

# **Investing in Global Agriculture and Food Systems Development**

*A United States Policy Imperative*

By  **By** 

**Earl D. Kellogg  
University of Illinois**

and

**Susan G. Schram  
TBR International, Inc.**

 **For** 

**The International Agriculture Group**

**May, 2000**



***A United States Policy Imperative:***

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

***By***

***Earl D. Kellogg  
University of Illinois***

***and***

***Susan G. Schram  
TBR International, Inc.***

***For***

***The International Agriculture Group\*\****

***June, 2000***

*The authors gratefully acknowledge contributions of the following colleagues to this paper. Responsibility for the final text is that of the primary authors.*

*G. Edward Schuh, University of Minnesota  
Gary Alex, USAID/World Bank  
Kate Cloud, University of Illinois  
Gerald F. Coombs, Cornell University  
Cathryn Ives, Michigan State University  
Raymond J. Miller, University of Maryland  
Robert Paarlberg, Wellesley College  
David J. Sammons, Purdue University  
Norman Uphoff, Cornell University*

*\*\*This effort has been advanced over the past three years by presidents of 24 universities in 23 states. IAG membership has included the states of Alabama, California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Texas, Utah and Washington.*

# MICHIGAN STATE UNIVERSITY

Dear Colleague,

Although we live in an era of substantial economic prosperity, over 800 million people around the globe are still hungry and over 1 billion are desperately poor. Global demand for food is increasing rapidly with population and economic growth. The future viability of global agriculture and food systems will have a pervasive impact on the quality of life for all people in all countries in the next several decades. This is particularly critical in developing countries where the majority of the poor live in rural areas and agriculture and food systems development is vital to their survival and economic growth.

The following paper has been developed by the International Agriculture Group (IAG), a coalition of United States Land-Grant University Presidents, concerned about the decade-long decline of US commitment to global agriculture and food systems development. The paper seeks to communicate, in layman's terms, the importance of United States leadership in this area and the long-term mutual benefit of such activities to both the United States and developing countries. Intended audiences for the paper include members of Congress and their staff, U.S. agricultural groups, non-governmental organizations (NGO's), key academic leaders, leaders in development agencies who establish and implement foreign assistance policy and programs, and, lay persons interested in international development.

Over the past three years, supporters of this effort have worked closely with their Congressional delegations to renew awareness of the importance of global agriculture and food systems development to the economies and to the well-being of the citizens of both the United States and developing countries. In addition, the IAG has worked with the United States Agency for International Development (USAID) to reinvigorate work in global agriculture and food systems development conducted through USAID field missions and Washington-based bureaus. These efforts have resulted in modest strengthening of US commitment to this area.

**S**

OFFICE OF  
**THE PRESIDENT**

Michigan State University  
450 Administration Building  
East Lansing, MI  
48824-1046

517/355-6560  
FAX: 517/355-4670

The IAG has been particularly concerned that the vast resources of US universities be more fully employed in global agricultural science, education and technology transfer, toward the continuing goal of alleviating world hunger and poverty. To that end, this paper addresses new policies and programs that should be undertaken at USAID, USDA and by other public and private partners to make this possible.

To meet the World Food Summit goal of cutting world hunger in half by the year 2015, this paper recommends renewed, coordinated effort in global agriculture and food systems development across US government agencies, in partnership with the private sector. Please join me in support of this important work.

Sincerely,



M. Peter McPherson  
President, Michigan State University  
Former Administrator, United States Agency for International Development

*The Michigan State University  
IDEA is Institutional Diversity:  
Excellence in Action*

*MSU is an affirmative-action,  
equal-opportunity institution.*

## TABLE OF CONTENTS

|   | Page   |
|---|--------|
| <i>Letter of introduction</i> .....   | 3      |
| <i>Table of contents</i> .....  | 4      |
| <i>Executive summary</i> .....  | 5      |
| <i>Introduction and context</i> .....   | 7      |
| <br><i>Questions addressed:</i>   |        |
| <br><i>WHY is it urgent that development assistance in global agriculture and food systems be strengthened and increased?</i> ..... | <br>8  |
| <br><i>WHAT is in it for the United States?</i> .....   | <br>10 |
| <br><i>HOW does transforming agriculture and food systems advance other US development priorities?</i> .....                        | <br>12 |
| <br><i>WHAT are the fundamentals of agricultural development and roles for universities?</i> .....                                  | <br>15 |
| <br><i>WHAT new investments are needed?</i> .....   | <br>19 |
| <br><i>Conclusion</i> .....   | <br>32 |
| <br><i>References</i> .....   | <br>33 |

## EXECUTIVE SUMMARY

*This paper asserts that increasing and strengthening US investment in global agriculture and food systems development is urgently needed to stimulate economic growth and alleviate hunger in developing countries and to capture long-term economic, scientific and educational benefits back home in the United States. A major focus of the paper is the long-term successful contribution of US universities to global agriculture and food systems development.*

*It is recommended that the overall foreign operations appropriation for the United States Agency for International Development's (USAID) agricultural development programs be funded at a minimum of \$500 million for FY 2001 (still less than half of the \$1.2 billion allocated to this area a decade ago). At the United States Department of Agriculture (USDA) an international competitive grants program is recommended, at the level of \$30 million in FY 2001, to support the Globalizing Agricultural Science and Education Programs For America (GASEPA) agenda.*

*This paper responds to five questions:*

**1) *WHY is it urgent that development assistance in global agriculture and food systems be strengthened and increased?*** Global food production, processing and distribution systems must grow significantly in the next few decades to meet demand created by income and population growth, particularly in developing countries. Failure to address food insecurity reduces overall economic growth and increases vulnerability to civil conflict and wars that leave millions of people hungry. Investing NOW in international agricultural science, education and technology transfer is critical for future food security. While research will have profound impact, 10-20 years may be required before some investments result in increased food production. US assistance to developing countries in agricultural research, education and technology transfer not only has a proven record of accomplishment abroad, but brings high economic returns to the United States.

**2) *WHAT is in it for the United States?*** In addition to the positive benefits for developing countries, investment in global agriculture and food systems development is a policy that is in the clear self-interest of the United States. With a large market for US exports in developing countries, it's good business to improve their buying power and establish business contacts! As well, supporting agricultural research, education and health standards development in other countries helps to assure that imported foods consumed by Americans are safe. Collaborating in global agricultural science networks allows US scientists to leverage US resources for greater impact and provides access to the new agricultural varieties, germplasm, management practices and other technologies developed around the globe. This access results in significant improvements in the US food and agriculture system. International involvement is critical for US higher education faculty and for students who must be prepared for work in the global economy.

International agriculture and food systems development addresses environmental issues that cross national boundaries. Working collaboratively with other countries can help the United States address problems related to water and air quality, biodiversity and land preservation. Finally, research shows that investing in agriculture, the economic livelihood for most developing countries, contributes to peace and reduces demands for US-funded disaster relief.

**3) *HOW does transforming agriculture and food systems advance other US development priorities?*** Because over 70 percent of the population lives in rural areas in many developing countries, agriculture and food systems development is the key to alleviating poverty and to advancing other strategic social goals set forth in USAID policies. The "big picture" for US development assistance policy must place priority on sustainable economic growth in the agriculture sector and on preparing developing countries to compete in the global marketplace. *In addition to economic growth, attending to the agriculture*

*sector is fundamental to: (a) improving health and nutrition; (b) improving prospects for child survival; (c) safeguarding and enhancing environmental resources; (d) improving the status of women, and, (e) fostering democratization.*

**4) WHAT are the fundamentals of agricultural development and what is the role of universities?**

Universities have a special “niche” when it comes to the fundamentals that underpin sustainable development: human capital development; research and technology transfer; policy reform and institutional development; development of input supply industries, and, information technologies. The accomplishments of Title XII of the Foreign Assistance Act demonstrate that long-term US/developing country educational institutional partnerships have strengthened the capacities of universities in both the United States and the developing world to contribute to global agriculture and food systems development.

**5) WHAT new investments are needed?** Additional resources must urgently be focused on: *(a) strengthening the global agricultural research system* — particularly expanding Collaborative Research Support Programs (CRSPs) and improving strategic linkages among universities, the International Agricultural Research Centers (IARCs), National Agricultural Research Systems (NARs) and the private sector; *(b) developing human capital* — agricultural scientific, technical and managerial human capital required both in the United States and in developing countries; *(c) forming biotechnology partnerships* — to increase crop yields, improve growing environments, reduce chemical pesticide use and improve the nutritional content of food; *(d) harnessing information technology* — education and research applications, planning and monitoring programs, agricultural producer applications and rural enterprise development opportunities; *(e) initiating a Partnership for Rural Sector Institution Building* — to engage the United States in multi-lateral partnerships to build the capacity of developing country institutions; *(f) strengthening the international dimensions of US public and private institutions* — internationalizing domestic assets to better address global agriculture and food systems issues, and, *(g) establishing a United States-based Institute for Global Agriculture and Food Security* — to assure effective coordination and increased emphasis on global agriculture and food systems development.

This paper primarily discusses policies related to the United States Agency for International Development. However, because global agriculture and food systems development is in the self-interest of the United States, international programs of other domestic public and private institutions must be strengthened in tandem with USAID, especially the International Programs Office of USDA’s Cooperative State Research, Extension and Education Service (CSREES) and the USDA Foreign Agriculture Service/Office of International Cooperation and Development (FAS/ICD). US universities must have long-term stable support to effectively internationalize their agricultural research, extension and education programs. An international competitive grants program is recommended at USDA/CSREES, to support the Globalizing Agricultural Science and Education Programs For America (GASEPA) agenda at \$30 million in FY 2001.

Although recommendations in this paper focus primarily on the public sector, the private sector must be more effectively engaged in global agriculture and food systems development, including partnering with universities. Private voluntary organizations are important for grassroots development efforts. Private companies provide capital, management and marketing know-how, and technology to developing countries. Public sector investment can complement and support private investment by nurturing indigenous leadership and institutions, advancing appropriate public policies, and assuring a more educated, healthy populace, with resources to purchase goods and services.

## INTRODUCTION AND CONTEXT

In the United States, many groups<sup>1</sup> are concerned by a perceived lack of understanding of the importance of global agricultural and food systems development. There are several reasons for this concern:

- Over 800 million people are hungry, over 1 billion are desperately poor, and food demand is increasing rapidly;
- The majority of the poor live in rural areas in developing countries and agricultural and food systems development is vital to economic growth; improving environmental quality; strengthening nutrition, health and child survival; improving the status of women; and democratization;
- Food security and agricultural development investments by the United States have steadily declined for the past decade, despite the fact that these programs continuously show a high return on investment and are of mutual benefit to both the United States and developing countries;
- Lack of progress on agricultural and food systems development will have long-term negative consequences for people in both developing and developed countries, and for world peace.

The future viability of world agriculture and food systems will have a pervasive impact on all people in all countries in the next several decades. This paper has been developed by members of the university community to communicate the importance of these issues to members of Congress and their staff, US agricultural groups, non-governmental organizations, key academic leaders, leaders in development agencies who establish and implement foreign assistance policy and programs and lay persons interested in international development.

---

<sup>1</sup>These groups include the National Center for Food and Agricultural Policy (NCFAP), the Board for International Food and Agricultural Development (BIFAD) and the Association for International Agriculture and Rural Development (AIARD). NCFAP sponsored a Commission study on International Trade, Development and Cooperation in 1996-97. This commission developed three reports and held a forum at the end of its proceedings on the US interests in economic growth, trade, and stability in the developing world. The Forum included leaders from private agribusiness firms, the public sector and NGOs (Working Group on International Agricultural Research 1997a; 1997b; Commission on International Trade, Development and Cooperation, 1997). BIFAD meets regularly to advise the Administrator of USAID on food and agriculture programs. Its primary responsibility is the implementation of Title XII of the Foreign Assistance Act of 1961. AIARD has developed Congressional testimony, held Congressional Policy Forums on the importance of global agriculture and food system development in 1997, 1998 and 1999 and its members include constituents in every state in the union.

## QUESTIONS ADDRESSED

*This paper responds to the following five questions:*

- *WHY is it urgent that development assistance in global agriculture and food systems be strengthened and increased?*
- *WHAT is in it for the United States?*
- *HOW does transforming agriculture and food systems advance other US development priorities?*
- *WHAT are the fundamentals of agricultural development and roles for universities?*
- *WHAT new investments are needed?*

*WHY is it urgent that development assistance in global agriculture and food systems be strengthened and increased?*

***Hunger and poverty persist.*** Current US development assistance policies do not adequately respond to the compelling need to increase investments in international agricultural development and food security. The world food problem is far from being solved. Global food production, processing and distribution systems must grow significantly in the next few decades to meet rapidly growing demands, particularly in developing countries. Some 73 million people, equivalent to the population of the Philippines, will be added to the world's population on average every year between 1995 and 2020, increasing it by 32 per cent to reach 7.5 billion in 2020 (see Table 1). An overwhelming 97 per cent of population increase will occur in the developing world, whose share of global population will increase from 79 per cent in 1995 to about 84 per cent in 2020. Income growth will lead to improved caloric intake, a rise in the demand for food, and greater demand for services from the food processing and distribution system (IFPRI, 1999).

| Region                          | Population level |                   | Population increase, |                     | Share of increase (percent) |
|---------------------------------|------------------|-------------------|----------------------|---------------------|-----------------------------|
|                                 | 1995             | 2020 <sup>a</sup> | 1995–2020 (millions) | 1995–2020 (percent) |                             |
| Latin America and the Caribbean | 480              | 665               | 185                  | 38.5                | 10.1                        |
| Africa                          | 697              | 1,187             | 490                  | 70.3                | 26.7                        |
| Asia, excluding Japan           | 3,311            | 4,421             | 1,110                | 33.5                | 60.5                        |
| China                           | 1,221            | 1,454             | 233                  | 19.1                | 12.7                        |
| India                           | 934              | 1,272             | 338                  | 36.2                | 18.4                        |
| Developed countries             | 1,172            | 1,217             | 45                   | 3.8                 | 2.5                         |
| Developing countries            | 4,495            | 6,285             | 1,790                | 39.8                | 97.5                        |
| World                           | 5,666            | 7,502             | 1,836                | 32.4                | 100.0                       |

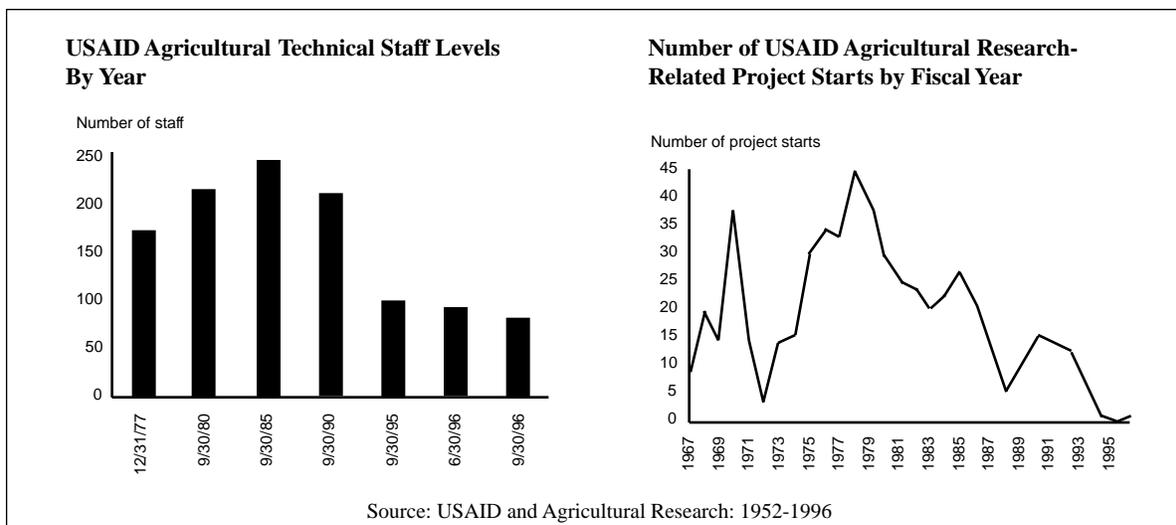
Source: United Nations, *World Population Prospects: The 1998 Revision* (New York: UN, 1999).  
<sup>a</sup> Medium-variant population projections.

More than 1.3 billion people in the world now live on less than one dollar a day (World Bank 1997). Approximately 800 million people are hungry and that number may exceed one billion by the year 2020. The global population of underweight children below age five is expected to increase from 193 million today to 200 million by the year 2020. Despite urbanization, nearly 75 percent of the poor will continue to live in rural areas well into the next century and depend on agriculture and agribusiness for their livelihood.

***The nature of global competition in the post-cold war economy is changing.*** We live in an era of rapid global shifts from closed, nationally focused markets (protected and subsidized) to open, global markets (competitive and less subsidized). These competitive economies offer opportunities to developed and developing countries, but new policies and strategies are needed to help developing countries adapt and find competitive niches to prosper and become good US trading partners (Bathrick, 1998).

***Poverty, hunger, and environmental degradation lead to conflict and war.*** Many conflicts are concentrated in regions heavily dependent on agriculture, but also with high levels of poverty and malnutrition. People fight over vital necessities — food, protecting livelihoods, economic injustice and safety from violence and want. Increasing numbers of people are displaced to refugee camps. Developed countries pay the price of these conflicts through the costs of international peacekeeping efforts and aid to large refugee populations (De Soysa, Gleditsch, et al, 1999).

***Investing NOW in international agricultural science, education and technology transfer is critical for future food security.*** US assistance to developing countries in agricultural research, education and technology transfer has a proven record of accomplishment abroad and has shown high economic return to the United States. However, while food security challenges have grown and international agriculture has become more market-driven and complex, US public investment in agriculture and food systems development has steadily declined. While research may have profound impact, 10-20 years may be required before some investments result in increased food production. For future food security, renewed investments must be made now and programs re-focused to meet contemporary contexts that are quite different than just 10-20 years ago.



---

## ***WHAT is in it for the United States?***

---

Whether an American is a consumer looking for fresh raspberries in January; a farmer supporting his or her family through agricultural exports; a patient taking a life-saving medication originating from a developing country plant; or a college student studying food preferences in other countries, they all benefit from US involvement in international agriculture. In the United States, we have become so accustomed to these benefits that the connection is rarely made to the key role of US public investment in international agricultural development.

The story of the mutual benefit of US foreign assistance investment in agriculture to BOTH the United States and developing countries is an under-appreciated and under-told success story. Americans have long felt a strong humanitarian commitment to aid the less fortunate in other countries, often their own countries of origin. But we now know that this strong humanitarian commitment is also in the clear self-interest of the United States.

***It's good business.*** Assistance for agricultural and food system development in poor countries is the best policy for boosting US exports. Despite short-term fluctuations in regional export markets, assistance to developing country agriculture helps to generate the long-term income growth those countries need to become better customers for all US exports. Most of the developing countries experiencing rapid income growth in the 1980s previously experienced rapid agricultural growth. Because so many people live in the countryside in today's poor countries, it may be impossible to achieve substantial economic growth without first investing in a broadly-based agricultural revolution.

Developing countries are growth markets for U.S. agricultural and other exports. Eighty percent of the world's population is located in the developing world and about 20 percent of agricultural exports from industrial countries go to developing countries. U.S. sales to these countries are expected to grow at roughly 9 percent annually — twice the rate of growth of sales to developed countries (Pinstrup-Andersen, Lundberg, and Garrett, 1995). About 50 percent of U.S. agricultural exports go to developing countries (Kellogg, 1997). For all developing countries, each dollar of added agricultural output means 73 cents more in total imports, including 17 cents more in agricultural imports and 7 cents more in cereal imports.

***It improves US competitiveness by providing access to global science.*** Future US competitiveness in agriculture will depend to a significant extent upon US access to global agricultural science. Many of the new technologies and genetic resources necessary to be competitive will come through US linkages with agricultural research institutes, private companies, and individual scientists overseas.

Policies supporting collaboration with developing countries return big dividends to US agriculture, leveraging US resources for greater impact. A recent study found that the returns to US investments in international wheat and rice research were very high, with benefit/cost ratios of 190:1 in wheat and 17:1 for rice (Pardy, et al, 1996). The studies project high returns with additional investments.

The United States must have wide access to new technology, including germplasm. International collaboration is especially important to assure that US agricultural researchers have access to germplasm contained in land races, wild relatives and diverse varieties of important crops, much of which is located in countries concerned with foreign exploitation of these materials. International research is also critical to pre-emptive research on disease or pests before these pathogens arrive in the United States.

***It improves food safety and quality for the US consumer.*** Investments in international agriculture help assure that imported food products are safe for consumption. Harmonizing food safety and quality standards is critical to facilitating expansion of world food trade. US collaboration with foreign producers, industry scientists, and governments can improve food production, processing and distribution systems in other countries, increasing efficiencies and opening them to imports. US assistance can insure that scientists in exporting countries have access to the newest technologies to produce safe food products. International collaboration can also enable the United States to identify potential food safety problems and access foreign technologies appropriate for use back home.

***It prepares the US workforce of the future.*** US agricultural higher education programs must equip graduates with knowledge of other cultures, languages and ways of doing business in order for them to function in the global marketplace. Faculty need international experience and educational curricula must foster global competency. Collaboration with developing country agriculture provides US researchers, educators, extension workers, private firms and agribusiness personnel at universities with knowledge of other countries' demands, tastes, systems and policies. Private firms will be looking to hire graduates equipped to help them develop transnational business and face increasing competition from abroad.

***It encourages US private sector investment.*** United States private sector investment in developing countries continues to grow, despite infrastructure and other constraints. For the private sector to thrive in a developing country and for the US private sector to have a profitable market, that country must develop a business climate that promotes competition and minimizes risk. Development projects can help create a climate conducive to private sector investment by establishing: (1) fair and transparent trade, fiscal and monetary policies; (2) a legal system based on the rule of law, reliable and enforceable law of contracts and a fair resolution system; (3) secure rights of property ownership; (4) wide access to credit, and, (5) increased democracy, civil development and greater individual freedoms (Raquet, 1998). Contacts and business opportunities developed under assistance programs grow into new business and investments. Business opportunities from multi-lateral development banks require a boost from US assistance to introduce farmers to these markets.

***It addresses critical global environmental challenges.*** Environmental issues are closely intertwined with agricultural development and span country boundaries. The United States is affected directly by the quality of air and water in other regions, the loss of biodiversity, and use of toxic chemicals. Struggles over land, water and other resources can lead to instability and conflict, which may directly threaten US security. The best scientific minds must be engaged in international scientific collaboration to address problems of water quality, air quality, land degradation, deforestation, fisheries depletion, and biodiversity important to agriculture. The complexities of global warming are far from being completely

understood, but it is affected by actions in all parts of the world. Much of the potential to absorb carbon put in the atmosphere by fossil fuels is in the tropical rain forests and grasslands of developing countries.

***It fosters global peace and reduces demands for US-funded disaster relief.*** Agriculture supplies the economic livelihood of the majority of people in most developing countries. Research by the International Peace Research Institute (IPRI) shows that, when this sector falters, internal armed conflict often ensues. The United States pays a high price to address resulting problems. Developing agriculture is, therefore, important for reducing conflicts resulting from poverty and environmental degradation. Paying attention to agriculture pays dividends in fostering global peace and prosperity. Without cultivating development (a process highly dependent on the conditions facing agricultural production and rural livelihood) there can be no sustainable peace (De Soysa, Gleditsch, et al, 1999).

---

## ***HOW does transforming agriculture and food systems advance other US development priorities?***

---

In recent years, the US foreign assistance portfolio has shifted to a new set of priorities. Concerns of the 1960s and 1970s over widespread famine and economic growth to underpin nation building and prevent the spread of communism have given way in the 1990s to issues focused on environment, child survival, population stabilization, nutrition, health, the status of women, and democratization. Some of the shift is due to the very real success of past development efforts that reduced widespread famine, controlled disease and stabilized political systems.

In most developing countries, however, improving conditions in the agriculture sector and the rural household, is *fundamental* to the achievement of social goals. The viability of a country's agriculture and food system impacts the social status of people, the ability to support health, nutrition, population and environmental programs, and the attention that government and people are able to pay to these issues. If broad-based global food security is to become a reality and other US development goals are to be advanced, the "big picture" for United States development assistance policy must place priority on sustainable economic growth in the agriculture sector and on preparing developing countries to compete in the global marketplace. It is essential to understand how attending to agriculture is primary in advancing current US development priorities.

***It improves health and nutrition.*** An important form of human capital for development is the health of the rural population. Good health makes the labor force more productive in the physical sense and enables the population to absorb cognitive skills more effectively. Development of the agriculture and food system is fundamental to improving health and nutrition in developing countries. In short, it is difficult to work or to learn without a safe, adequate and affordable supply of food.

One key to improving nutritional status is that food must be available at declining real prices. Poor people spend a significant amount of their income on food. Simply stated, if food can be

profitably supplied at lower costs by more efficient food systems, more people can consume adequate calories, proteins, vitamins and minerals. Agricultural production patterns, processing and marketing programs, educational efforts, and increased purchasing power are all keys to improving the nutritional status of people in developing countries.

Most of today's malnutrition involves imbalances in diets that provide insufficient amounts of vitamins and minerals. Although these "micronutrients" are needed in only small amounts, each is critical to normal metabolism and, thus, has "macro" importance for good health. An estimated 2 billion people live at risk to diseases resulting from deficiencies of three micronutrients: vitamin A, iodine and iron. To meet the demands of population growth, large increases in food production must occur, but, if human health is to be significantly improved, increased production, processing and distribution of food must be achieved in ways that also increase micronutrient supplies.

***It improves prospects for child survival.*** Malnutrition affects the most vulnerable — children and their caregivers. Not only is adequate nutrition most critical for normal physical and intellectual development of children but children are least able to acquire that nutrition themselves. Some 35% of the world's children show severe growth retardation ("stunting") due to inadequate diets. In 1993, nearly 13 million young children died in developing countries. *Half of those children died due to the effects of malnutrition — both direct in compromising metabolic health, as well as indirect in increasing susceptibility to infectious disease.* The primary causes of nutritional problems in children are in adequate caloric and protein intake and deficiencies in vitamin A, iron, iodine, zinc, selenium and riboflavin.

The linkage of agricultural and food system development to improvements in nutritional status is inescapable. Over two-thirds of all children in developing countries live in rural areas where agriculture provides the primary source of family income. Child survival and development programs are dependent upon family income and access to a safe, healthy, and balanced diet. Agriculture and food system development programs are essential to provide opportunity for children to survive, grow, and function at their full potential.

***It helps safeguard and enhance environmental resources.*** Agriculture is not only a means of producing food for the billions of people on the planet, it is a primary interface between humans and the natural environment. In developing countries, where agriculture accounts for about 70 per cent of the land and 80 per cent of the water used, what happens in agricultural development obviously has a major impact on the condition of the environment. If the agriculture sector does not develop in an environmentally sound fashion and high quality land does not produce the food needed, people will clear additional land — usually on hillsides — to expand production. This expansion of cultivation on marginal land inevitably leads to deforestation, soil degradation and erosion, loss of water resources and persistent poverty and hunger (Serageldin, 1997).

- ***Water quality and availability*** affect and are affected by agricultural production. The supply of water is fixed, while demand is growing along with development and population increases. The International Food Policy Research Institute asserts that the defining issue of the twenty-first century may be the control of water resources. Currently, 338 million people are subject to sometimes severe water shortages and, by 2025, this number is

projected to jump to about 3 billion (Rosegrant, 1997). Irrigation, which helped fuel the Green Revolution, uses 70 per cent of water globally, but pressure is mounting to divert water from irrigation to other segments of the economy. Irrigated land must increase crop yields while using water more efficiently and research is needed to maximize yield per unit of water, rather than per unit of land (Yudelma, 1997). Research and development related to agriculture and food systems will be required to solve water quality and availability problems in the coming decades.

- ***Improved land and soil management*** are fundamental to agricultural development. Projected increases in food demand require looking critically at available land and its uses. Bringing additional land into production will be prohibitively expensive or environmentally unsound in most parts of the world — increased food demand will have to be met through use of improved technologies and higher yields on existing land. Failure to invest in the required technologies will have far reaching economic and environmental effects. Any rise in food prices as a consequence of failure to develop new technologies would have devastating effects on the world's poor, reducing food security and leading to widespread social tensions and conflicts. Additional encroachments on hillsides and wildlife habitat will have serious environmental impacts. Strategies such as improved plant nutrient management must be addressed to prevent runoff from agricultural lands and reduce water pollution. Preserving and improving land and soil resources will require close attention to the development of the agriculture and food system.
- ***Biodiversity and the preservation of genetic resources*** needed for agriculture and other uses are dependent on management of agriculture and natural resources of developing countries. Agricultural systems and natural ecosystems and species provide a wide range of goods and services crucial to well-being. These range from tangibles, such as those directly consumed (food, medicine, firewood), traded in the market (timber, fish,) and non-consumptive services (watershed protection), to the more intangible values of knowing that species exist and providing options for the future (McNeeley, et al., 1990). Wild species have long been the foundation for agriculture and have provided new genetic material and species for crop use. Many of the foods commonly used in the United States and many of our medicines originated from the biodiversity of other countries. Increasing yields on good agricultural land will help reduce land expansion into forests and other natural areas which contain much of the biodiversity in our plant species. Enhancing biodiversity will require wise investments in international agriculture and food systems.

***It improves the status of women.*** Because so many poor women are engaged in agricultural activities in developing countries, investing in broad-based agriculture and food system development is the path to poverty alleviation and to improving the status of women. According to the International Food Policy Research Institute (1995) women account for 70 to 80 percent of household food production in Sub-Saharan Africa, 65 percent in Asia, and 45 percent in Latin America and the Caribbean. Women are critically important to agricultural production, marketing and processing. The rural woman stands at the nexus of the family and the agro-ecosystem. In many developing countries (particularly in Africa) women are the primary farmers, in addition to their responsibility to feed and care for the children. Their nutritional status is closely tied to that of their children; and they are stewards of, and key consumers of environmental resources. Income in the hands of women contributes more to household

food security and child nutrition than income controlled by men, yet women face enormous social, cultural, economic and institutional constraints. Developing women in agriculture is an investment that is instrumental to improving problems of food security, child survival, population, and environmental conservation.

Women often manage different crops and livestock than men and many are defacto managers of the entire farm while men migrate for paid employment elsewhere. Women often farm despite unequal access to land, modern inputs (such as seeds and fertilizers) and information. Many countries still have laws limiting female ownership of land, and right to inherit land, even though such insecure tenure limits productivity-enhancing investments. Credit for women farmers is limited. Research and extension systems have often ignored the needs of women, the most important producers. Improving women's status and agricultural income potential can have far reaching effects. Higher levels of education; additional opportunities for employment beyond traditional roles; later age of marriage; and more positive economic circumstances are well documented as means of stabilizing population growth. Without investing in agriculture and food systems development it will be difficult to do much about raising the status of rural women in developing countries.

***It fosters democratization.*** In poor countries, agriculture and food systems development is key to achieving democratization. In developing countries where the bulk of the population is rural, agricultural development projects are an excellent tool through which to instill basic democratic values and methodologies. Agricultural associations and farmer cooperatives play important roles in fostering democratic systems and empowering rural people. US-based international development organizations implementing agricultural projects in former centrally-planned instill democratic processes by working through local farmer organizations. Where such groups do not exist, they can be organized around particular needs of a village or region and an association or cooperative can be formed. The process of electing officers can be a farmer's first exposure to the fundamental steps of the democratic election process. Working with farmer associations requires new approaches and patience as many past efforts have failed due to government controls and top-down organization. Development of civil society and cooperation efforts is essential to obtaining sustainable development goals and greater empowerment of rural people and this requires investing in the agriculture sector.

---

### ***WHAT are the fundamentals of agricultural development and roles for universities?***

---

In a recent article about US foreign aid to Africa (Choices, Fourth Quarter, 1998) John W. Mellor observed that, for US investment to have the same type of impact in Africa that it has had in areas such as Asia, policy focus must return to the basic processes of agricultural development. As a result of US development assistance policy focus on important, but narrower, "second generation" development variables (child survival, vitamin A, microcredit, environment, wildlife preservation, etc.) the "first generation" focus on the basic processes of economic growth has been lost. It is in the area of stimulating economic growth through agricultural development that the United States brings a comparative advantage and a history of success.

In order to understand investments needed to advance agriculture, it is important to first examine the fundamentals of agriculture and food systems development in developing countries. Agriculture is the “engine of economic growth” because the majority of developing countries have a major share of their resources in the agriculture sector. This changes as economic development proceeds and other sectors of the economy become more viable, but investing in agriculture is investing in the foundation on which most of the rest of development relies.

Investment in agriculture and food systems development has broad impact because everyone consumes food, but it is critically important to the poor, who need it the most. *There is no other sector where the development benefits are so widely distributed in the economy, and in favor of the poor.* As agriculture develops, broad-based increases in per capita incomes increase the demand for non-food goods and services and this provides incentives for expansion of these sectors, thus inducing additional rounds of economic expansion and development.

How does agricultural development happen? What investments must be made to stimulate it? Key areas for investment are listed separately below, but decisions about them must be linked. For example, decisions about investing in technology for future production growth must be linked with infrastructure and human capital investments, and provide for environmental considerations.

***Human capital.*** If a single investment could be cited as key for agricultural development it would be the investment in human capital. People: their capabilities, talents, ambition, education, health, and the way they organize through institutions are the drivers of development.

Rural education is needed for the modernization and development of agriculture. The adoption of modern technology requires development of cognitive skills to decode the information in new technology. As economies experience economic growth there will be a continuous need to transfer labor from agriculture to the non-farm sector. Basic skills in reading and writing, and knowledge on the economy as a whole, will facilitate that mobility and migration.

Improvement in the quality of basic education will require effective higher education to produce leadership for higher quality primary and secondary education and innovation in all sectors of the economy and society. As an essential long-term development strategy, countries must also strengthen tertiary education in agriculture and food systems to support broad institutional needs. Developing country universities must become more market-oriented in operation and in their curricula, adapting to meet the needs of their countries. Long-term US/developing country educational institution linkages can strengthen the capacities of both for teaching, research, and service.

***Research and technology transfer.*** Productivity-enhancing technology induces broad-based economic growth. Technology-driven modernization increases productivity, which releases resources for expansion of the non-farm sector of the economy. The contemporary challenge for new technologies is to increase agricultural productivity while enhancing sustainability and environmental conditions and to do it in a way that promotes equity — use by the poor and in marginal areas.

Agricultural research provides the new knowledge imbedded in technology. Developing country agricultural research networks vary widely in their ability. Some (e.g. Brazil and India) are premier institutions, but many others are poorly funded and isolated. All need greater linkages to regional and global programs to become more efficient and effective. Public extension systems are also eroding. Reforms are needed to decentralize large extension systems and help them embrace opportunities from the information technology revolution.

United States universities have a proven record of accomplishment in the development and transfer of technologies needed to advance agriculture and food systems in developing countries, and in linking with researchers to develop their research institutions. An important part of the US capability is a large capacity to provide graduate training for public and private sector researchers and institutional managers from other countries.

***Policy reform and institutional development.*** Institutions are the means by which people in a society interact with one another. In addition to research, education, marketing and community health care institutions, relevant types also include international trade, agricultural commodity, market, and formal and informal labor market institutions. Financial institutions help channel, aggregate, mobilize and optimize the legitimate movement of money and capital assets through commercial markets. They are the means by which resources are organized and directed to high payoff investments. US universities have much to contribute to the development of institutional arrangements for agricultural and food systems in developing countries.

Most economic policy is imbedded in institutions. The lack of proper institutions can be a very important constraint on economic development. Agricultural development depends on a network of institutions in the public and private sectors as well as in what might be called “the middle sector” in civil society — involving self-help to solve problems on a collective action basis, through cooperatives, farmer associations, women’s organizations and other membership structures. US universities and NGOs have extensive experience in community development through farmer cooperatives, associations, women’s groups, trade associations and consumer groups.

Public/private institutional balance is also important. The agricultural sector is one where goods and services have often been provided through public institutions, for research, education, training, extension, marketing and input supply. The poor, especially, have depended on public institutions for information to improve their condition. While shifting as many functions as possible to the private sector opens up important opportunities for greater efficiency and spread of productive possibilities, bottlenecks can occur without appropriate public sector participation.

Establishing an appropriate policy and regulatory environment is a critical initial step toward developing the agriculture and food system. Strengthening organizations that support the sector is a longer-term need.

***Development of modern input supply industries.*** The use of modern production inputs (seed, fertilizer, pesticides) was the basis of the Green Revolution. The new transformation of agriculture (accounting for the environmental considerations) must develop more complex strategies, but the delivery of modern inputs will remain an important element. Vital to intensifying agricultural production is to appropriately link the agricultural sector to the rest of

the economy and to ensure efficient delivery of seed, fertilizers and chemicals. The development of a competitive agricultural inputs market is especially important for Sub-Saharan Africa.

Seed is a critical input for crop agriculture and provides the primary basis for productivity gains. Continued public sector investment in germplasm development and breeding must be complimented by policies that encourage private sector breeding and seed production. Harmonization and liberalization of seed laws can make good seed more available to farmers and create opportunities for seed companies. The public sector also needs to address ways to better respond to seed emergencies (drought, civil disorders) and to help countries address issues related to genetically modified organisms (biotechnology) and intellectual property rights. US universities can play a strong assistance role in this area.

While the use of commercial fertilizer has become controversial in terms of environmental impacts, in certain areas providing more nutrients for plant growth and production is basic to development. Low soil fertility is particularly limiting to crop production in Africa. Fertilizer application techniques have evolved, making it possible to use fertilizers much more efficiently with reduced pollution effects. Supplying plant nutrients only from organic sources can give growth rates of only 1 to 2 percent per year, when 3 to 5 percent is needed if agriculture is to contribute importantly to economic development in developing countries. The development of an efficient fertilizer marketing system that provides quality fertilizer to a broad number of farmers is critical and requires development of domestic fertilizer industries, appropriate policies for fertilizer importing and pricing and development of a distribution and information system.

Input supply is a relatively short-term response capable of providing important gains, especially in Africa and transitional economies. Research and policy relating to long-term environmental issues must assume increasing importance and input use must evolve with increasing knowledge.

***Physical infrastructure (roads; telecommunications).*** Agriculture is a transportation-intensive industry. Production takes place at long distances from markets, and inputs such as fertilizers have to be transported either from points of production or from points of importation. The combined effects of low productivity, low output prices and high input prices, may make it unprofitable to adopt modern technology. The importance of efficient transportation infrastructures has been neglected in recent years by many development economists and policy makers, especially in Sub-Saharan Africa.

Telecommunications infrastructure is becoming increasingly important for agricultural development. Private investment is needed to improve connectivity in developing countries, while public sector attention is needed to analyze economic development needs of rural areas and how Internet applications can become more “demand driven” to help achieve food security and find markets for tradable goods. The information resources of universities have a great deal to offer in this area.

---

## ***What new investments are needed?***

---

In the final section of this paper, the International Agriculture Group recommends a strategy for increasing US investment and leadership in global agriculture and food systems development. It provides an opportunity for collaboration among US universities, the United States Agency for International Development (USAID), international research and development institutions, developing country institutions, the United States Department of Agriculture (USDA), private voluntary organizations and the private sector. Within the context of investing for the mutual benefit of both the US and developing countries and for the highest return on investment, the focus should be on creative *linkages* among the various institutions. This renewed emphasis will enable US leadership to re-emerge, energizing and leveraging the resources of existing international programs. In the United States this effort could be led conceptually by an Institute for Global Agriculture and Food Security to ensure effective coordination and a strategic approach that does not allow the important challenge of global agriculture and food systems development to become a low priority of any given agency.

Recommendations for investment discussed herein include: *(1) strengthen the global agriculture research system; (2) develop human capital; (3) form biotechnology partnerships; (4) harness information technology; (5) initiate a Partnership for Rural Sector Institution Building; (6) strengthen the international dimensions of US institutions, and, (7) establish a United States-based Institute for Global Agriculture and Food Security.*

### **Investment I: Strengthen the Global Agricultural Research System**

Technological innovation — including new technology, management systems, policies and institutions — drives productive and sustainable agriculture and food systems worldwide. Policies and investments in support of a strong global research system are needed to provide a continuous stream of technological innovation. The existing global agricultural research system has evolved over time in an ad hoc way. The challenge for the new millennium will be to more strategically harness the existing assets of the system and financially support it for the mutual benefit of developing and developed countries.

The components of the system are organized and managed in different ways. The Consultative Group on International Agricultural Research (CGIAR), with its 16 International Agricultural Research Centers (IARCs) is closest to an integrated system. The United States has benefited enormously from its investments in, and linkages with, the CGIAR and other regional and international agricultural research centers in areas important to US agriculture.

The National Agricultural Research Systems (NARS) — the research systems organized by national governments — are a cornerstone of the global system and are particularly important for applied and adaptive research and technology implementation in developing countries. Developing country NARS vary greatly in strength and capacity. The NARS are composed of government and university research organizations and there is a growing private sector research

system with a presence in both developing and developed countries. The private sector system is often on or close to the frontier of knowledge as it strives to apply basic scientific knowledge in the development of proprietary products. Given that it is driven by a profit motive, the private sector tends to be more proprietary in its concerns about intellectual property rights than are public sector research institutes.

Policies and flexible modalities are needed to foster closer integration of the components of the global agricultural research system. The Collaborative Research Support Programs (CRSPs), supported by USAID, integrate the efforts of US universities in collaboration with multiple research institutions in 52 developing countries. Impacts have been significant in both research and training but need to be expanded to assure a stronger role. In the past, CRSPs were a complement to large country research programs. Now they are nearly the only remaining US international agricultural research program and need to be strengthened and used more strategically.

CRSPs address problems where solutions will be mutually beneficial to the United States and developing countries. They achieve their goals not only through collaborative research, but also by strengthening research capacity in developing countries through formal training and mentoring. The CRSPs are an excellent investment for the US taxpayer. Fifty land-grant universities from 34 states, the District of Columbia and Puerto Rico are involved and provide a 25% match to USAID's core funding.

***Recommendation: Strengthen and Expand CRSP Program Research; Expand Strategic Research Linkages with International Agricultural Research Centers***

As a central element of a strategy to strengthen the global agricultural research system, the United States should invest in revitalizing and expanding the CRSP program. Revitalizing the CRSPs could entail providing resources for underfunded aspects of existing CRSPs, as well as expanding long-term program funding to include a broader array of institutions and new strategic areas such as: new commodity areas; food safety; utilization of strategic natural resources; small grains, post-harvest losses, and other topics as determined by a scientific panel.

US universities must also develop more strategic links with international agricultural research centers. US universities should examine their long-term comparative advantage, by State, to determine how to best serve their respective states and the global village through these mutually beneficial linkages. If topics for collaboration represent high priorities for both parties, overall US political support for international agricultural research could increase. US university faculty and graduate students have much to offer in collaborative arrangements. It is recommended that there be a greater degree of consultation among USAID, IARCs and US universities when collaborative research topics are identified and that these linkages be more aggressively supported financially.

In addition to strengthening existing programs, United States policy needs to support the establishment of a major competitive international agricultural research program focused on

projects with mutual benefit to both the United States and developing countries. As Senator Richard Lugar has noted: “A large share of research dollars is provided to widely dispersed land-grant universities where research focuses on the local communities that they serve... this is important work, but ...we ought to devote more of our money to a competitive research system that gives priority to scientists who have identified significant breakthroughs. They should be provided with the resources that will enable them to push forward with projects of national and global significance” (Lugar, 1998).

***Recommendation: Establish a Major Competitive/Cooperative Program***

Policies are needed that would support re-establishing a USAID/university competitive/cooperative program in global agriculture and food systems development. Such a program should foster USAID/university/private sector research and development in areas of mutual benefit to the US and developing countries. The University Development Linkages Program is a good example of a program of this type. Under this program one or more US universities links with one or more developing country universities to carry out development projects. A new competitive program should be conducted under the new vision for Title XII, presently under consideration by the US Congress.

The United States could well provide the overall leadership for a fuller integration of the emerging global agricultural research system. In this way it would help retain the international leadership it has long held in agricultural research — a leadership it shares in many cases with other members of the OECD. A sound process of comprehensive priority setting should be established under the leadership of either USAID or an overall coordinating such as an Institute for Global Agriculture and Food Security (see Investment VII).

## **Investment II: Develop Human Capital**

Nobel Prize winner Gary S. Becker has noted that: “During this century, education, skills and other knowledge have become crucial determinants of a nation’s productivity. One might call the Twentieth Century the Age of Human Capital in the sense that the primary determinant of a country’s standard of living is how well it succeeds in developing and utilizing the skills, knowledge and habits of its population” (World Bank Seminar, 1994).

Human capital development underpins sustainable agriculture and food systems. It is an area of comparative advantage and successful experience for US universities, with its strong network of higher education institutions. US policies supporting human capital development carry additional benefits of building long-term linkages and international good will between US institutions and developing country scientists and institutions. In today’s environment, knowledge will be increasingly important in defining the amount and quality of development a country generates. Human capital development will be increasingly important for long-term agricultural development.

Many current developing country leaders were educated in the United States, because of Title XII programs. But because US funds for education and training of agricultural scientists,

educators and managers have declined in recent years, the quality of developing country national institutions has been affected (Title XII Report to Congress, 1998). Investing in a new generation of agricultural scientific, technical and managerial human capital for developing countries is instrumental for future food security.

Given the vibrancy and pace of today's global economy and the importance of trade and international business development, the "human" connection between the US and developing country professionals is even more important than in the past. Policies supporting US scientists and students working in development assistance result in contacts that lead to improved research and education, trade, equipment sales, and other economic opportunities.

In addition to addressing the needs of developing countries, educating US human capital for global agriculture and food systems development is a critical concern. On the bright side, US universities have recognized that both students and faculty must be globally-focused and knowledgeable and have adjusted curricula across disciplines. Many have increased study abroad programs. Creative partnerships with the private sector are also increasing. However, due to the declining agricultural population in the United States, the number of students and graduate students enrolled in agriculture programs has also declined and the group interested in international agriculture is even smaller. The generations trained in international agriculture and food systems development in the 1950s and 60s are retiring and fewer US leaders are trained to carry out vital new roles.

***Recommendation: Strengthen Human Capacity-Building Aspects of the CRSP Program; Strategic Links with Developing Country Universities***

The decline of America's leadership role in educating human capital for global agriculture and food systems development can be halted. Overall, policies encouraging USAID support for short- and long-term partnerships between US and developing country research and higher education institutions are greatly needed. An initial step would be to strengthen the human capacity-building aspects of existing programs – especially the CRSPs. Many US and foreign students received graduate training under the CRSPs and now hold scientific leadership roles around the world. Expanding education and training aspects of the CRSP program would be an excellent way to address human capital development needs.

United States-led leadership programs for training the new generation of developing country scientists and policy makers would be an important short-term measure to increase the contribution of US higher education institutions to developing country agriculture and food systems development. For the longer term and for broader-based human capacity development, major initiatives are needed to strengthen developing country universities, possibly through greatly expanding training under CRSPs and forging exchange programs. These initiatives should select high quality institutions with commitment to reform and to meeting the market demand for graduates.

### **Investment III: Form Biotechnology Partnerships**

The United States is the world leader in biotechnology, both in basic scientific work and in commercialization of the technology, and is uniquely situated to take a leading role in developing and adapting this technology for developing country needs. Agricultural biotechnology is the fastest growing sector of the biotechnology market, with 41.3% annual growth between 1985-1995. Revenues from products developed from agricultural biotechnology research are expected to reach \$8.5 billion by 2005.

Biotechnology in agriculture is an important tool to address food security, environmental, and economic growth concerns, particularly in developing countries. Advances in biotechnology can increase crop yield, improve growing environments, reduce use of chemical pesticides and improve the nutritional content of food. An increase in productivity of 10-25% from transgenic crops is feasible and realistic. This increase in productivity would be a significant contribution to global food security, more nutritious food and feed and a safer environment.

Simply stated, biotechnology is the use of living organisms, or parts of organisms, to produce new products or processes. Modern biotechnology is based on scientific advances in molecular and cellular biology. Within agriculture, biotechnology uses DNA technology to enhance traditional plant breeding, pest control techniques and to improve various processing procedures. It is the next step in improving plants and animals to produce better nutrition, flavor and yield.

Although the benefits of biotechnology continue to be debated, there is now hard evidence from commercialized products that this technology is economically viable and in demand by growers and consumers. In the United States in 1996, the total benefits for Bt cotton, corn and potato were \$80 million; benefits were \$190 million for Bt corn alone in 1997. Knowledge gained from 25,000 transgenic crop field trials (1986-1997) in 45 countries with 72% of the trials in the United States and Canada suggests that transgenic crops can be grown safely using responsible management practices.

Revenue from agricultural biotechnology products is expected to increase significantly in the future as expansion of transgenic crops continues and as a shift occurs from the current generation of “input” agronomic traits to the next generation of “output” quality traits. This will result in improved and specialized nutritional food and feed products that will satisfy a high-value-added market.

Such a shift away from basic agronomic improvements will have consequences for developing country agriculture where the main concern is increasing productivity and yield for food security. Developing countries have not yet received the benefits of this new technology. On a global basis, the proportion of transgenic acreage grown in industrial countries increased from 57% in 1996 to 75% in 1997, and it decreased in developing countries from 43% in 1996 to 25% in 1997. Growth in the area planted of transgenics between 1996 and 1997 in the industrial countries was significant and almost 4 times greater than in developing countries.

Despite the promise of biotechnology, there are hurdles that hinder developing countries from accessing this new technology:

- ***Trained Personnel.*** Well-trained personnel to adapt molecular biology techniques to crops and animals of importance to developing countries is a critical need in developing countries. With strong basic research capabilities and links to US agribusiness, US universities are in a unique position to provide needed technical training.
- ***Intellectual Property Rights (IPRs) and Other Policies.*** The policy environment in many developing countries is presently not conducive to attracting investment in biotechnology and producing products that will move from the laboratory to the field. However, failure to invest in biotechnology transfer condemns developing countries to dependency on conventional technology when they have the greatest need for biotechnology to ensure broad-based food security.

The comparative advantage of agricultural systems is becoming less dependent on natural resources, and more dependent on proprietary science and human skills to evolve, manage and protect intellectual property. Many policy makers in developing countries are uncertain whether IPRs will promote economic growth, catalyze innovation and attract external investment and technology or whether the reverse will happen. Private sector companies in the United States (and indeed many universities) are usually unwilling to collaborate with developing country systems that cannot provide a certain level of IPR understanding and protection. Intellectual Property Rights affect not only imported finished products, but also the management and protection of biodiversity, a rich but under-developed resource in developing countries.

- ***Biosafety Regulations.*** The lack of operational biosafety regulations in many developing countries often precludes the critical step of field testing transgenic crops; hence the lack of movement of research results beyond the laboratory.

Agricultural biotechnology can play an important role in the future of developing countries but much needs to be done to assure that the potential of this new technology is realized in these countries. Inaction will mean that these countries will fall even further behind in agricultural research and technology development in the next millennium.

The public and private sectors will have to work collaboratively on agricultural biotechnology; no one entity will have all the talent, incentives, policies and technology needed to commercialize a wide array of biotechnology products. Developing countries must develop policies, procedures, and, most importantly, a culture which fosters partnerships between the public and private sectors — within countries, regionally, and internationally.

### ***Recommendation: Develop A Biotechnology Network***

Developing countries lack the depth and breadth of policy, scientific and management expertise, along with required private sector investment and policy and regulatory systems, to fully benefit from biotechnology. These constraints can be addressed through integrated long-term linkages between US universities and developing country biotechnology centers, increased public/private partnerships and investment, and additional technical, policy and management expertise. Without progress in these areas, developing countries are not likely to see progress from biotechnology, with serious consequences for their national food security.

A biotechnology network model is recommended to strengthen biotechnology work in developing countries through USAID/university collaboration. The model would involve collaborative partnerships that link developing countries with US universities to strengthen the biotechnology sector, broadly defined. Linkages would focus on strengthening biotechnology research capacity, technical skills, managerial capability, policy development, regulatory system development and public/private partnerships. In developing countries where development of a full-scale national agricultural biotechnology capacity is not feasible, regional biotechnology centers could be developed that would be governed by representatives from nations in the regions.

Partnerships would link designated developing countries/regions to specific US universities, private sector institutions/associations and international agricultural research centers. Collaborating groups would constitute an overall network. This network would develop a strategy for the agricultural biotechnology sector in developing countries, share experiences and lessons learned, share technical resources and develop funding strategies.

An initial set of activities of these partnerships and the overall network would focus on: (1) defining the directions for agricultural biotechnology research and development within the overall network and in specific partnerships; (2) developing an appropriate set of policies, laws and regulations dealing with IPRs, biosafety and commercial development of biotechnology products; (3) training developing country scientists in biotechnology, and, (4) building a biotechnology research and development center in the developing country/region.

The research program would initially be undertaken in a US university center, but the research direction would be defined in collaboration with agricultural researchers and policy-makers from the country or region of focus. Host country centers would develop concurrently. As more people are trained and the regional or national center becomes operational, additional research and development would move to that center. The work on appropriate policies, laws and regulations would be centered in the countries of focus. Long-term linkages between developing country centers and US universities would facilitate keeping in touch with new developments.

Private agribusiness biotechnology companies interested in joining the partnership could contribute: (1) internship opportunities; (2) genetic resources; (3) research and technology development assistance, and, (4) insights on developing appropriate policies and incentives for the development of private biotechnology efforts in the area of focus. International agricultural research centers (IARC's) could provide: (1) risk assessments of newly developed products; (2) information about the agronomic and management systems in agroclimatic zones for new products; (3) testing of new products across agroclimatic regions and zones, and, (4) analysis of gene flows moving among various countries and centers. In developing countries where scientific resources are more available and commercial biotechnology results are more feasible, private agribusiness biotechnology firms would assume a larger role in the partnership. There is also a role for trade associations in bringing a variety of players to the table.

## **Investment IV: Harness information technology**

The World Bank ranks information as a major development resource, along with human, natural and financial resources (World Bank, 1991). Information technologies hold great promise to accelerate international agriculture and rural development and to contribute to food security, but for many developing countries, connectivity problems have made this a distant dream. The USAID-implemented Leland initiative has shown that financing modest infrastructure investments can promote pro-competitive policy reforms and help pave the way for private investment. The Internet can be used strategically to meet the economic development needs of rural areas and to help achieve food security.

Training should be an important part of the US contribution to developing the global information infrastructure. In *Harnessing Information for Development* the World Bank cites demand for specialized informatics professionals, computer literacy throughout the workforce and lifelong training as challenges for most countries in the face of rapidly changing technology. Meeting the demand for training will require the efforts of universities, NGO'S, private companies, training institutions, computer societies and accreditation councils (World Bank, 1998).

Much can be done to use information technology and existing information assets to further global agriculture and food systems development goals without spending large amounts of public sector resources. A strategy is needed for US support of information applications for: ***(1) education and research; (2) planning and monitoring; (3) agricultural producers, and, (4) rural enterprise development.***

### ***Education and Research Applications***

Information technology has enabled education to take place regardless of the geographic location of the student. Distance learning opportunities available through the Internet have enabled universities to lower costs of education, deliver continuing education regardless of location and help prevent the isolation of food and agriculture professionals returning to their countries after studying abroad. Internet-based distance education partnerships between developed and developing country universities have proved beneficial to both.

Information technologies underpin the concept of “global science.” Innovation depends on information sharing and collaborating on new ideas. Where connectivity is adequate, international networks of leading scientists can stay in communication, share data, access information and expertise and economize on travel costs while working on global problems from the perspective of their own country.

Information technology is particularly important for biotechnology research. Molecular biology has resulted in large amounts of data and databases on the genetic make-up of major crops and livestock species. For developing countries, issues related to obtaining and managing information resources for biotechnology include: (1) access to electronic information; (2) assessing the quality of information obtained via electronic format, where the critical review process, error detection systems and correction mechanisms are weak, and, (3) the costs of an information system, including initial start-up costs, maintenance costs, training costs, and the costs for acquiring quality information (Ives, 1998).

The Integrated Voice and Data Network (IVDN) of the CGIAR system is a good example of using information technology to connect agricultural scientists and improve data access around the world. In addition to connecting the Centers themselves, the IVDN has improved information exchange with developing country National Agricultural Research System (NARS) scientists. More needs to be done in this area, as well as linking educational institutions in developing countries that could benefit from access to research information and contribute their research results.

Information technologies can also expand international database sharing. The IVDN, for example, has made it possible for several databases to be available on the World Wide Web facilitating access to information that was not previously readily available. The best known is SINGER ([www.cgiar.org/singer](http://www.cgiar.org/singer)) which makes germplasm information from 13 databases in 11 countries on 4 continents searchable on the web.

Information technology can also be used to solve immediate problems in the production, processing and distribution of food and food products — information that has helped to solve a problem in one country can be used by specialists to diagnose a problem in another country over the Internet. “Virtual communities” of this type could be further developed around the world to enhance agricultural productivity in key areas.

### ***Planning/Monitoring Applications***

Geographic information systems (GIS) can provide a spatially-referenced framework for organizing physical, biological, cultural and socioeconomic data and a basis for decision making on variety of scales. GIS can be used to integrate information about a country’s population, its natural resources, and its agriculture. It can analyze research and policy questions having to do with land degradation, carrying capacity, environmental stress and population distribution and can help to determine the most cost-effective agricultural research investments, given ecological conditions. GIS can be linked with models and a variety of data and with electronic meeting software for group decision making and evaluation.

### ***Agricultural Producer Applications***

Information technology can help address the reality of the changing nature of global competition and its implications for developing country agriculture. Some have called the information highway the *new global trading route*. As noted by FAO: “trade decisions in Rome or Chicago today affect campesinos in Mexico within hours. Interest rates, global commodity situations, changing trade patterns, transportation developments and tariff structures all have impact on even the smallest farm operation. Without knowledge and the communications capabilities required to access, analyze and share the information required to create knowledge, small producers remain at the mercy of global market forces.” (FAO, 1997).

USAID, in partnership with universities and other US-based development organizations can further assess the information needs of developing country producers and help develop “demand-led” programs to meet their needs. Training for indigenous development professionals in the use of information technologies should be an essential part of such an effort.

***Recommendation: The Community Information Center (Telecenter): A Rural Enterprise Development Opportunity that Responds to Local Demand***

While the Internet is spreading rapidly in many developing countries, many countries lack the basic telecommunications infrastructure for widespread internet access. The concept of rural “telecenters” has helped to bring access to modern communication and information technologies to the rural areas in developing countries and introduces the possibility of a new type of viable rural economic enterprise. It provides global information access to small farmers attempting to compete in a global marketplace.

Telecenters provide access to telephone and fax services, e-mail, Internet and electronic networks, databases and libraries. Some link the Internet to local media to make telecenter information available to a wider audience. The lowering cost of communication and information technologies as well as their ability to be wireless and operational with solar power sources is encouraging networking of the centers.

FAO reports (1998) that telecenters are not only serving as facilities for single point access to external information services (e.g. government marketing and price information) or to global information through the World Wide Web, but are also serving as facilities for organizing virtual village-to-village meetings. In the United States, a group of businesses, universities, non-government organizations and government representatives have formed the World Info-Change Foundation, to consider how best to employ telecenters for development. A key principle behind this effort is innovative public/private collaboration — community-based centers that provide a range of information services, responding to local demand, as reflected in a business plan. USAID should collaborate with FAO, other donors, US universities and the private sector to develop a strategy in support of employing telecenters more effectively toward sustainable rural development and food security.

**Investment V: Initiate a Partnership for Rural Sector Institution Building**

The United States alone cannot finance all of the major investments needed to modernize developing country agriculture, but the United States has unique assets that can lead efforts in development of research, extension, policy formulation, environment, rural credit, marketing, education and other rural programs. Substantial funding will continue to come from international agencies, principally the World Bank and other multi-lateral development banks.

The multi-lateral development banks lack technical skills in many areas and are in need of expertise to assist developing countries in planning, implementing and evaluating programs. Universities can offer many of these skills, but may lack entre to and experience working with these institutions.

***Recommendation: A Partnership Fund***

A fund to enable partnering of universities with multilateral development banks could be created at the initial level of \$10 mil. per year. It could be partially funded by and managed by USAID, and open to contributions by the World Bank and other multi-lateral development banks. The funds should be awarded on a competitive basis, but it should be easily accessed in order to provide rapid assistance to developing countries.

The fund approach would provide the United States with a way to become more engaged in multi-lateral partnerships to leverage resources of international programs and make them more effective and efficient.

**Investment VI: Strengthen the international dimensions of US public and private institutions**

In this era of globalization, the United States must strengthen the international dimension of its domestic public and private institutions related to agriculture and develop more creative partnerships with US private sector companies that can provide management, technical and marketing skills to developing countries. These efforts are in the clear self-interest of the United States. It is imperative that US agriculture competes effectively in the international marketplace. For producers to make informed, competitive decisions they must have knowledge of the agricultural production, economic, social and cultural conditions that impact on marketing in other countries. Garnering this knowledge is not a one-time effort; it is the product of on-going relationships.

United States consumers benefit from an international agriculture that experiences continuing development and technological progress in both production and marketing. Significant amounts of this nation's food supplies are imported. US scholars and researchers can contribute to the modernization of international agriculture and help assure global food safety and security.

Students graduating from US universities today will enter an international labor market. They will work for firms that have international interests, who have overseas offices, who export and import. This is true even for graduates who return to the home farm or local agribusiness. If graduates go into the public sector or work for a private voluntary organization, the same applies — both at the national and local levels. The globalization of our economy has immediate and direct effects at the local level. This is evidenced by effects of economic decline in certain parts of the world on US agriculture.

***Recommendation: Globalizing Agricultural Science and Education Programs for America***

United States colleges and universities need long-term support in order to internationalize their agricultural research, extension and education programs. It is recommended that an international competitive grants program be developed at USDA to support the Globalizing Agricultural Science and Education Programs For America (GASEPA) agenda, adopted by the Board on Agriculture of the National Association of State Universities and Land-Grant Colleges (NASULGC). The funding level for this program should be \$30 million in FY 2001, administered through the Cooperative State Research, Extension and Education Service (CSREES) at USDA.

The GASEPA agenda is in the self-interest of the United States. It is consistent with the mission of the USDA, and with a mutually beneficial US foreign assistance portfolio. GASEPA is dedicated to:

- Enhancing global competitiveness of US agriculture through human resource development;
- Developing and disseminating information about market, trade and business opportunities;
- Establishing mutually beneficial collaborative international partnerships;
- Promoting trade through global economic development;
- Promoting global environmental quality and the stewardship and the stewardship of natural resources.

The USDA has a wealth of expertise in international agricultural policy, marketing, cooperative organization, rural development, food safety, research and natural resources to advance global food security. Within the Foreign Agriculture Service, the International Cooperation and Development program (FAS/ICD) should be strengthened and formally institutionalized with appropriated funding for salaries and administrative costs. A strengthened ICD is needed to work closely with a strengthened USAID and to supply critical human expertise through collaborative arrangements. The longer-term market development focus of ICD is increasingly recognized as important to the FAS mission and should be treated accordingly within the USDA/FAS organizational structure.

Also at USDA the *Agricultural Research Service (ARS)* should expand partnerships and innovative personnel exchanges with universities and International Agricultural Research Centers to conduct research of mutual interest to the U.S. and developing countries and the *Natural Resource Conservation Service (NRCS)* international program should be expanded to assure that the latest natural resources conservation and information technologies could be applied to a greater extent in development programs.

The expertise of the *Animal Plant and Health Inspection Service (APHIS)* is particularly important in the area of international harmonization of biotechnology regulation policies and the *Economic Research Service (ERS)* analyzes the current international situation and offers

data and economic analysis in the areas of trade, market conditions and international production for Asia and the Pacific Rim, Europe, and the Western Hemisphere.

Other US government agency programs could be examined for opportunities to strengthen their international programs. For example, given the depletion of international fisheries, important to the diet of those in developing countries, the *National Oceanic and Atmospheric Administration's National Marine Fisheries Service* could expand research in fisheries and aquaculture in order to enhance aquatic food supplies as a source of protein in developing countries.

## **Investment VII: Establish a United States-based Institute for Global Agriculture and Food Security**

An option for bringing greater attention to international agriculture and food security issues would be to create an independent Institute for Global Agriculture and Food Security, funded by USAID, but able also to draw funding from the multilateral development banks, the private sector, foundations, and private individuals. Such an institute would advance international collaboration in agricultural research and education and would bring together the public and private sectors, the university community, technical agricultural NGOs, and other research institutions, to work together on key problems related to food security.

The Institute would provide leadership for identifying priority areas for investment in international agricultural research and education. It would allocate funding through competitive grants, with resources provided on a matching basis. The Institute could be patterned after the National Institute for Health (NIH), but with international responsibilities. The Institute would be governed by a Board with international membership, but drawn largely from US universities, the US government, the private sector, NGOs, etc. Its ultimate mission would be to promote economic development in developing countries and to address the challenge of global food security.

An Institute approach could do much to introduce a consistent, strategic approach with input from key stakeholders and scientific leaders. It could be a focal point for raising the visibility of food security as a pressing problem and help harmonize complimentary elements of the current system. It could nurture international cooperation, an important means to furthering international peace. By increasing the payoff from investments in agricultural research it could increase the support for such research in the longer term. For universities, an institute approach would provide the means for strengthening the international knowledge base of the faculty of US colleges of agriculture. It would produce new knowledge and technology critically needed for the development of low-income countries.

## **CONCLUSION**

United States policies must strengthen and expand development assistance in global agriculture and food systems. The benefits derived from investing in the seven areas that the International Agriculture Group recommends in this document will be substantial for both the United States and developing countries.

Agricultural higher education, science and technology (particularly biotechnology) and information are top priorities of US universities and key needs of developing country agriculture. The United States can no longer afford to under-invest in the development of global agriculture and food systems.

## REFERENCES

- Alex, Gary. 1997. "USAID and Agricultural Research: Review of USAID Support for Agricultural Research – 1952-1996." Agricultural Research and Extension Group (ESDAR). Washington, D.C: The World Bank.
- Bathrick, David D. 1998. "Fostering Global Well Being: A New Paradigm to Revitalize Agricultural and Rural Development." Food, Agriculture and the Environment Discussion Paper 26. Washington, D.C.: International Food Policy Research Institute.
- Bathrick, David D. 1996. "Agricultural Development for Global Well Being: Expanded Roles for Multilateral Development Banks." Washington, D.C.: Chemonics International, Inc.
- Becker, Gary S. 1994. "Human Capital and Poverty Alleviation." Human Capital and Operations Policy Working Paper. Washington, DC: The World Bank.
- Commission on International Trade, Development and Cooperation. 1997. "U.S. Interests in Economic Growth, Trade, and Stability in the Developing World: Conclusions and Recommendations." Washington, D.C.: National Center for Food and Agricultural Policy.
- De Janvry, Alain; Elisabeth Sadoulet, and T. Kelly White. 1989. "Foreign Aid's Effect on US Farm Exports: Benefits or Penalties?" Washington, D.C.: US Department of Agriculture, Economic Research Service, Foreign Agricultural Economic Report Number 238.
- De Soysa, Indra, Nils Petter Gleditsch, Michael Gibson, Margareta Sollenberg and Arthur H. Westing. 1999. *To Cultivate Peace: Agriculture in a World of Conflict*. Oslo, Norway: International Peace Research Institute.
- Food and Agriculture Organization of the United Nations. 1997. "The Internet and Rural and Agricultural Development: An Integrated Approach." Rome, Italy: Author.
- Food and Agriculture Organization of the United Nations. 1998. "Knowledge and Information for Food Security in Africa: from Traditional Media to the Internet." Rome, Italy: Author.
- Hanna, Nagy K. 1991. *The Information Technology Revolution and Economic Development*. Washington, DC: The World Bank.
- Houck, James. 1987. "Foreign Agricultural Assistance: It's Mostly a Good Thing for U.S. Farmers." *Choices* (First Quarter), p.19.
- Kellogg, Earl D. 1997. "Internationalization, U.S. Agriculture and the Land Grant University Response." Presentation at the Southern Region Mini Land-Grant Meeting. College Station, Texas: College Station Hilton and Conference Center.
- \_\_\_\_\_, Richard Kodl, and P. Garcia, 1986. "The Effects of Agricultural Growth on Agricultural Imports in Developing Countries." *American Journal of Agricultural Economics*, Vol. 68, No. 5 (December), pp. 1347-1352.
- Lee, John E., Jr., and Matthew Shane. 1985. "U.S. Agricultural Interests and Growth in the Developing Economies: The Critical Linkage." Washington, D.C.: Economic Research Service., USDA.
- Lugar, Richard G. 1998. "Meeting the World Demand for Food: Opportunities and Responsibilities." Proceedings: Policy '99 — Association for International Agriculture and Rural Development Capitol Hill Forum, January, 1998. Washington, D.C.: Association for International Agriculture and Rural Development.
- McCalla, Alex F. 1994. "Agriculture and Food Needs to 2025: Why We Should be Concerned." Washington, D.C.: Consultative Group on International Agricultural Research.
- McNeely, J.A. 1990. "Conserving the World's Biological Diversity." Washington, DC:IUCN, World Resources Institute, Conservation International, World Wildlife Fund, World Bank.
- Mellor, John W. 1998. *Closing the Last Chapter on U.S. Foreign Aid: What to do About Africa*. Choices, Fourth Quarter.
- Paarlberg, Robert. 1984. "United States Agriculture and the Developing World: Partners or Competitors?" *United States Agriculture and Third World Development: The Critical Linkage*. Ed. Curry Foundation. New York: Associated Faculty Press.

- Pardy, Philip G., Julian M. Alston, Jason E. Christian, Shewggan Fan. 1996. "Hidden Harvest: U.S. Benefits from International Research Aid." Food Policy Report, Washington, D.C.: International Food Policy Research Institute.
- Petit, Michel J., et. al. 1996. "The Emergence of a Global Agricultural Research System: The Role of the Agricultural Research and Extension Group." Washington, DC: The World Bank.
- Pinstrup-Andersen, Per, Rajul Pandya-Lorch, Mark Rosegrant. 1999. "World Food Prospects" Food Policy Report. Washington, D.C.: International Food Policy Research Institute.
- Pinstrup-Andersen, Per, Mattias Lundberg, and James L. Garrett. 1995. "Foreign Assistance to Agriculture: A Win-Win Proposition." Food Policy Report. Washington, D.C.: International Food Policy Research Institute.
- Population Reference Bureau. 1998. "World Population Data Sheet, 1998." Washington, DC: Author.
- Quisumbing, Agnes R, et al. 1995. Women: The Key to Food Security. Washington, DC: International Food Policy Research Institute.
- Raquet, Bonnie. 1998. "Rural Development Opportunities in Africa." Proceedings: Policy '99 — Association for International Agriculture and Rural Development Capitol Hill Forum, January, 1998. Washington, D.C.: Association for International Agriculture and Rural Development.
- Richardson, Don. 1997. "The Internet and Rural and Agricultural Development." Rome, Italy: Food and Agriculture Organization of the United States.
- Rosegrant, Mark. 1997. "Water Resources in the Twenty-First Century: Challenges and Implications for Action." Food, Agriculture and the Environment Discussion Paper 20. Washington, D.C.: International Food Policy Research Institute.
- Serageldin, Ismail. 1997. "New CGIAR Partnerships to Advance Global Well-being." Presentation at the 33<sup>rd</sup> Annual Meeting of the Association for International Agriculture and Rural Development. Washington, D.C.: Association for International Agriculture and Rural Development.
- Serageldin, Ismail. 1999. "Chairman's Opening Address: International Centers Week, 1999." Washington DC: The World Bank.
- Talero, Eduardo and Philip Gaudette. 1996. Harnessing Information for Development: A Proposal for a World Bank Group Strategy. World Bank Discussion Paper No. 313. Washington, D.C.: The World Bank.
- United States Agency for International Development. 1997. Strategic Plan. Washington DC: Author.
- Working Group on International Agricultural Research. 1997a. "The Crucial Role of International Agricultural Research: Improving Global Food Production, Benefiting U.S. Agriculture, Enhancing the Economies of Developing Countries and Stimulating U.S. Trade." Report to the Commission on International Trade, Development and Cooperation. Washington, D.C.: National Center for Food and Agricultural Policy.
- Working Group on International Trade and Development. 1997b. "Development, Trade Expansion, and U.S. Agriculture: Policies for the 21<sup>st</sup> Century." Report to the Commission on International Trade, Development and Cooperation. Washington, D.C.: National Center for Food and Agricultural Policy.
- Woman: an Untapped Resource for Agricultural Growth. Genderaction. Vol. 1, No 3. Washington, D. C.: USAID.
- World Bank. 1996. Poverty Reduction and the World Bank: Progress and Challenges in the 1990's. Washington, D.C.: Author.
- World Bank. 1997. "Rural Development: From Vision to Action: A Sector Strategy." Washington, D.C.: The World Bank.
- Yudelman, Monte. 1997. "Cooperating on Natural Resource Issues: The Case of Water." Presentation at the 33<sup>rd</sup> Annual Meeting of the Association for International Agriculture and Rural Development. Washington, D.C.: Association for International Agriculture and Rural Development.
- Zijp, Willem. 1994. Improving the Transfer and Use of Agricultural Information: A Guide to Information Technology. Washington, D.C.: The World Bank.



**NASULGC**

International Agriculture Section — Board on Agriculture  
1307 New York Avenue, N.W., Suite 400  
Washington, D.C. 20005-4701

[www.nasulgc.org](http://www.nasulgc.org)