general information and data on the new methodologies of biotechnology research. The development of biosafety and regulatory procedures for testing and introducing new technologies should be applicable to other recombinant DNA products. The ultimate goals of this collaborative project are a greater food supply, lower prices for urban consumers, increased rural employment, and higher incomes for Mexican potato producers.

Because the three viruses are common to potatoes in other parts of the world, at one point the project considered including Kenya as a full partner. The decision was made, however, to extend the new technology first to Mexico. After success there, efforts could be made to extend and market the technology in Africa and other developing regions of the world where it would be of relevance, applying a strategy similar to the one followed in Mexico.

Through the partnership between Monsanto and CINVESTAV, Monsanto swapped its professional services and a license for its gene technology to Mexico (ultimately executed in 1991) with CINVESTAV, which contributed knowledge about locally grown potato varieties, the growing environment, and Mexican agriculture as a whole. In a first phase of the project, scientists from CINVESTAV in Irapuato, Mexico traveled to St. Louis, Missouri to receive training in gene transformation protocols and plant regeneration, using the Ti plasmid of *Agrobacterium tumefaciens*. The plasmid contains sequences for X and Y coat proteins which, in turn, enable scientists to confer resistance to both viruses in a single transformation.

Later, CINVESTAV established laboratories to conduct the transformations and Mexican scientists began adapting the virus resistance technology to the three potato varieties. The first trials of the transformed Alpha, Rosita and Norteña varieties took place in 1993; these showed highly promising results. By the year 2001, these transformed varieties will be made available to local seed producers. Shortly thereafter, they should become widely available to Mexican potato producers.

An alternative strategy was considered early on by project partners, namely, the importation of Monsanto's Russet Burbank potato variety for

seed production, due to its resistance to the viruses. Because this variety is not consumed locally, however, it would not have met with demand unless substantial investments were made in market development. Inserting the genetic resistance into the three Mexican varieties already consumed locally appeared to be a far more promising strategy.

**Mutual benefits.** Although ISAAA has reported that yields of the improved Mexican potato varieties are as much as 142% higher than those of traditional varieties, a more conservative estimate would be that yields (and total potato production) should increase by about 30% once full adoption has occurred—a figure roughly equivalent to the current economic loss from potato viruses in Mexico. For the U.S. private commercial sector, the improved regulatory framework in Mexico will benefit the transfer of other technologies and product sales. Furthermore, the Mexican experience will increase the general acceptance and understanding of the benefits of agricultural biotechnology, a payoff of real value for private and public U.S. and Mexican research organizations.

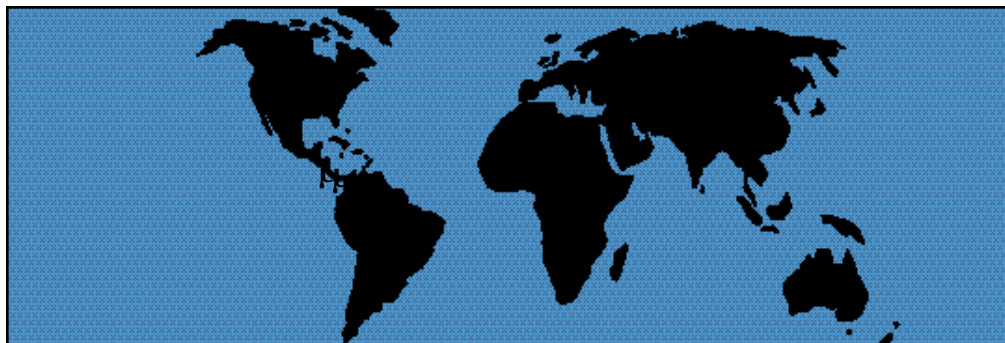
**Project costs.** Although there was some cost sharing by project partners, including costs incurred by Mexican institutions that cannot be fully documented, the major elements of project costs include US\$50,000 made available by the ISAAA and the Rockefeller Foundation, funding for two biotechnology training fellowships for CINVESTAV scientists, a William Brown Fellowship for one scientist from the Kenyan Agricultural Research Institute (KARI)—to transfer the technology from Mexico to Kenya in a later phase—and Monsanto's costs of training CINVESTAV scientists. It is readily apparent that the value the new potatoes add to production will be vastly superior to these modest costs incurred over the past nine or 10 years, without even taking account of the benefits of a better public understanding of agri-biotechnology and an improved biotechnology regulatory framework in Mexico.

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## **IV. Solving Environmental Problems Across Borders**

**International Agriculture and Food Systems Development: An Investment with Mutual Benefits for the U.S. and Developing Countries**  
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**AMISCONDE: Natural Resource Protection and New Income Sources for U.S. Partners and Local Rural Communities Through New Institutional Alliances**

**Program Area.** Solving environmental problems across borders

**Partners**

**U.S.** Coca-Cola, Clemson University, Conservation International, East Balt Bakeries, Inc., Keystone Foods, L&O Fleischwaren, McDonald's Corporation, Monsanto, Nestle, OSI, SONY Corporation, and Texas A&M University

**Costa Rica and Panama.** Tropical Science Center (CCT) in Costa Rica, and Foundation for Sustainable Development (FUNDESPA) in Panama

**Principal mutual benefits.** Successful protection of a biologically rich biosphere reserve in Central America was accomplished through alliances between U.S. universities and the private commercial sector, producing new means of livelihood and income for local rural communities and for participating U.S. partners.

**Issue.** The concept of an internationally recognized biosphere reserve requires that important conservation reserves and parks be protected by buffer zones from large-scale development. Strategies for the protection of buffer zones are critical to the conservation of reserves and parks worldwide.

La Amistad Biosphere Reserve, with 2.7 million hectares in western Panama and southern Costa Rica, is the largest undisturbed block of natural habitat in Central America, protecting much of the power and water resources of Costa Rica and Panama. It is also the ancestral home of four indigenous groups: the Bribri, Cabecar, Teribe and Guaymi. Over 75% of the migratory birds in the Western Hemisphere pass through the region and are affected by its environmental degradation. La Amistad's buffer zone in the project area, which covers some 14,000 hectares, was seriously threatened by the growth of local rural communities.

**Project activities and objectives.** Project partners undertook efforts in 1991 to stem habitat destruction and provide new means of livelihood for the people settled in the La Amistad buffer zone. Their project name (AMISCONDE) is a Spanish acronym from the words meaning friendship, conservation and development. Working with 30 community groups from 14 rural communities, project partners sought to: improve agricultural technology and productivity to reduce the negative environmental impact of farming; introduce and expand cash crops as well as related processing and marketing facilities; restore degraded lands, protect forests and better control fires; provide environmental education for 1,500 primary and secondary students annually; furnish equipment, adequate remuneration and training for

guards, fire fighters and agricultural agents of the biosphere reserve; establish women- and youth-run community tree nurseries, which produce 100,000 seedlings each year; and establish well-managed and sustainable community credit systems.

These activities were selected and managed by a Project Advisory Committee that delegated responsibilities for day-to-day operations to an Executive Committee composed of representatives of Conservation International, Texas A&M staff and faculty members, and staff of the McDonalds Corporation. Conservation International was chiefly responsible for on-the-ground project implementation, working in collaboration with local non-governmental and community organizations.

**Developing country and U.S. benefits.** Since its inception in 1991, the project has become a very successful buffer zone preservation project for poor, rural hillside communities. Local farmers now export fruits and vegetables from the region and local organizations have been assuming increasing responsibility for project operations. By late 1999, the initial 14 rural communities will have acquired full ownership of the program and AMISCONDE will be able to shift its operations into new regions of the biosphere reserve.

Seven Ph.D. theses on AMISCONDE have been completed by Clemson and Texas A&M University students, and university faculty have conducted and completed numerous research projects in support of the project. Partners are now

moving into new collaborative projects unrelated to natural resource and environmental conservation, for example, to improve rice and sugar cane production in Panama. Some 20 Panamanian animal science students have initiated a student exchange program between their country and Texas A&M University.

Building on university/private commercial sector collaboration, the AMISCONDE approach has spread to other regions in the world. For example, McDonalds and Texas A&M are engaged with other partners and donors (e.g., the U.S. Agency for International Development) to improve poultry, beef and potato production in India, Indonesia, Mexico, the Philippines, Thailand and Turkey.

**Project costs.** Financial support for AMISCONDE has come chiefly from its corporate sponsors and their family of suppliers. The university partners have made in-kind investments that account for about 25% of total project costs, mainly in the form of graduate student researchers and scientific leadership. About US\$3.0 million were invested between 1991 and 1999.

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**Natural Resource Conservation and Sustainable Improvement of Living Conditions on Central American Hillsides**

**Program Area.** Solving environmental problems across borders

**Partners.** The Government of Holland; the Inter-American Institute for Cooperation on Agriculture (IICA); third parties in Central America

**Principal mutual benefits.** The burning of biomass, deforestation and rural poverty were reduced through appropriate technologies, human resources development and new sustainable approaches that are reducing in the U.S. the associated pollution, smog, health risks, atmospheric carbon and in-migrations from the region.

**Issue.** With few exceptions, the countries of Central America have been experiencing serious social, economic and environmental imbalances and disruptions. Natural resource and environmental degradation, the intensification of conditions contributing to rural poverty, and the difficulties countries are experiencing in taking advantage of the "opening" of the Americas—to say nothing of the limited participation of their people in democratic processes—all constitute examples of these imbalances and disruptions. The working hypothesis of this project is that they can be attributed largely to institutional weaknesses and shortcomings in the fabric of society, especially shortcomings in human capital development.

One environmental problem, the burning of the land, is a generalized practice of farmers in the region that affects practically all areas and has tragic consequences for human health, environmental degradation and the economies overall. When the land is very dry and rainfall has been scarce, the effects of burning are felt not only at the local and national levels but at the regional and international levels as well. For example, in 1997, when conditions were especially dry, the generalized burning of lands in Central America and Mexico provoked the temporary closing of important international airports in Tegucigalpa, Managua, San Salvador, Mexico City, and even in the southern U.S. As the smoke mass moved northward, President Clinton called it to the public's attention and committed resources for preventing re-occurrences in the future.

Where forests are prevalent, the demand for farmland for food production prompts the development of a crop cultivation system called in Spanish *tumba-rosa-quema* (clear-cutting trees and burning biomass). The consequence is that forest lands have been steadily denuded and exposed to winds and rainfall that have produced erosion, natural resource degradation and flooding. The devastating effects of Hurricane Mitch in 1998 (to say nothing of the tropical storms of 1999) reveal all too clearly the frailty of the land in Central America, where conditions are further aggravated by economic and social poverty.

Historically, although much effort and resources have been channeled to these problems, significant and sustainable results have not been achieved. This project seeks to identify and apply new approaches and methods.

**Objectives and activities.** The project is divided into two phases (1995-98 and 1998-2002) and its general goal is to help develop institutional frameworks that can more adequately respond to social, economic and environmental imbalances and disruptions at the local and national levels in Central American countries, focusing efforts on fragile hillside areas. To this end, three specific objectives were adopted for the project and involve the creation of appropriate "platforms" for the generation of needed human resources, agricultural technologies and methodologies for effective diffusion, communication, and local participation in project activities. Platforms consist of the conditions necessary for ensuring the sustainable development of human, technological and methodological resources.

Activities associated with the first specific objective relate principally to the training of leaders/facilitators who can, in turn, conduct project-relevant training at all levels. About 70% of the project's training is done at the local level. Most activities relating to the second objective revolve around a competitive fund established to support small-scale innovative projects that help identify and demonstrate promising approaches for increasing agricultural productivity and resource conservation. The project team itself works most directly in connection with the third objective to consolidate and systematize approaches and findings that have been found to work and can be transferred to a wider range of project participants.

These activities have been effective. For example, in the case of activities to control the burning of agricultural lands, the project began by mobilizing local residents in two counties in El Salvador and two in Honduras, showing them agricultural practices that could be used in place of burning. In just two years' time, this resulted in an 80% reduction in the area burned and a 75% reduction in the number of producers using this practice, reductions that have been successfully sustained to the present.

Another case illustrating the project's effectiveness is the different performance of two villages after Hurricane Mitch. The village of Sulaco

(Department of Yoro, Honduras) was effectively organized at the village level as a result of the project, which permitted it to respond effectively (and without external prompting) to the consequences of Mitch. Residents monitored the rise in the local river; organized the evacuation of people along the river's edge; provided food, health services and protection from the rain to the needy; made quantified estimates of losses due to the Hurricane; and laid out a plan for post-Mitch recovery efforts. Marales, a neighboring and similarly positioned village in the Department of Yoro, had not benefited from project interventions and demonstrated a limited capability to react to the natural disaster. Villagers appeared to be taken by surprise by the effects of Mitch and really did nothing to improve their lot until external assistance arrived. Damage to Marales by Mitch, including the loss of three lives, was visibly greater than in the case of Sulaco.

**Benefits to Central American countries.** The project plans to perform quantitative estimates of its economic costs and benefits in the near future. However, it is important to note that project associates provided almost US\$0.40 for each U.S. dollar invested by the project during the first three years, clearly indicating the benefits and worthiness of the undertaking for local villagers. In addition, a thorough-going, qualitative external evaluation was conducted of the project in October 1997, which concluded that ". . .the project is one of the best externally financed rural development projects . . .that can be found at present in countries of Central America." This conclusion was based on the large number of project beneficiaries; the number of local organizations and agencies formed to work with the project teams; the significant number of project beneficiaries trained in natural resource management; the project's incorporation and management of gender issues; the support provided by the project to other institutions; the replication of project methodologies in a US\$40 million World Bank project for Panama, in another US\$16 million European Union project for Honduras, and in a US\$22 million Inter-American Development Bank environmental project for El Salvador; and in the biomass not being burned as a result of project activities, which now covers soils and improves water retention, soil fertility and soil structure.

**U.S. benefits.** The U.S. benefits from the reduced pollution, smog and health risks resulting from the

decreased burning of biomass on the Central American peninsula. In addition, by increasing absorption of carbon from the atmosphere, forest conservation is an environmental service of significant value to the U.S. Finally, enhancement of the livelihoods of rural people in the region helps stem migration to the U.S. of competing supplies of labor and welfare dependents.

**Costs.** In the first phase (1995-98), project costs totaled US\$2.0 million, including a contribution from the Government of Holland of US\$1.6 million and local counterpart contributions totaling US\$0.4 million. A total of US\$2.67 million has been budgeted for the second phase (1998-2002), which includes a Dutch contribution of US\$1.80

million, an IICA contribution of US\$0.15 million, and a counterpart contribution of US\$0.72 million. These are small amounts when compared with the external capital the project has helped draw in from the European Union and development banks.

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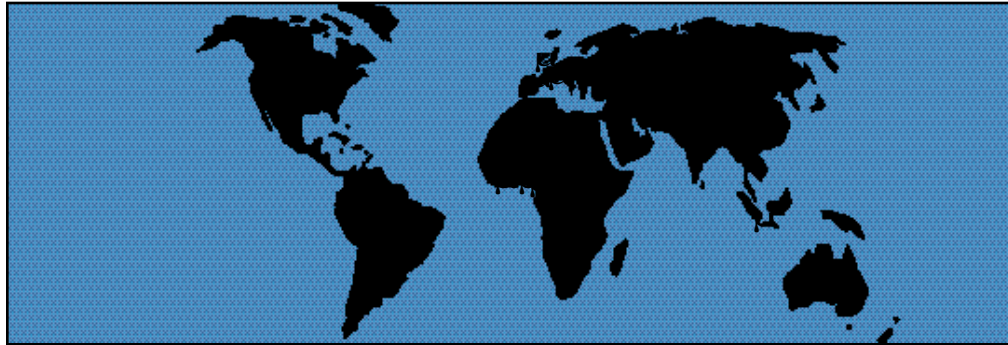
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## Sustainable Forest Management: Criteria and Indicators

**Program Area.** Solving environmental problems across borders

### Partners

**Overseas.** University of Indonesia; University of Benin (Nigeria); BHF (Germany); CIRAD-Foret (France); Center for International Forestry Research (CIFOR); Tropenbos (Holland); ODI (UK); IUCN (Switzerland); University of Hamburg (Germany); University of Greenwich (UK), EMBRAPA-CPATU (Brazil); ONADEF (Cameroon); IRAD (Cameroon); SODEFOR (Cote d'Ivoire); LEI (Indonesia); WWF-Cameroon FORDA (Indonesia); Bogor Agricultural University (Indonesia); IPEF (Brazil); University of British Columbia (Canada); Umweltbundesamt (Austria); State Forests of Lower-Saxony (Germany); IITA-HFS (Cameroon); ONF (France); GTZ (Germany); FFT (Brazil), IBAMA-Para (Brazil).

**US. New Jersey:** Rutgers University; **Idaho:** Idaho Department of Lands; Boise State University; **Illinois:** University of Illinois; **Washington, DC:** U.S. Department of Agriculture (USDA) Forest Service.

**Issue.** Developing international standards for natural resource sustainability

In today's world, while there are pressing demands for "sustainability," a lack of definition continues to hinder natural resource management. A clear definition of sustainability is essential for natural resource managers and project evaluators. The ability to evaluate objectively and consistently various forms of natural resource management around the world and in varying physical, biological, social and economic environments is essential for conducting credible and comparable impact assessments. Sustainable forest management indicators will contribute to reducing the environmental and social costs of logging and other types of forest use; enabling more productive use of forests; and reducing environmental impact and degradation. These indicators can also enhance opportunities for income generation, while improving social inequities and the quality of life.

### Project objectives and activities

The purpose of this project is to:

- develop and test indicators for sustainable forest management that can be applied internationally;
- develop practical guidelines for sustainable forest management;
- develop methods for reaching consensus on sustainability and weighting criteria, and
- distribute these indicators internationally.

Tests of Criteria and Indicators (C and I) for natural forest management have been conducted in Austria, Brazil, Cameroon, Cote d'Ivoire, Germany, India, Indonesia, Trinidad and the U.S. Research and development is concentrated in five areas for the purpose of developing a "tool-box" for those interested in developing and applying C and I: a) biodiversity; b) forest management for local communities; c) plantation forests; d) social C and I; and e) new tools for C and I development and application. Training modules have been delivered to certification training courses and a prototype method for determining the most important stakeholders in forest management has been developed. A manual of 12 methods to be tested for social C and I has also been developed.

**Developing country benefits.** The project has made major progress to achieve two main outputs: the adoption of the criteria and indicators by a number of organizations internationally and expanding collaboration with other agencies.

The research has been utilized by:

- the African Timber Organization, which based its draft set of criteria and indicators on this work;
- the Intergovernmental Panel on Forests (IPF), which recommended the project outputs to member countries;
- the Forest Stewardship Council, which recommended the project documents to its national development working groups as useful conceptual tools;
- a number of certification bodies, which testified to the utility of the Center for International Forestry Research (CIFOR) results for the development of effective assessment systems;
- the state of Para in Brazil, where results were used as a basis for reforming regulations on forest management planning;
- Austria, where they were used to define the regulations governing certification of the sustainability of forest management and forest products;
- several international institutions (e.g. International Institute for Environment and Development, IUCN), which have drawn on the research to provide a better focus for their research; and

- finally, the work provided the basis for training courses on certification and forest monitoring in Sweden, Indonesia and Costa Rica.

## U.S. benefits

**Forest management** Project methods and results are being used by U.S. federal agencies and the State of Idaho to develop a set of criteria and indicators for the Boise and Sawtooth National Forests and adjoining forests owned by the Boise Cascade Corporation and Idaho Department of Lands. This experiment was deemed successful and useful for the development of sustainable forest management by the corresponding federal and state authorities; as a result, the 'CIFOR-Boise Model' is to be replicated in a number of other states.

**Research** Project findings are fostering research to develop appropriate monitoring and reporting systems in the U.S. (at the USDA-Forest Service, Rocky Mountain Research Center).

**Institutional reporting** Project-developed indicators are under consideration by U.S. forest management and international development agencies as a basis for reporting their own performance.

## Project costs

### Total costs

(August 1994-March 1999):	US\$5.1 million
Donors:	US\$4.1 million
CIFOR:	Approx US\$300,000

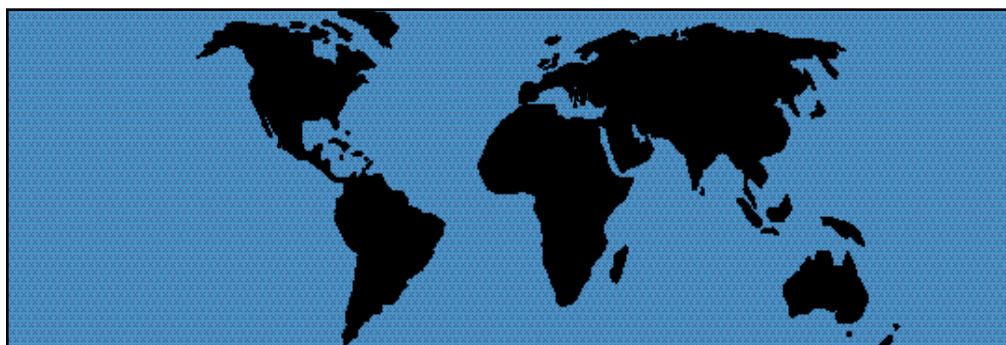
### Cost sharing

US institutions:	Approx. US\$300,000
Foreign institutions (excluding CIFOR):	Approx. US\$400,000

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**Land Tenure Reform and Land Retention in Africa,  
 Eastern Europe and the U.S.: Applying Overseas  
 Experiences to North American Problems**

**Program Area.** Solving environmental problems across borders.

**Partners.** Several research institutes, universities, government agencies and community-based groups in Albania, Canada, Mexico, Uganda and the U.S.

**Principal mutual benefits.** Providing the rural poor and disadvantaged with secure land rights, equal opportunities, more secure land access, protection against land loss, and less risk of land conflict through knowledge generation, partnerships and networking to improve land policy.

**Overview.** The Wisconsin Idea embodies a partnership between the University of Wisconsin, government and citizens working together to solve state and national problems through programs of instruction, applied research and outreach. The University of Wisconsin-Madison's Land Tenure Center (LTC), established in 1962, helped extend this outreach mission to issues of land tenure reform and land use policy in Latin America in the 1960s and 1970s, in Africa in the 1980s, and in Eastern Europe in the 1990s (two illustrative projects are summarized in Box 1). Knowledge gained from these programs, combined with University investments in networks, staff, library resources and critical thinking on land tenure issues, enabled and encouraged LTC in 1996 to establish a North America Program (NAP).

**About the North America Program.** NAP was the first of its kind on the continent to work on issues of social and cultural conflict and inequality in social and economic power relative to land and natural resource tenure. From 1996-1999, over US\$1.1 million was committed to NAP (US\$900,000 from the Otto Bremer, Ford and Kellogg Foundations and US\$242,978 in extramural grants). During this period, proposals were formulated for establishing two centers devoted to land tenure issues: the Appalachian Land and Resource Center (with the Mountain Association for Community Economic Development, in Berea, Kentucky), and the Center for Minority Land and Community Security (with Tuskegee University in Alabama).

To date, NAP has developed three programs (selected projects are summarized in Box 2). The Political Economy Program helps community-based organizations identify the forces that shape land tenure patterns and develop comprehensive strategies for a more equitable utilization of land and natural resources. The Social and Cultural Conflicts Program sponsors research on a broad range of property rights issues that generate land use conflict, including state-based property rights legislation, land and resource consolidation and concentration, land use regulations, and legal challenges to the regulatory powers of government. The Tenure and Sustainability Program reviews and as-

**Box 1: Selected international projects on land tenure reform; the Land Tenure Center**

**Albania (1994 – 2001)**

**Total funding** US\$10.1 million.

**Institutional partners** Chief Registrar, Project Management Unit, Albanian Ministry of Agriculture and Food, Ministry of Construction and Transport, Ministry of Justice, Ministry of Finance, Ministry of Public Economy and Privatization, Ministry of Defense, and Ministry of Local Government.

**Project objectives**

- Assist the Albanian government in creating the informational, legal, and administrative basis for socially and environmentally sustainable land markets
- Delineate, record and publicize the nature and extent of private and public rights to land as an input for democracy and equitable and sustainable growth in the country.

**Principal outcomes**

1. A land registration institution was created for the protection of private and public interests in land and buildings; 1.3 million properties incorporated into the Immovable Property Registration System
2. Enhanced information was made available on property rights, providing an improved climate for private investment and the implementation of local development projects
3. Major land legislation was developed and approved (Immovable Property Registration Act of 1994; Transfer of Ownership of Agricultural Land, Pastures and Forests of 1995).

**Box 2: Selected research activities; the Land Tenure Center’s North American Program**

<b>Institutional affiliation</b>	<b>Summary of research</b>
UW-Madison, Dept. of Sociology	Study of land tenure among American Indians in Wisconsin, and implications of recent population growth and tribal registration on future land tenure.
Mountain Association for Community Economic Development (MACED)	Pilot community-level planning with community-based organizations and local government in the "coal county" for sustainable economic development. The project resulted in the creation of the Appalachian Land and Resource Center.
UW-Madison, Dept. of Forest Ecology and Management	Study of conflict over ownership of public forest land, where private owners frustrate public forest expansion efforts and the practice of ecosystem management. Study looks at tax incentives and conservancy alternatives for forest development.
Norfolk State University, Dept. of Political Science	Study to develop a land registry and interactive community development program serving black land owners in Surrey County, Virginia, including web-based interface for the dataset of entering and exiting farmers.

Continuation

<b>Box 2: Selected research activities; the Land Tenure Center's North American Program</b>		
<b>Project</b>	<b>Institutional affiliation</b>	<b>Summary of research</b>
5. Ecosystem Co-Management in Southwest Colorado	UW-Madison, Dept. of Rural Sociology and Institute of Environmental Studies (IES)	Study of the evolution of a successful co-management coalition in southwest Colorado that includes the U.S. Forest Service, loggers, ranchers, environmentalists and local government officials.
6. Indigenous Land Tenure and Land Use in Alaska: Community Impacts of the Alaska Native Claims Settlement Act	UW-Madison, Dept. of Urban and Regional Planning, and IES	Study of community-level impacts of the Alaska Native Claims Settlement Act of 1971 (11% of state of Alaska, or 44 million acres, to be transferred to native corporations) and corporation-government relations.
7. African-American Land Ownership and Civic Engagement in the Rural South	UW-Madison, Dept. of Rural Sociology	Examination of the ties between citizenship and land ownership among blacks in the rural south, including case study of the Resettlement Community of Milestone in Holmes County, Mississippi
8. State-Based Property Rights Legislation and Security of Land Tenure: A National Assessment	UW-Madison, Dept. of Urban and Regional Planning, and IES	Commissioned papers on property law (both constitutional and administrative frameworks) in seven states across the U.S., with regard to land use and environmental planning and regulation. Project results were used in the requested testimony to a Congressional sub-committee in Washington in September 1997.

sesses the effects of tenure arrangements on the long-term productivity and sustainability of the economic foundations of rural communities: agricultural land, mineral deposits and forest resources.

One of NAP's successful activities was to establish the Center for Minority Land and Community Security. In 2000, USDA Secretary Glickman announced US\$3.5 million in funding for the Center over the next four years. To be housed on the Tuskegee University campus, the Center will collaborate with NGOs working closely with African American, Latin American and Native American groups (the Federation of Southern Cooperatives, New Farms, and the Indian Land Working Group). Its work will focus on three substantive areas: community legal education, natural resource-based community economic development, and social and cultural community development.

Another of NAP's successful activities was a 10-week Summer Law Externship Program. Each summer, law students are placed with community-based organizations and law firms to work on land tenure dispute cases, primarily with low-income minority farmers and landowners. NAP also organized two conferences entitled "Who Owns America?", which brought together land tenure researchers, educators and activists from Canada, Mexico and the U.S. to share information.

A wide network of Canadian, Mexican and U.S. institutions are involved in NAP-sponsored training and capacity building, research and outreach activities, including the production of videos and publications. On U.S.-Mexican border issues, NAP works with the Colegio de la Frontera Norte (COLEF), the Center for North American Studies at the National Autonomous University (NAU) in



Mexico, and the Monterrey Technological Institute. On Canadian land tenure issues, it works with the Center for Property Studies at the University of New Brunswick, Simon Fraser University, and the First Nations Development Institute. In the U.S., NAP cooperates with the College of the Menomonee Nation in Wisconsin, the Black Farmers and Agriculturalists Association, and national organizations such as the Lincoln Institute of Land Policy and the U.S. Department of the Interior.

**Mutual Benefits.** The precise value of these programs is difficult to estimate; nevertheless, it is substantial and takes many forms. Establishment of property rights reform in Albania and Uganda helps support democracy through individual property ownership, and contributes to improving livelihoods through greater economic opportunities and political stability. Land tenure reform in Uganda helped articulate problems of environmental degradation, and assisted in the implementation of policies to arrest those problems. Privatization and economic growth in Albania and Uganda expanded opportunities for U.S. export sales and private investment.

LTC's international activities expand and strengthen the capacity of the University of Wisconsin to extend its mission to U.S. land tenure problems. NAP is positively impacting economic opportunities for disadvantaged rural communities and users of the environment. The design of property management systems abroad has provided techniques for dealing with common property management on native American reservations, land loss by rural black people in the southern U.S., and conflicts between the U.S. government and the public in the Western States over the control of natural resources.

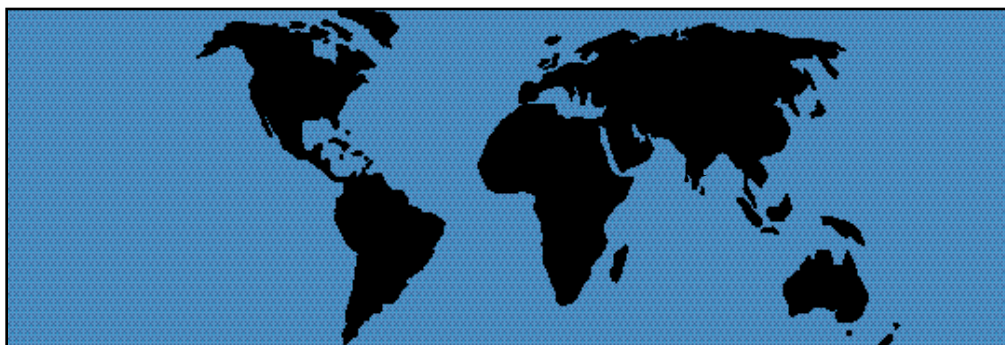
In Letcher County, Kentucky, for example, NAP-supported research revealed that mineral deposits were systematically being undervalued, resulting in an under-funding of county schools by approximately \$600,000 annually in state revenues. (A lawsuit to recover lost funds is pending.) In Madison, Wisconsin, the Troy Drive Gardens project documented the efforts of a neighborhood citizens' group to successfully negotiate a long-term, no-cost lease of state-owned land for use as urban gardens. With the co-sponsorship of the College of Menominee Nation, a workshop held in Keshena, Wisconsin, attended by 21 tribal representatives from the North Central Region of the U.S., produced a list of priority land tenure issues that serves as a planning guide for the tribes' efforts to develop solutions.

NAP's success derives from many factors other than LTC's international activities. However, it can be said that the Program would not have been as effective (or even possible) had it not been for the critical thinking skills, staff and resources that resulted from LTC's (and donors') long-term commitment to the international research and to the extension of the Wisconsin Idea. The University and its partners abroad will benefit as long as LTC continues its efforts to span countries through collaborative research, outreach and partnership.

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**The Impact of Climate Variability on Agricultural Production:  
The Case of Rainfed Groundnuts**

**Program Area.** Solving environmental problems across borders

**Partners**

- Centre for Atmospheric and Oceanic Sciences (India)
- Secretariat: Global Change System for Analysis, Research and Training (START)
- University of Georgia (U.S.)
- National Oceanic and Atmospheric Administration, Office of Global Programs (U.S.)

**Principal mutual benefits.** In this project, international collaboration between scientists at the University of Georgia (where peanuts are an important crop) and India's Centre for Atmospheric and Oceanic Sciences is improving farmers' capabilities to utilize predictions of seasonal climate variation to enhance groundnut production.

**Issue.** Within the broad area of global climate change, climate variability and severe weather events can cause billions of dollars of damage to agricultural production worldwide. The rainfed groundnut project (CLIMAG) is part of a larger effort to utilize climate variability predictions to improve agricultural production. CLIMAG focuses on using climatic variability predictions on the

scale of months to one year to improve crop production decision making at the farm and up to the national level. The research conducted through CLIMAG's four pilot projects addresses the following: a) modeling the impact of climate variability on rainfed groundnut; b) climatic variability and rice production in Thailand; c) effects of climate variability on rice production in the Asia-Pacific region; and d) use of climate information in winter wheat production in Northern China.

**Objectives and project activities.** U.S. and Indian scientists work together to model the impact of climate variability on rainfed groundnut. This project developed and tested a model for the indirect impact of climate variability on the triggering of pests, diseases and weeds for rainfed groundnut in the Anantapur region of Central India.

A simple hydrological model was used to determine soil moisture in any given year. The criteria for determining when specific farming operations are performed (such as plowing and sowing) are defined in terms of soil moisture, based on farming practices in the region. Once the sowing date is determined, the dates of occurrence of the different life history stages are known for any given year.

The events that trigger the growth and incidence/infestation of the major pests/diseases

relative to wet/dry spells are also defined in terms of soil moisture and/or rainfall. In the model, the probabilities of the occurrence of the pests/diseases were calculated by using eight years of daily rainfall data from the India Meteorological Department. The model was validated by comparing the results with observations of the incidence/infestation of specific pests/diseases at the Anantapur agricultural station of Andhra Pradesh University.

The PNUTGRO model, developed at the University of Georgia, is a numerical framework for the growth and development of the groundnut plant. It simulated well the variability of the yield at the Anantapur agricultural station, where pest/disease incidence produce lower yields compared to optimal yield predictions. When the heuristic model for pests/diseases was used in conjunction with the PNUTGRO model, the simulated variation of the yield during 1970-90 was close to the observed district yield. This suggests that models that incorporate the direct impact of climate on growth and development, as well as the indirect impact of triggering pests and diseases, can be used to understand the response of groundnut yield to climate variability and in decision support systems for the region.

**Developing country benefits.** According to the U.N. Food and Agriculture Organization (FAO), agricultural production will need to increase by 250% in developing countries by 2030 to meet the needs of the future population. Advanced integrated climatological and meteorological models are needed to determine the timing of crop management practices (fertilizing, plowing, application of pesticides, etc.). Ultimately, these tools will improve seasonal climate prediction and crop growth modeling, improve advance planning in response to climate forecasts, and increase economic benefits for farmers by alleviating the consequences of unforeseen climatic events. Since project inception, scientists have extended the modeling applications to other crops such as rice, wheat, and sorghum, which are important subsistence crops for developing countries.

**Main benefits to the U.S.** In Georgia and other Southern states, weather is one of the main limiting factors controlling agricultural production. Although rainfall is abundant in the southeastern U.S., the availability of water for agriculture is still limited. The PNUTGRO and related crop simulation models will play a significant role in the near future in helping farmers with irrigation management. Application of the PNUTGRO model will provide farmers with options for conserving natural water resources and optimizing the yields of peanut, soybean, maize and other crops. A worldwide web-based information delivery system is currently being developed, which links the PNUTGRO model with weather data bases. The system can be accessed by anyone in the agricultural sector.

Application of US-developed agricultural models in the developing world provides "real world" opportunities for testing and validation in areas where significant increases in production are both possible and necessary. Techniques developed by the CLIMAG case studies can be easily transferred to peanuts and other crops in the U.S..

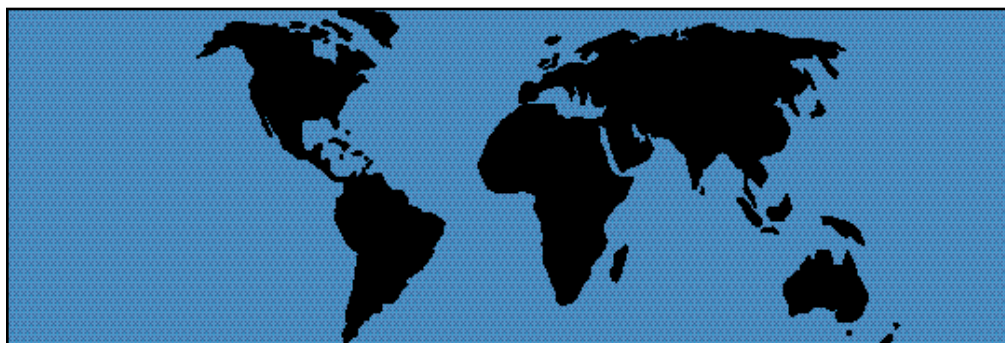
**Project costs.** This project was supported by a grant of US\$25,000 from NOAA's Office of Global Programs. Two short-term fellowships and one visiting scientist award were provided by START in support of this project. The duration of the study was one year (1997-1998).

Significant in-kind support was provided by the Indian Institute of Science. Use of facilities, staff and computer equipment for implementing this study was valued at approximately double the amount of direct funding.

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### Development of a Low Cost Technique to Restore Contaminated Soils

**Program Area.** Solving environmental problems across borders

**Partners.** U.S. Department of Agriculture's Agricultural Research Service, Beltsville Agricultural Research Center (ARS) U.S. Environmental Protection Agency; Virginia Polytechnic Institute and State University; and the Institute of Soil Science and Plant Cultivation, Poland.

**Principal mutual benefits.** This technique, discovered through a USDA/ARS collaborative effort with Poland, is being applied at numerous waste sites in the Upper Silesia region. The procedure is expected to bring major benefits to the U.S. through its application to Superfund sites.

**Issue.** Poland's Upper Silesia region is home to over three million people (10% of the country's population), occupying two percent of the land area. Located in the southwestern part of the country, it has coal, zinc and lead resources and a conglomeration of mines, steel plants, smelters, chemical plants and other industries. Years of poor mine waste disposal techniques formed piles of mining wastes, containing an estimated 87 tons of potentially toxic materials. Most of these wastes are exposed to water and wind erosion and to the leaching of toxic constituents by rain. Worst of all, the groundwater beneath the piles and associated mine workings has been extensively contaminated with metals and acidity.

A 1994 screening analysis supported by the U.S. Agency for International Development (USAID) concluded that lead exposure via airborne particles elevated blood lead levels among children, who were also found to be exposed to high doses of zinc and cadmium. A primary source of the lead particles was dust from the smelter wastes; other sources included vehicles, coal and coke burning, and smelting stack emissions. Lead is a neurotoxin, affecting the nervous systems of children and contributing to high blood pressure in adults.

In its efforts to enter the European Community, Poland came under significant pressure to deal with such pollution problems. As a result, it has undertaken a massive program to construct wastewater treatment plants to clean up the Baltic Sea. Some 60% of the wastewater from plants enters directly into wastewater streams with little or no prior treatment. Due to this lack of pre-treatment, biosolids from wastewater treatment have toxic compounds that prevent the use of land disposal techniques, particularly in agricultural lands. Other efforts have significantly reduced industrial pollution, but the country must still deal with the existing piles of mine waste and the increasing level of biosolids produced in new wastewater treatment facilities.

**Project objectives and activities.** A demonstration project was mounted, led by USDA's Agricultural Research Service (ARS) and Poland's Institute of Soil Science and Plant Cultivation, the

main objective of which was to reduce the risk to human health caused by airborne metal dust and the erosion of the mine waste disposal piles. The demonstration project left the groundwater problem to future efforts.

To address both issues of mine waste and biosolids, the project team sought to develop a viable and cost-effective technology for the revegetation of mining and smelter wastes, using biosolids and liming treatments. Major research on waste geochemistry and the selection of metal-tolerant plants was required, however, before this technique could be demonstrated to be practical and widely applicable.

In the spring of 1994, the team experimented on two, two-hectare sites, Welz and Doerschel, at a lead/zinc smelter in the Katowice area. The sites were barren of vegetation and contained different waste materials deposited between 1950 and 1985. The team collected and then analyzed 160 samples for pH, total sulphur, zinc, cadmium and lead. Water soluble forms of zinc, cadmium and lead, as well as electrical conductivity, were measured by water extraction. Once the geochemistry was identified, the team adjusted the Doerschel site's pH, which was very acid, with selected chemical applications. The Welz site's pH was close to neutral, but it was limed to suppress water soluble metals. Biosolids were then applied to both sites, and amendments were mixed into the soil with a chisel plow. In the fall, metal- and salt-tolerant grasses were seeded, using varieties selected on the basis of results from earlier germination and growth tests.

In the spring of 1995, the team found vegetation successfully established on 85% of the Welz site; however, the vegetation did not survive beyond germination on the Doerschel site. The team decided that this was due to high salinity and water toxicity from soluble zinc and cadmium. Doerschel was re-treated in 1995 with additional lime and sludge material. The result was a much improved ground cover by the spring of 1996. That same spring saw the Welz site continuing to support vigorous herbaceous vegetation, including legumes, with plant roots penetrating to a depth of 10 to 20 centimeters.

Subsequent studies will determine whether these sites should remain as wildlife areas or might be used for crop and livestock production. Animal

grazing is not recommended because of soil ingestion by grazing stock. However, a USDA feeding study showed that there was no health risk in the meat of calves fed grasses grown at the site.

Another outcome from this cooperation was the identification and analysis of metal hyper-accumulator plant varieties. ARS had already been researching the use of *Thlaspi caerulescens* or Alpine pennycress. This variety, however, presented a problem for mechanical harvesting and the rate of metal uptake by the plant was so slow that 16 years would be required for all metals to be removed from the soil. Thus, in collaboration with Central and Eastern European scientists, the ARS team began to look for different genotypes of pennycress that were both more susceptible to mechanical harvesting and more efficient as metal accumulators. The team found and tested new varieties that could reduce the 16-year period for rehabilitation to only four years.

The team also considered two additional possibilities: using the harvested pennycress as biomass and recovering metals from incinerated pennycress ash. It was later confirmed that metals can be recovered by means of a relatively simple procedure. Therefore, it was concluded that, with appropriate economic incentives, this technique not only provides a low-cost method for cleaning up heavy metal contamination in soils, but the plant metal accumulators can provide energy from biomass and the residual ash can be "mined" for metals for subsequent sale to industry.

**Shared mutual benefits.** Based on this successful project experience, recommendations were developed for the use of biosolids and lime to revegetate toxic mining wastes such as those in Poland's Silesia region. The technique provides a template for rehabilitating similar sites in Poland and around the world, including Superfund sites in the United States.

The real attraction of the technique stems from the fact that it is inexpensive and very effective when compared to conventional techniques. For example, one alternative involves covering smelter waste piles with topsoil, which requires that soil be removed from land elsewhere and results in greater expense and environmental damage than when biosolids and lime are employed. Furthermore, the technique is environmentally safe and makes beneficial use of biosolids exactly

when dramatic increases in the number of wastewater treatment plants and sewage sludge production are being seen, making it a strategic component of regional sludge management programs. Finally, this technique uses vegetative cover on waste piles to reduce wind and water erosion of metal-rich dusts, thus reducing the associated medical risks of inhalation and ingestion. Also, decreased erosion and run-off contamination of surface waters aesthetically improves the communities surrounding waste piles.

**Project costs.** Project costs are insignificant in comparison with present and future project benefits. Funding was provided by local currency gen-

erated from U.S. commodity sales to Poland under PL416/480. Total funding was equivalent to US\$202,000, and an estimated US\$100,000 of additional financing was provided in-kind by Polish and U.S. cooperating institutions.

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## **V. Preparing Human Capital for a Global Economy**

**International Agriculture and Food Systems Development: An Investment with Mutual Benefits for the U.S. and Developing Countries**  
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**Washington State University and the University of Chile:  
 Globalizing Higher Education and Collaborating  
 on Environmental Issues**

**Program Area.** Preparing human capital for a global economy; solving environmental issues across borders

**Partners**

**Primary** Universidad de Chile (UCH), Santiago, and Washington State University (WSU)

**Others** Universidad Austral de Chile (UA), Universidad de Magallanes (UM), Universidad de Concepcion, and numerous other public and private sector organizations/firms (Chile and U.S.)

**Principal mutual benefits.** This Washington State University/University of Chile partnership fosters collaboration between Chile and the U.S. to identify and test improved environmental policies, regulations and technologies. Collaborative educational, research and outreach programs have increased the quality and efficiency of both universities' environmental programs.

**Issue.** Increased competition for environmental resources, economic growth, demographic changes and resulting social pressures all call for improvements in higher education in order to be better able to address development needs. As north-south "mirrors" of one another geographically and in historic patterns of European settlement, Chile and the state of Washington share sig-

nificant similarities in agro-ecological diversity, natural resources, maritime resources, demographics and trade. As a result, they face similar problems and issues. This WSU/UCH partnership addresses a variety of specific problems shared by both the state of Washington and Chile.

**Objective, activities and benefits.** In this increasingly interdependent world, education, technology and information (the core products of universities) are increasingly global in nature. It is the objective of Washington State University (WSU) and the University of Chile in Santiago (UCH) to implement a strategic, long-term partnership in the area of environmental resources. The partnership is yielding benefits to the universities and their clientele in Chile, in other parts of Central and South America, and in the U.S.

Because the generation of mutual benefits is a primary criteria for selecting partnership activities, examples of specific activities and benefits to both Chile and the U.S. are summarized together below. Results of this partnership are contributing to social and economic development in a spectrum of areas:

- Collaborative research on conservation tillage ("zero-tillage") agriculture is adding to Chile's long-term experience with these practices; lessons learned are being adapted to address soil erosion problems in the state of Washington.



Because Chile's growing season is during Washington's winter, coordinated research trials can be carried out year-round, accelerating progress and results.

- A master's degree program in environmental management, jointly developed by WSU and UCH, is assisting professionals and lay persons in implementing Chile's new national environmental policies and legal framework. Modeled after Washington State programs designed for working professionals, the program serves government officials, clients from the industrial and agricultural private sectors and communities. Demand for these programs has spread to other countries in the region, giving rise to the development of short courses and training modules, some of which are being adapted for use with distance learning technology.
- The partnership has increased integration of Latin American cultural and socio-political concepts into WSU curriculum and programs. This is important to Washington State, which has a large and rapidly growing Hispanic population.
- Collaborative research on various aspects of global climate change is ongoing, primarily relative to Chile's Antarctic "ozone hole" and on comparative studies north and south of the equator. Using combined expertise to access resources from Chilean, U.S. and third-country funding agencies, UCH and WSU are conducting joint research on the physiological response of food crops to ozone depletion, which is expected to result in the development of crops and trees with improved performance under conditions associated with the thinning of the ozone layer.
- Comparative studies and collaborative outreach programs on environmental conflict prevention and resolution are helping communities in Chile and Washington better deal with the escalating competition for use of dwindling natural resources. Results and feedback from activities carried out both in Chile and the U.S. are improving approaches to balance the often conflicting demands of economic development and conservation and environmental safety.
- Collaborative development of degree and continuing education courses for distance delivery

in Latin America and the U.S. is ongoing in several program areas, which is resulting in course content and methodologies that are more international in perspective and thus more useful and marketable to higher education's expanding global clientele.

**Partnership costs.** The partnership model has encouraged long-term investment of time and resources by the partner institutions as opportunities evolve. This diversified approach has attracted resources from the U.S. and Chilean governments and the private sector, as well as from international funding agencies. The strategy to leverage funds and in-kind resources internal and external to the core partners makes it difficult to accurately monitor costs, but U.S. government investments have been extremely modest, and the funding base is steadily broadening. In sum:

- Strategic planning and start-up costs were funded entirely by the universities themselves, and the universities continue to invest in ongoing activities. WSU and UCH investments to date are estimated at more than US\$500,000.
- A U.S. Information Agency grant of US\$120,000 supports part of the environmental program.
- The pharmaceutical industry in Chile has provided funding for collaborative research and training.
- Trillium Corporation (a U.S. natural resource-based firm with operations in Chile) has provided personnel and other resources for research and education in sustainable development.
- A National Science Foundation (NSF) grant of US\$25,415 covers part of the work on effects of ozone depletion on photosynthesis.
- Funds have been obtained from numerous agencies of the Chilean government.
- The Fulbright Foundation has funded a portion of the activities on environmental conflict resolution.

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### **Russia/Illinois Agricultural Student Exchange**

**Program Area.** Preparing human capital for a global economy

#### **Partners**

**U.S.** University of Illinois at Urbana-Champaign (UIUC); Southern Illinois University at Carbondale (SIUC); U.S. Information Agency (USIA)

**Russia** St. Petersburg State Agrarian University (SPAU)

**Principal mutual benefit.** Promotion of cooperation and development between U.S. and Russian university youths through a student exchange study program.

**Project objectives and activities.** Student exchange is a proven way to advance international relations and to further continuing international collaboration among higher education institutions. The benefits to youth in both cultures can last a lifetime. In today's globalized world, students studying agriculture and natural resources need to understand what is occurring in other parts of the world and to be prepared for the possibility of living and working overseas during the course of their careers. This requires familiarity with other cultures and languages, with economic, social and political conditions abroad, and with international business practices and market opportunities.

This project helped to advance long-term relationships among students and faculty at the University of Illinois at Urbana-Champaign, Southern Illinois University at Carbondale, and St. Petersburg State Agrarian University in Pushkin, Russia. The major project activity was to enroll ten Russian students in Illinois universities for the spring 1996 semester and to enroll ten U.S. students at the St. Petersburg State Agrarian University in Pushkin, Russia for the summer 1996 semester. U.S. students were required to complete a minimum of two semesters of Russian prior to their departure; Russian participants were required to be conversant in English.

**Developing country benefits.** For Russia, the most tangible result of this project was the academic experience in agriculture that each of the Russian students had while in exchange status. Each participant was registered as a full time, non-degree student and received a transcript from the host institution that was delivered to the home institution, where it became part of each student's permanent academic record. Life-long American friendships were formed that can be called on to stimulate future agricultural development in Russia.

**U.S. benefits.** Student exchanges and long-term partnerships with developing country higher education institutions contribute to "internationalizing" U.S. universities and their faculty and to

preparing internationally literate graduates. The Illinois students participating in the Russian exchange program referred to their own internationalization saying:

- "I learned so much about myself and the world; this experience gave us a true picture of what it is like to be a Russian."
- "I made some good contacts in the business community that could pay off in the future."
- "They gave us the best they had to offer, but the life of the Russian student is hard."

The students studied Russian agriculture in a formal classroom setting, but also learned about international human relationships. In addition to the direct beneficiary students, this project touched the lives of their families and neighbors and made a significant contribution to the education and attitudes of many individuals.

### **Project costs**

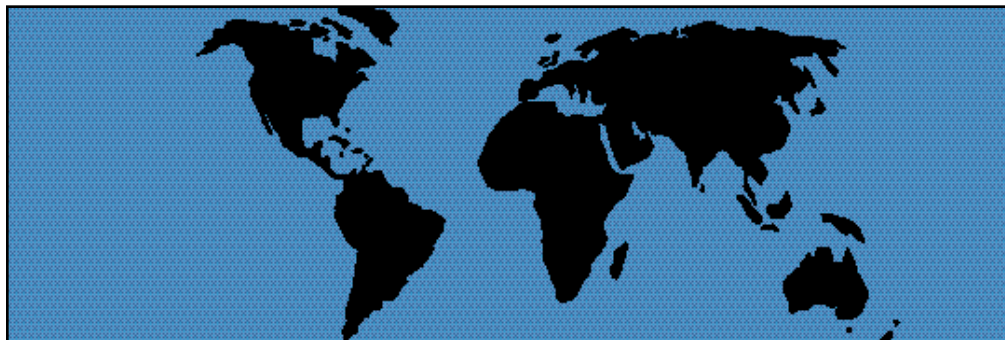
U.S.I.A.	US\$ 99,985.00
U.S. universities' cost	US\$ 50,226.93
Total cost	US\$150,211.93

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### **The Polish-American Extension Project 1990-96**

**Program Area.** Preparing human capital for a global economy

**Partners.** The Polish American Extension Project (PAEP) was established as a joint educational project of the U.S. Department of Agriculture's Cooperative State Research, Education and Extension Service (CSREES) and the Agricultural Advisory Service of Poland's Ministry of Agriculture and Food Economy (MAFE). The PAEP involved over 100 U.S. extension professionals, most of whom worked on two-person teams in provincial-level extension offices (ODRs) for six months or more.

**Principle mutual benefits.** The PAEP was successful in orienting the Polish advisory service toward client-defined needs, incorporating science-based programming, and enhancing the capacities of Polish extension staff and clientele to deal with the challenges of a market-based economy. In the U.S., the project strengthened the international competence of extension personnel in 31 states and brought the benefits of U.S. international involvement to citizens at the community level. The project was especially meaningful to extension-served communities with a significant Polish constituency.

**Project objectives.** The primary objective of this project was to assist the Polish Ministry of Agriculture and Food Economy to re-focus and reorganize agricultural advisory centers to serve

the Polish agriculture sector in a private market economy. The project achieved this objective by establishing business planning centers, developing training curricula and providing specialized training for local agricultural advisors.

A senior U.S. extension advisor (project director), a staff development specialist and an agricultural economist worked with the national ministry in Warsaw. At the provincial level, 42 teams of U.S. Extension Specialists (each consisting of a general farm advisor and an agricultural economist) served a six-month assignment. The two-person teams worked collaboratively with local Polish advisory center specialists, extension workers and farmers to design and implement new extension programs based on local needs. Much of the training requested by the Poles concerned the development of farm business plans.

Another 20 U.S. specialists worked on special regional projects to develop training curricula (for Polish trainers to use after project conclusion) and communications networks; improve computer capacity; and foster leadership development and management. Local demand from Polish communities was high for assistance to youth development programs. U.S. extension personnel in Poland provided training in 4-H youth development to over 100 provincial representatives. The movement has grown from a single 4-H summer youth camp in 1992 to active clubs in 39 of the 49 provinces.

**Developing country benefits.** Evaluation studies indicated that the PAEP was highly successful in orienting the Polish advisory service toward client-defined needs, incorporating science-based programming, and enhancing the capacities of staff and clientele to deal with a market-based economy.

**U.S. benefits.** In the U.S., the project strengthened the international competence of extension personnel in 31 states and brought knowledge of the benefits of U.S. international involvement to citizens at the community level. The project was especially meaningful to communities with a significant Polish extension constituency.

As a result of this project, U.S. citizens and community leaders became supportive of an international dimension of their Cooperative Extension Services and welcomed interactions with Polish guests. In addition, more than 15,000 citizens have increased their knowledge of Poland and over 500 long-term linkages between U.S. and Polish interests have developed. U.S. Cooperative Extension

Service staff gained international knowledge and perspectives that improved their performance in the extension service and in their communities.

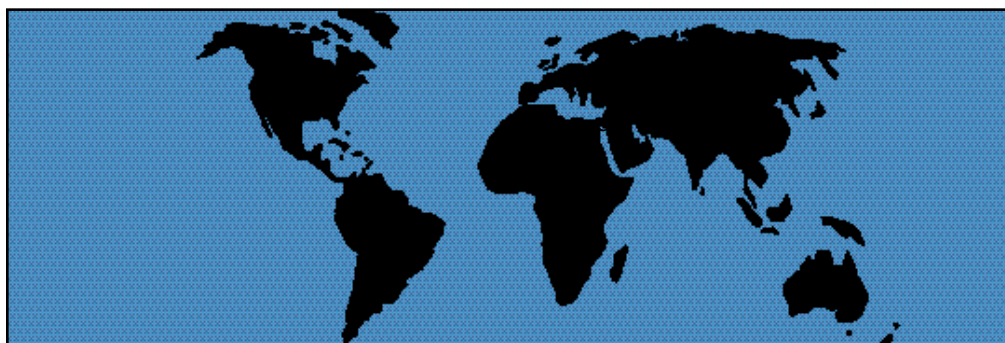
**Project costs.** The project was funded under the Support for Eastern European Democracy (SEED) Act. Resources were also made available from local currency accounts administered by USDA/Foreign Agricultural Service/Warsaw and the Polish Ministry of Agriculture.

Total USAID Funding	US\$6,631,568
Local cost sharing	US\$ 887,500

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**Improving University Development Performance and Human and Institutional Capacities through Long-Term, Cross-Country Linkages**

**Program Area.** Preparing human capital for a global economy

**Principal partners.** University of Jordan (UOJ), Amman, Jordan; Washington State University (WSU), Pullman, Washington

**Principal mutual benefits.** Higher education programs of greater relevance to the global marketplace, generating diverse economic, social and political benefits for their primary clients

**Issue.** Jordan faces major challenges posed by a rapidly expanding population, severe water shortages, a fragile environment, and significant political and economic turbulence. A well-educated population is required for fostering regional peace and stability, and a skilled and flexible workforce is needed if Jordan is to compete successfully in the global marketplace, achieve sustainable economic development, help develop appropriate legal and regulatory frameworks for progress, and expand the ranks of an environmentally-sensitive citizenry. With a big stake in the stability of the region, the U.S. has a major interest in helping Jordan meet these challenges successfully.

In response to these challenges, WSU partnered with the UOJ in 1973 to help prepare the educated population and skilled workforce and to develop,

adapt and extend needed information and technology. Clients of university programs in both countries were to be the primary beneficiaries.

**Objectives and activities.** The relationship between the two universities has had a two-fold purpose:

- To improve and expand the content and relevance of academic programs in an increasingly interdependent world, especially through improved communications and information flows between scientists and educators, with a view to internationalizing the content of higher education
- To increase the positive impact of university teaching, research and technology/information transfer programs on their clients. In both Jordan and the U.S., clients have included the citizenry at large, public sector institutions, the private commercial sector and non-governmental organizations. WSU and UOJ serve regional and international clients, as well as those within their own state and national borders.

The partnership has consistently focused on the agricultural sector, including improved management and use of scarce water and other natural resources.

Now in its twenty-sixth year of existence, the multifaceted relationship between WSU and UOJ has involved the principals in a rich range of joint ventures and partnerships, from participation in donor-funded development projects and collaborative educational programs to more traditional faculty development and exchanges. Although early phases of the relationship primarily involved development assistance by WSU to UOJ, benefits to both parties began to emerge as the partnership evolved and matured. Examples of some especially significant activities include:

- Launching in Jordan an interdisciplinary program leading to the M.S. degree in environmental management, the graduates of which are contributing to upgrading the skills of human resources in other institutions concerned with water and natural resources in the Middle East.
- Establishing two Ph.D. programs for water and environmental management at UOJ, one outcome of which was the development of new and unique materials for related programs at WSU.
- With collaboration from WSU, installing and testing Internet access and e-mail at UOJ, connecting UOJ faculty not only to WSU but also globally through the world's new information highway.
- Inserting UOJ in the worldwide stream of competitive grants through WSU assistance in grant writing and grantsmanship techniques, which produced 15 full-scale proposals in just the past two years, 12 of which have been awarded funding.
- Drawing numerous other U.S. and Jordanian institutions into cross-country activities, including Brigham Young University, the Jordan University of Science and Technology, Purdue University, Texas Tech University, Yarmouk University, and the University of South Carolina. In one instance, cross-country activities involved the development of an "Environmental Research, Education and Economic Development Network" which offers participants greater access to funding, research and education, including distance education. In another instance, a "U.S.-Middle East Conference on Dryland Farming Systems and Technologies for a more Sustainable

Agriculture" was held at WSU (the so-called "Extraordinary Peace Conference") with support from the U.S. Department of Agriculture and the U.S. State Department.

**Benefits.** Certainly, both countries gained a vehicle by which they can make meaningful contributions to peace and stability in the Middle East. Additionally, the U.S. and Jordan are gaining a more skilled and flexible workforce, improving university-client relationships, infusing the two universities with globally relevant programs, opening more effective scientific and informational exchanges, and developing a network of professionals worldwide in the agricultural, environmental and natural resources fields. The success of this partnership and its sustainability demonstrates to donors and other investors the payoffs of university participation in collaborative development programs.

Specific examples of how the universities have established closer and more vital relationships with producers in their agricultural sectors (important clients for both universities) include:

- Biological control agents collected in Jordan were used to help control the Russian wheat aphid, a major cereal pest in the U.S.
- Collaborative activities between the universities introduced improvements in Jordan that raised irrigation efficiency under protected agriculture by 30% through the use of better irrigation schedules and management.
- A collaborative WSU-UOJ-Ministry of Agriculture biological control research and extension effort rapidly controlled a potentially catastrophic outbreak of the spherical mealy bug, a non-native pest accidentally introduced into Jordan Valley citrus orchards. Following rapid, successful field testing of a natural predator, a team of Jordanian women extension workers managed the production and release of the bio-control agent until it was established. As a result, this pest is no longer of commercial importance. This successful effort also paved the way for use of future biocontrol agents in Jordan.
- Utilizing technologies and practices extended by their partners, farmers in the Jordan Valley doubled production in a single year and subsequently increased yields another 400%, raising them to world standards.

- National agricultural research investments in Jordan are now directly related to the economic importance of the given problem and commodity. This prioritization process has increased agricultural productivity and economic returns on research investments. By focusing their collaboration on areas of shared interest and complementary strengths, WSU and UOJ gain in program effectiveness and cost efficiency.
- UOJ's Water and Environmental Research and Study Center has provided leadership and support for establishing or upgrading many water centers throughout the Middle East. Several of these are collaborating in research efforts addressing the Middle East water crisis. WSU benefits by being able to access resources (scientific expertise, students and funding) through this expanded network.

**Costs.** Funding from three U.S. Agency for International Development (USAID) projects and one cooperative agreement contributed to the development and maturation of the WSU-UOJ partnership. The first USAID investment was a US\$2.25 million four-year project (1975-79) for UOJ faculty development. Two subsequent USAID projects were highly successful in better linking agricultural research in Jordan with end-users, first in the Jordan Valley and then on a

national scale. Both these projects were under the Ministry of Agriculture; the second involved numerous non-university and university partners in the U.S. and Jordan. Both UOJ and WSU faculty played major strategic and operational roles in both projects, funded by project monies and institutional cost-sharing. The most recent USAID investment was a US\$500,000 grant to the two institutions to strengthen the UOJ's Water and Environmental Research and Study Center (WERSC). These USAID monies succeeded in leveraging significant additional funding of about US\$1.5 million from WSU and the UOJ, plus other investments from over 20 institutions in the Middle East, the U.S., and Europe. Examples include the Arab Development Fund, the Fulbright Foundation, the Hebron and Beir Zeit Universities in Palestine, the University of Idaho, the Portuguese Ministry of Construction, the University of Valladolid in Spain, and HR Wallingford in Great Britain.

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### **Bringing the U.S. Supermarket to China**

**Program Area.** Preparing human capital for a global economy

**Partners.** Chinese participants involved in supermarket businesses; Cornell University; US Department of Agriculture/Foreign Agricultural Service/Food Industries Division (USDA/FAS/ICD)

**Principal mutual benefits.** Rapid expansion of Chinese supermarkets, yielding greater choice, selection and variety for consumers. Program participants started up their own businesses and were promoted to senior management in food retailing. U.S. food exports to China expanded and U.S.-Chinese joint ventures in local manufacturing of food products were accelerated.

**Issue.** The Chinese supermarket was created in the early 1990s, but its growth did not accelerate until around 1993. In part, this was a result of China's shift from a planned economy to a more open, market-based economy that encouraged the introduction of new concepts and technologies in retail businesses. The traditional grocery store, which responded to the Chinese practice of "buying little, buying often," largely because of a lack of refrigeration in homes, consisted of only one counter with products stored behind it. The customer presented a ration coupon for a particular product and the clerk retrieved it. Choice, selection and variety were not options.

Supermarkets were initially established by state-owned companies that lost their monopoly privileges after the revitalization of economic reforms in China in 1992, or they were introduced into large department stores (as is the case in Japan), where grocery sales accounted for up to 10% of total business. Other factors providing an impetus for the upsurge of supermarkets were rising incomes, an expanding desire for wider variety and convenience, and the acquisition of new appliances, including refrigerators, which came on the heels of China's rising personal incomes.

In 1990, the first Chinese supermarket was opened in Shanghai; in 1993, the first privately owned chain supermarket was opened; and by 1997 there were 1,000 supermarkets in the region, belonging to more than 20 different companies. Typically, these supermarkets are small by U.S. standards, with only about 2,700 square feet of space (comparable, perhaps, to a neighborhood bread and milk store in the U.S.). These smaller-scale operations, plus the high tariffs on grocery imports from the U.S., led supermarket owners to buy through Hong Kong agents who break up large containers of imports for resale and whose food selections accord with Chinese tastes.

However, two problems accompanied the accelerated growth of supermarkets: a shortage of capital and insufficient competent retail managers. The capital shortage constrained the use of refrigeration and modern facilities; managers of the new

supermarkets came from a variety of business backgrounds (i.e., from former state-owned retail operations or from the state-owned food service industry), but generally had neither in-depth professional training nor practical experience in the operation of supermarkets within the new economic climate.

**Activities and objectives.** The U.S. government's Cochran Fellowship Program (CFP) seeks to:

- assist eligible countries in developing agricultural systems that help meet the food needs of their domestic populations; and
- strengthen trade linkages between eligible countries and agricultural interests in the United States.

These objectives are met through short-term training opportunities (up to three months), which include interaction with U.S. professional peers, field observations and industry visits, on-the-job training and attendance of university courses and seminars. Most programs, tailored to the particular needs of participants, offer a mixture of technical instruction, practical field observation and hands-on experience.

In the 1993-98 period, the CFP sought to respond to the deficit of human capital that had become evident in China's rapidly growing supermarket industry. To this end, specific objectives adopted by the CFP were:

- to expose Chinese participants to U.S. products and technologies which might enhance trade between the two countries;
- to encourage the development of linkages and relationships between U.S. supermarket representatives and Chinese supermarket managers; and
- to assist the development of Chinese management skills and distribution technologies.

Specific programs were tailored to participants' needs with the assistance of local USDA/FAS Foreign Agriculture Affairs officers. It was determined through this means that the Chinese specifically sought advanced training and information on supermarket development and on the effective management of day-to-day operations, especially in regard to location, selection, store layout and

display, marketing, distribution, storage, inventory control, sales promotion, personnel training, store security and theft prevention. More recent participants have expressed additional interest in computer systems operations for retail businesses. Because speedy and effective distribution continues to be one of the greatest challenges for retail grocers due to China's size and poor transportation infrastructure, there is rising interest in this aspect of the overall program.

Participants attended lectures and short courses at Cornell University. Lecture topics included a comprehensive treatment of the distribution and retailing of food, groceries, and consumer packaged goods. Most participants also attended the Food Marketing Institute (FMI) trade show which showed them the commercial potential of supermarkets; introduced them to the vast variety of products available to U.S. consumers; and helped them appreciate the concepts of choice, variety, and catering to consumer desires and preferences. In addition, they toured numerous supermarket companies in New York, Arizona and on the West Coast. These contacts with U.S. businesses were highly rated by all participants.

**Mutual benefits.** Fifty-four Chinese trainees participated in this supermarket management program. When Sun Yoon Xun returned to China, he started his own food additive import company, the revenues of which now amount to US\$6.0 million annually. He attributes the inspiration for and success of this start-up company directly to the CFP. Jian Hua Zhang, Lian Wange and Jie Zhu, who were in the same group as Sun Yoon Xun, also started their own companies. Most participants report starting up their own food companies after the program, or obtaining employment on the senior management teams of supermarkets and the retail food industry.

Imports of U.S. products for Chinese supermarkets have continued at a modest pace. Several Cochran alumni report regular imports of container loads of U.S. consumer-ready products. But the growth in U.S. exports into this market has not expanded as widely as first thought. The Chinese argue that U.S. products are too expensive and are not packaged for the average Chinese family. Many U.S. products that sell successfully in Chinese supermarkets today are the result of joint ventures with the Chinese, including some former program participants, and produced in China.

The most striking evidence of the success of the program from the Chinese side of the equation is that the Chinese participants no longer need training in the fundamentals of supermarket management. The Cochran Program has done its job. The Chinese executives now arrive with specific questions they want answered and are ready for advanced supermarket training. This function has largely been taken over by U.S. private industry, which has sponsored advanced supermarket training for Chinese the past several years. USDA has continued to support this effort in China.

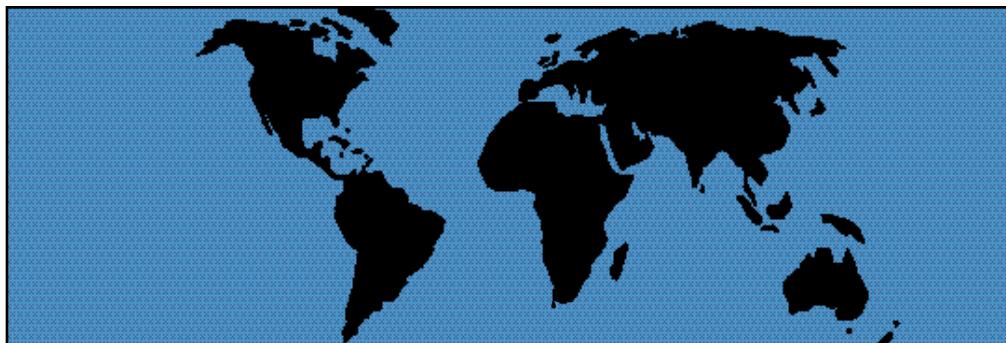
**Project costs.** Total costs of the supermarket management program are estimated at about US\$425,000, or roughly US\$7,500 per participant. The Chinese participants paid their own airfare to

the U.S. (about US\$2,200), roughly a 30% contribution to the program. Nonetheless, cost sharing was probably less than the 40% figure cited for similar U.S. government travel and study programs. Still the program's cost was quite modest—about one fourth the annual revenues created just by Sun Yoon Xun's new company!

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**Accelerating Economic Growth and Expanding Opportunities for South African Professionals in Agricultural Fields**

**Program Area.** Preparing human capital for a global economy

**Partners.** South Africa: 67 professionals in agricultural business and trade development, management, marketing, policy development, and agricultural technology transfer. U.S.: USDA/FAS/ICD as administrator of the Cochran Fellowship Program (CFP).

**Principal mutual benefits.** U.S. commodity and technology exports to South Africa were expanded by program participants; collaborative U.S.-South African research was implemented; agreements with U.S. universities for training and research were executed; and attitudes concerning the U.S., and its goods and services became more positive. Participants' job performance improved, leading to job advancement; 15% of participants launched their own businesses based on program experience; and many participants are engaged in helping develop improved agricultural systems/policies in South Africa at the provincial and national levels.

**Issue.** One public and one private sector mission were commissioned in 1994 by USDA's Emerging Markets Office to identify a priority need of South Africa as the country provided a rush of new opportunities for long-neglected segments of its population and sought to position itself to acceler-

ate economic growth and development. Short-term training in carefully targeted areas was identified by each of these missions as a priority need, and plans were then laid to launch a short-term travel and study program of training in 1995.

**Activities and objectives.** In 1998, the Cochran Fellowship Program (CFP) evaluated its activities in South Africa since 1995 financed by USDA's Emerging Markets Office. In its first two years of operations, 67 participants had received training in the U.S.

The CFP's founding legislation calls for it to provide training for selected senior and mid-level agricultural specialists and administrators from the public and private sectors (in middle income countries and emerging democracies and markets), involved in agricultural trade, management, marketing, policy and technology transfer. The aim of the training must be to help develop the agricultural systems necessary to meet domestic food needs and strengthen trade linkages with the U.S. From 1984 through 1997, training was provided under the CFP for over 6,000 individuals. Through 1999, over 6,800 individuals from 70 countries participated in the CFP (see table below).

South African candidates for training applied to the local CFP representative, some having been invited to apply by USDA and U.S. government

### Cochran Fellowship Program Participants by Region for Selected Years, 1984-98

Year	Africa	Asia	Latin America	Newly Independent States	Non-EU Europe	Total
1984	18	24	50	0	17	109
1988	20	57	116	0	82	275
1993	13	126	79	191	216	625
1984-99	574	1,345	1,331	1,538	2,073	6,861

agencies represented in that country. CFP Washington-based staff traveled to the country to conduct interviews with applicants and in-country interviews served to outline individual training programs which would be most beneficial to South Africa and the U.S. Final selections were made on the basis of the interviews, the relationship of training needs to CFP objectives, local recommendations, and budget availability. Participants were notified of their selection, the program designed for each individual was then fine-tuned, and CFP Washington-based staff implemented the programs of individual participants.

Individual programs did not exceed three months in duration. In general, they included meetings with U.S. professional peers, field observations and industry visits, on-the-job training, and attendance at university courses and seminars, thus combining technical instruction with practical field observations and hands-on experience. All programs dealt with one or more of the following topics: agricultural business and trade development, management, marketing, policy development, and agricultural technology transfer.

**Mutual benefits.** In spite of depressed economic conditions in South Africa, participants with trade and business development objectives in their training programs established a number of initiatives. For example, commercial ties were developed with a U.S. company for the importation of cheese for sale in South Africa and in Kenya; another participant started by purchasing wine and then opened his own winery, for which he is importing white oak barrels from the U.S.; and one participant provided training to specialists in the Ministry of Agriculture, resulting in a more expeditious process for maize imports from the U.S. Another participant is importing technologies for his laboratory, which he observed in operation while visiting the U.S.; he also conducted a

research project with a Penn State University faculty member and developed a memorandum of understanding with the University. One participant is now producing herbal botanical products for U.S. firms in partnership with the Herb Research Foundation; another worked with USDA's Grain Inspection, Packers and Stockyards Administration to standardize the training of grain graders in South Africa.

One participant took over her father's business and became the only black, female landscaper in Soweto.<sup>1</sup> Another participant received a grant from the South African Department of Agriculture for a cooperative-run maize milling project, which he is using to leverage technical assistance from AfriCare. Mill operations are now bringing in profits.

Following their CFP training, some 70% of the participants remain in contact with U.S. individuals and organizations. For example, several have contacted U.S. universities concerning opportunities to enter formal, academic training programs, and one arranged an exchange program with North Carolina A&T University. Many former participants hosted U.S. delegations visiting South Africa.

Based on their CFP experiences and training, participants also contributed to agricultural systems and policies at both the provincial and national levels, which have developed rapidly since the 1994 elections. At the national level, one participant consulted with the Ministry of Agriculture in connection with the development of a national agricultural policy paper, much of which was built directly on the CFP experience; another assisted with the design of an agricultural credit policy that addresses the needs of all the nation's farmers; still

<sup>1</sup> As an aside, the CFP was disappointed with the percentage of women participants in the program, which ranged from only 13% in 1995 to 25% in 1997.

another contributed to developing a new rural electrification policy for small-scale farmers.

Five participants are making major policy contributions at the provincial level, one in a specific reconstruction and development project and another in a liaison unit that connects small farmers with their provincial governments. Another participant is developing a market information system as a member of two regional councils, and one is in the post of deputy director of the provincial department of agriculture. These participants were also very impressed with the U.S. cooperative form of organization and have endeavored to introduce cooperatives to the small-scale farmers with whom they work.

For a host of personal and professional reasons, all participants view the CFP as a "lifetime experience." Among other things, the CFP changed their attitudes about U.S. citizens; they were especially impressed with how hard U.S. citizens work. They also reported improved opinions about the quality of U.S. goods and services. Following the CFP experience, 15% of the participants were promoted in their jobs, 57% were assigned greater job

responsibility and 15% started their own businesses. Over 70% indicated that the CFP helped them improve their job performance and 37% indicated that the CFP helped them improve specifically their management skills.

**Program costs.** Total program costs (direct and indirect) for the 1995-97 period were US\$1.2 million. This amounted to US\$12,448 per participant in 1995, US\$9,996 in 1996 and US\$11,263 in 1997. Costs for some participants were higher mainly because they engaged in formal training courses. The CFP does receive significant in-kind contributions but these were not quantified in the case of the South African program.

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### **Faculty Exchange Program in the Newly Independent States**

**Program Area.** Preparing human capital for a global economy

**Partners.** In the Newly Independent States (NIS) of Kazakstan and Ukraine, as well as Russia: 44 universities, institutes and training institutions. In the U.S.: International Food and Agribusiness Management Association, University of Arkansas, Colorado State University, University of Minnesota, University of Missouri, University of Nebraska-Lincoln, North Dakota State University, Pennsylvania State University, Purdue University, University of Wisconsin, and the U.S. Department of Agriculture/Foreign Agricultural Service/International Cooperation and Development (USDA/ FAS/ICD) Food Industries Division.

**Principal mutual benefits.** The openness and free exchange fostered by this program —through a network of people in the Newly Independent States who know the U.S. market and higher education systems well, have meaningful personal access to U.S. professors, and are implementing educational reforms that support a transition to a more open market economy—creates an ideal platform for mutual academic and commercial benefits between the U.S. and the NIS.

**Issue.** The Newly Independent States of the former Soviet Union are moving from a long history of operating within the framework of classical economics and socialism into an entirely new sys-

tem involving neoclassical economics and capitalism. Farmers and agri-business operators are having immense difficulty learning the new rules of the game and operating successfully with them. Because of inexperience with what constitutes appropriate policy in a capitalist economy, government strategies have not been designed to support the new system, resulting in frightening performance failures and corruption. University professors continue to teach outdated, irrelevant materials and methods designed for a centralized economy; students are learning what their parents were taught!

The resulting frustration and disappointment with the "new economics" is leading many citizens to call for a return to the old system which, for all its faults, would at least enable them to deal with the economy and better understand its potential for them.

**Activities and objectives.** Conducted by the Professional Development Program of the USDA/ FAS/ICD Food Industries Division, the Faculty Exchange Program (FEP) seeks to promote the development of sound agricultural policies and effective and competitive agricultural marketing and business systems in the Newly Independent States. Its specific objectives are to:

- increase the number of adults in the Newly Independent States who understand market economies by improving and expanding aca-

demic and adult education programs in agricultural economics, marketing, agribusiness, and agrarian law;

- create a capacity in participating Newly Independent States faculty to evaluate and revise curriculum; and
- establish enduring relationships between the U.S. and Newly Independent States for the purpose of fostering curriculum development, course revisions, and faculty strengthening in agricultural economics, business and law.

Each year since the program's inception in 1995, and after interviewing applicants and university administrators, the USDA Administrator of the FEP has selected for the program a small number of faculty (between 10 and 20) from Russian, Kazakstan and Ukrainian agricultural universities. Selected participants travel to the U.S. for an orientation program in Washington, D.C., plus intensive supplemental instruction in English (participants must have basic English skills prior to arrival). After successfully completing these training activities, participants travel to hosting U.S. academic institutions which have included the University of Arkansas, Colorado State University, University of Minnesota, University of Missouri, University of Nebraska-Lincoln, North Dakota State University, Pennsylvania State University, Purdue University, and the University of Wisconsin.

There they participate in selected courses on business, economics and law; learn new teaching methods; develop new courses and adapt classroom materials for use in the Newly Independent States. On average, participants have taken roughly four to five courses at the undergraduate level, including some short courses. Additionally, participants make extensive visits to nearby U.S. farms and agri-businesses and, whenever possible, internships are arranged with local business firms. Participants also travel to a U.S. region that contrasts with the region to which they have been assigned by the FEP to observe farm production, storage and marketing activities, and to visit land-grant university programs where they discuss faculty course offerings, curricula and teaching programs. Before returning home, participants are debriefed at the USDA in Washington, D.C., during a three-day wrap-up program. Program duration is approximately six months.

U.S. faculty provide follow-on advisory visits to the home university of participants as a regular part of the program. These usually entail discussions and interactions on curriculum reform, course development and other activities initiated by participants as a result of their FEP experiences. For example, in 1999, six U.S. university faculty members provided follow-on support visits to 15 participants from the 1998 program and five participants from the 1997 program, reviewing newly developed course outlines and materials; holding meetings and discussions with department heads, deans and rectors; offering lectures and seminars on market economies and agri-business; holding visits and meetings with farmers; reviewing extension and adult education programs; and discussing collaborative research and future exchanges.

**Mutual benefits.** Through the year 2000, the FEP has supported 85 participants (41 from Russia, 36 from the Ukraine and eight from Kazakstan), representing 44 different universities, institutes and training institutions. These figures reinforce the conclusion that the FEP has played a critical role in upgrading human and institutional capacity for the Newly Independent States' transition to a market-based economy.

Participants maintain contact with other FEP participants and the U.S. faculty they met during the exchange program; they also share their experiences with other participants and co-workers. They believe they have applied their improved skills and understanding of the free market economy in teaching. For example, the 11 Ukraine participants were teaching 18 courses to 2,655 students just one year after returning home; they were also instrumental in revising 22 courses and introducing 12 new courses, using materials from their FEP experience. They conducted 26 seminars, wrote 22 research and extension articles, and five of the participants were in the process of writing new textbooks. Participants reported improving their teaching methods as a result of the FEP experience through the use of case studies, discussion formats, out-of-class papers, quizzes and ongoing assessment of student progress. Moreover, all participants have reported that the FEP experience accelerated their professional development, expanded their collegial and professional networks, and renewed their professional motivation.

Evaluations performed through surveys of participants indicate that they value most the follow-on communications with U.S. faculty and especially



the opportunity to improve their English-language skills. Follow-on has been reinforced by the signing of eight U.S.-NIS university cooperative agreements (through 1998).

An evaluation of the program concluded that: "One of the largest impacts of the FEP is that there is now an emerging network of people in the Newly Independent States who know a great deal about the U.S. system of higher education, have meaningful contacts with U.S. professors, and are trying to implement U.S. style reforms in higher education systems that support the transition to a more open market economy."

There are other FEP-like programs in the Newly Independent States. The FEP, however, is a longer-term program, permitting more in-depth practical experiences, study, understanding and the building of more lasting relationships. It remains focused on a few disciplines; accepts participants only with interests relating to agricultural economics, business and law; and requires participants to produce immediately usable materials on returning home. Finally, the FEP offers a fine mix of theory and praxis. In the Ukraine there is an expression that runs to the effect: "Tell me one hundred times, or you can show me just once."

The U.S.-NIS university linkages are beneficial to both countries. They promote an international perspective on all campuses. Newly Independent States faculty gain firm understandings of the U.S. market and of public-private relationships which they transmit to their students. Thus, a solid cadre of professionals with an understanding of U.S. principles and approaches is developing. As those professionals implement policies and programs and conduct their everyday lives, U.S. principles and approaches are being emulated and permeating the ways things are done in the Newly Independent States. This change, and the network

of U.S.-NIS relationships developed through the program, also result in the enhancement of markets in these countries for U.S. products, goods and services.

**Project costs.** Funding for the FEP has been provided through a U.S. government inter-departmental arrangement, involving the USDA, the Department of State and the U.S. Agency for International Development. Total (direct and indirect) out-of-pocket costs per participant are estimated at about US\$40,000, implying that the 85 program graduates in the past five years have cost the U.S. government about US\$3.4 million.

The program also receives considerable in-kind support from both collaborating U.S. universities and the private sector. It is estimated that approximately 40% of the total cost of the training program is offset by these in-kind contributions, including approximately US\$10,000 of in-kind support from the USDA itself. These estimates would place total program costs to date at US\$5.7 million, with US\$3.4 million being provided by the U.S. government and US\$2.3 million by other institutions. Additionally, the universities pay the full salary of each participant while in the U.S., or US\$100 per month for six months. This is a significant contribution where teachers are often not paid for four to six months at a time and electricity and heat are often shut off for non-payment of bills.

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# **Glossary of Acronyms**

## ACRONYMS

ABSP	Agricultural Biotechnology Support Project (U.S.)
ACDI/VOCA	Agricultural Cooperative Development International / Volunteers Overseas Cooperative Assistance
AFSTA	African Seed Trade Association
AIARD	Association for International Agriculture and Rural Development
AMISCONDE	La Amistad Conservation and Development Initiative (Costa Rica, Panama)
AMS	Agricultural Marketing Service (USDA)
APHIS	Animal and Plant Health Inspection Service (USDA)
ARS	Agricultural Research Service (USDA)
ASOSYE	Support Project for a Haitian Civil Society
ASTA	American Seed Trade Association
BNF	Biological nitrogen fixation
BRASS	Biological Resources Analysis Support System
CARDI	Caribbean Agricultural Research and Development Institute
CAST	Council on Agricultural Science and Technology
CCT	Centro Científico Tropical (Costa Rica)
CEA	Center for Agricultural Statistics (Mexico)
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIFOR	Center for International Forestry Research
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIP	International Potato Center
CIRAD	Center for International Cooperation in Agricultural Research for Development (France)
CLIMAG	Climate Prediction and Agriculture Project
CNFA	Citizens Network for Foreign Affairs (U.S.)
COLEF	Colegio de la Frontera Norte (Mexico)
CPATU	Center of Agroforestry Research for Eastern Amazonia (Brazil)
CRSP	Collaborative Research Support Program
CSREES	Cooperative State Research, Education and Extension Service
DAI	Development Alternatives International
DGESA	Agency for Agricultural Sector Studies (SAGAR-Mexico)
DOA	Department of Agriculture
DPVCTRF	Direction de la Protection de Végétaux de Controles Techniques et de la Répression des Fraudes (Morocco)
DREAM	Dynamic Research Evaluation for Management (a software program)
EMBRAPA	Brazilian National Agricultural Research Enterprise
EMPRES	Emergency Prevention System
EPA	Environmental Protection Agency (United States)
ERS	Economic Research Service (USDA)
FACN	Federation of Caféières Natives (Haiti)
FAO	United Nations Food and Agriculture Organization
FAS	Foreign Agriculture Service (USDA)
FDA	Food and Drug Administration Agency (United States)
FFT	Fundação Floresta Tropical (Brazil)
FIS	International Seed Trade Federation

FORDA	Forest Research and Development Agency (Indonesia)
FUNDESPA	Fundación para el Desarrollo Sostenible de Panamá
GAO	General Accounting Office (United States)
GEM	Germplasm Enhancement of Maize Project (U.S.)
GILB	Global Initiative on Late Blight
GIS	Geographic Information System
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IAAE	International Agency for Atomic Energy
IADB	Inter-American Development Bank
IAR	Institute of Agricultural Research (Ethiopia)
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICTA	National Institute of Agricultural Technology (Guatemala)
IES	Institute of Environmental Studies
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IICA	Inter-American Institute for Cooperation on Agriculture
IIED	International Institute for Environment and Development
IITA	International Institute of Tropical Agriculture
INIFAP	Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (Mexico)
INTSORMIL-CRSP	International Sorghum/Millet Collaborative Research Support Program
IPEF	Instituto de Pesquisas e Estudos Florestais (Brazil)
IPF	Intergovernmental Panel on Forests
IPM	Integrated Pest Management
IRAD	Institut de Recherche Agronomique pour le Developpement (Cameroon)
IRRI	International Rice Research Institute
ISAR	Institut des Sciences Agronomiques du Rwanda
IUCN	World Conservation Union
LAC	Latin America and the Caribbean
LAMP	Latin American Maize Project
LEI	Agricultural Economics Research Institute (Netherlands)
MACED	Mountain Association for Community Economic Development (Kentucky, U.S.)
MAFE	Ministry of Agriculture and Food Economy (Poland)
MAP	Moroccan Agribusiness Project
MARNDR	Ministry of Agriculture, Natural Resources and Rural Development (Haiti)
NAFTA	North American Free Trade Agreement
NAP	North America Program
NASS	National Agricultural Statistics Service (U.S.)
NAU	National Autonomous University (Mexico)
NGO	Non-governmental organization
NGSPA	National Grain Sorghum Producers' Association (U.S.)
NSF	National Science Foundation
NWS	New World Screwworms
ODI	Overseas Development Institute (United Kingdom)
ODR	Provincial-level extension office which provides agricultural advisory services (Poland)



OECD	Organization for Economic Cooperation and Development
OIRSA	Regional International Organization for Agricultural Health
ONADEF	Office National de Développement des Forêts (Cameroon)
ONF	Office National des Forêts (France)
PD/A/CRSP	The Pond Dynamics/Aquaculture Collaborative Research Support Program
PAEP	Polish American Extension Project
PAHO	Pan American Health Organization
PAU	Punjab Agricultural University (India)
PICTIPAPA	International Cooperative Program for Potato Late Blight
PNUTGRO	Peanut Crop Growth Simulation Model
PPQ	Plant Protection Quarantine
PROCI	Regional Programs for Horizontal Reciprocal Cooperation in Agricultural Research and Technology Transfer
PVP	Plant Variety Protection
RAFPP	Russian-American Farm Privatization Project
RCU	Regional Coordinating Unit
RFC	Rural Finance Corporation
SAG	Servicio Agrícola y Ganadero (Chile)
SAGAR	Secretariat of Agriculture and Rural Development (Mexico)
SEED	Support for Eastern European Democracy
SENASA	Servicio Nacional de Sanidad Agraria (Peru)
SIT	Sterile insect technique
SIUC	Southern Illinois University at Carbondale
SODEFOR	Société pour le développement des plantations forestières (Ivory Coast)
SPAU	St. Petersburg State Agrarian University (Russia)
START	Global Change System for Analysis, Research and Training
UA	Universidad Austral de Chile
UCDavis	University of California at Davis
UCH	Universidad de Chile
UIUC	University of Illinois at Urbana-Champaign
UM	Universidad de Magallanes (Chile)
UNFPA	United Nations Fund for Population Activities
UOJ	University of Jordan
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USIA	United States Information Agency
WNIS	Western Newly Independent States
WSU	Washington State University
WWF	World Wildlife Fund