THE COLLABORATIVE RESEARCH SUPPORT PROGRAMS (CRSP)

CRSP Contributions to Science and Technology for Development

Presented by:
The CRSP Council

UNITED STATES CONGRESSIONAL RECEPTION
and
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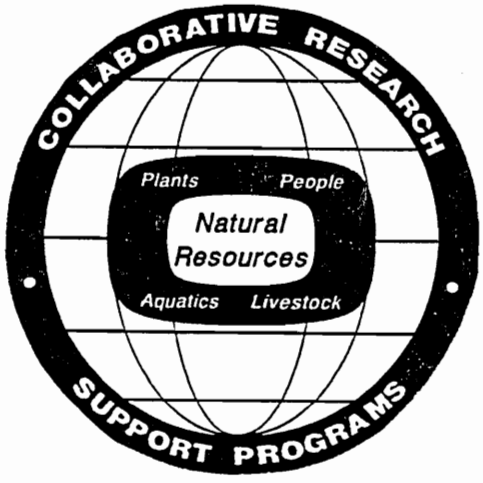

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PURPOSE

We have reached a time in which global philosophies have changed drastically. There is a strong awareness of the relationship between the impact of population growth and degradation of the environment. The world population doubled from 2.6 to 5.2 billion between 1950 and 1990, and is projected to reach 8 billion by the year 2020. To feed, clothe, and house this growing population will require a integrated approach. A major environmental consideration is the effect of this growing population on environmental sustainability. In the developing world, population, environmental sustainability, and poverty are all inter-related. The interaction of these three factors creates an exponential need for increased agricultural production, poses greater impact on sustainability of natural resources, and causes greater exploitation of the environment.

The World Commission on Environment and Development defined Sustainable Development as: "Development that meets the needs of the present without compromising the ability of future generations to meet their needs". We face enormous challenges in maintaining soil and water quality, biodiversity, food production and distribution, and appropriate information exchange, all of which are related to global sustainability and food security in supporting an ever expanding population.

The Collaborative Research Support Programs (CRSPs) provide a proven mechanism to bring together the components of the whole. The CRSPs were formed in the late 1970's to implement part of Title XII legislation, which was enacted by Congress in 1975. Our strong base of U.S. scientific capability from the U.S. Land-Grant and Sea-Grant universities is linked collaboratively with developing country scientists to help farmers increase their incomes and alleviate hunger without depleting the natural resource base upon which they depend for food, fuel, fiber, and shelter.

It is very appropriate to use the research base of the U.S. Land-Grant and Sea-Grant universities in international development, since our food production efficiency has allowed diversification of the American economy. An efficient agricultural sector lowers food costs and permits others in the work force to pursue other industrialized employment. If a developing country economy is to support a viable democracy, the country must develop a strong and productive agricultural sector.

The collaborative research mode is one of the most efficient mechanisms to build capacity for food production and distribution research in the developing countries. Collaborative research programs also have a strong track record in relation to the development of sustainable institutions and programs. Collaborative research has significant spin-offs for U.S. agriculture and food distribution. The economic impact of CRSP research in the U.S. alone exceeds the total cost of the CRSP programs since their inception.

The CRSPs have a history of success by helping to meet basic human needs while maintaining and/or enhancing the environment. There are presently eight CRSPs coordinated and funded by USAID through grants covering a wide range of research areas, which work through U.S. universities from 29 states and Puerto Rico and through partner institutions in 32 developing countries.

The eight CRSPs are Small Ruminant, Sorghum and Millet, Bean and Cowpea, Soil Management, Peanut, Fisheries Stock Assessment, Pond Dynamics/Aquaculture, and Sustainable Agriculture and Natural Resource Management. An Integrated Pest Management CRSP is in the planning stage. The collaborative nature of the CRSPs brings together resources of developing countries and U.S. institutions to increase the efficiency of food production systems of developing countries, with returns that are also beneficial to the United States.

IMPACTS

There are some broad environmental and sustainability concerns that are addressed by the CRSPs, particularly the Soil Management and the Sustainable Agriculture and Natural Resource Management CRSPs.

We have a challenge to provide leadership to social equity. By the year 2020, world population will have doubled. Now there is about 0.3 hectares of arable land for every person. By the year 2020, this will fall to 0.15 hectares per person. Our present production technology requires about 0.5 hectares per person (even more than what is now available), so we must shift technology generation into catch-up gear if we are going to meet today's basic human requirements and provide for future equity.

So that developing country children might receive equity, the Sorghum and millet and Soil Management CRSPs are collaborating with the Honduras Ministry of Natural Resources through the 'LUPE Project" to incorporate improved sorghum production technologies with environmentally sound soil and water conservation practices.

People need to be provided alternatives. As an example, coca production in the humid tropics of Bolivia and Peru has become a social problem in these developing countries. Will children in these countries grow up with the production technology means to provide for their families without resorting to coca production? A Soil Management CRSP socio-economic survey revealed that farmers in the Chapare of Bolivia are ready to accept new crops (peach palm, pineapple, black pepper, bananas, citrus, etc.), but want production technology and need marketing systems services. The Government of Bolivia has requested help to adapt humid tropics soil management and production technologies collaboratively developed in Yurimaguas, Peru into the Chapare of Bolivia. The objective is to replace coca with these perennial tropical crops that have ready markets in nearby industrialized Argentina and Chile. The goal is to develop sustainable and environmentally friendly "managed humid tropical rainforest systems." Similar needs and examples could be cited for other countries and regions.

The most recent CRSP is the Sustainable Agriculture and Natural Resource Management (SANREM) CRSP which was established in August 1992 to provide special leadership in solving problems of sustainability. The SANREM CRSP takes a very innovative approach to natural resource management research and information exchange by utilizing a landscape approach that focuses on linkages of food production with the environmental and the natural resource base.

The SANREM CRSP puts the traditionally "last" first by including the end-user or farmer. In this approach the linkages and interactions within the landscape and lifescape are considered and strategies for appropriate policy changes are identified. The outcome of the planning process is a fully integrated work plan based on the elements of sustainability which reflects the people's needs and provides for short and long term strategic research objectives.

The SANREM CRSP is implemented by a consortium of nine U.S. and 21 host country institutions that include universities, national programs, international agricultural research centers, non-governmental organizations, and farmer groups. The SANREM CRSP is currently working in the Philippines and Burkina Faso with proposed additional sites in Honduras and Ecuador.

Many impacts produced by research of the CRSPs are components of improved environmental and sustainable production and food delivery systems. We can group these impacts into five areas: Genetic Resources, Pest and Disease Management, Natural Resource Management, Food Delivery Systems, and Human Resource Development and Technology Transfer.

Genetic Resource Enhancement

Genetic resource enhancement uses a worldwide pool of germplasm for genetic improvement of plants and animals in order to increase production with minimal chemical inputs.

In Kenya, the Small Ruminant CRSP has been breeding a Dual Purpose Goat, which is a four-way cross that results in a genetically improved animal that produces more milk and meat for farmers. This goat is highly demanded by farmers, not only because it provides products that improve the nutrition and income of smallholder farm families, but also because it produces a greater yield of manure. This manure helps reduce the need to purchase fertilizer thereby improving the sustainability of small holder farms.

In the United States, Sorghum and Millet CRSP research has introduced several new sorghum hybrids between 1979 and 1989. These food-quality varieties are far superior to the red sorghums, previously used for livestock and poultry feed and for export to Mexico. Estimates show a net gain of $183 million to the U.S. agricultural economy in the last 10 years. Over this same period, research costs were only $7 million - a 38% annual rate of return.

Genetic resistance to most pests and diseases affecting peanut is found in wild species that do not cross with the cultivated species. Peanut CRSP researchers are employing new biotechnology techniques to transfer the desired genes to cultivated species. The gene that gives resistance to tomato spotted wilt virus in peanut has been transferred to susceptible germplasm and the progeny is being tested for resistance to the virus. This technology can contribute greatly to the breeding of pest and disease resistant peanut germplasm for sustainable production systems.

In Jamaica, the Peanut CRSP and the Caribbean Agricultural Research and Development Institute developed and released a higher yielding, disease-tolerant peanut variety. This variety is being adopted by farmers and yields 42% more than traditional varieties, in addition to having improved quality characteristics. The increase in income of small-scale farmers growing the new variety should reach $600,000 this year.

The Bean/Cowpea CRSP has supplied new germplasm to buffer the serious consequences of past genetic erosion of bean and cowpea germplasm in the U.S. For the first time, transgenic beans have been developed. The new particle gun technology for making transgenic plants was developed in collaboration with a private company.

Several states have released new bean cultivars developed by Bean/Cowpea CRSP breeders. In Michigan, new bean varieties developed from germplasm collected in developing countries increased yields by 20-25%. In a normal year the increase can mean over 3.7 million extra dollars for Michigan growers. One new red kidney bean variety was released in New York. It can yield 30 percent more than the old variety, which translates to $150,000 more per year for New York growers.

One goal of the CRSPs is to help farmers improve their incomes and alleviate hunger, without depleting the natural resource base upon which we all depend. The Pond Dynamics/Aquaculture CRSP works with scientists and technicians in host countries to insure water quality, not only for fish ponds, but for the larger ecosystems. The premier water quality lab in East Central Africa is run by the PD/A CRSP in Rwanda. In Honduras, the PD/A CRSP helps shrimp farmers and the

Honduran government analyze the quality of water discharged from ponds, protecting sensitive mangroves and estuaries.

Pest and Disease Management

A major concern of sustainable agriculture is controlling pests and diseases without damaging the environment. Effective and safe pest and disease control means reducing the use of chemicals, which leads to IPM or Integrated Pest Management strategies. All CRSPs emphasize good growing practices as important controls of diseases and insects.

In North Carolina and Virginia, the southern corn rootworm is a serious pest for peanut growers. The Peanut CRSP has identified a tolerant variety, NC-6, which can cut chemical use in half. Further, chemicals are applied only when the pest reaches economic threshold levels. A recent impact study of using pheromone traps to determine thresholds showed that chemical application could be eliminated on 42,000 acres of Virginia and North Carolina peanut, reducing the amount of chemicals applied by 42 tons or a savings of $840,000.

The cowpea weevil is a serious pest in Cameroon. In three short months it can destroy over 50% of the stored grain. The Bean/Cowpea CRSP found that exposing cowpea to high temperatures effectively kills these pests. They designed a solar heater, cheap and easy to build, that can be used by limited resource farmers throughout the world. Its use significantly reduces the need for dangerous and expensive chemicals.

The value of sorghum at the U.S. farmgate is about $840 million annually. Greenbug damage has been estimated at $40 million per year. Sorghum and Millet CRSP researchers developed greenbug resistant varieties that are used extensively in the U.S. A recent economic analysis has shown that these new varieties result in a net gain to the U.S. of $38.9 million per year; an annual rate of return of 48%.

Striga is a parasitic weed that has a devastating impact on sorghum and millet production throughout large areas of Africa. An African based study estimates that Striga causes the loss of up to 40% of potential sorghum and millet production in Africa each year. Sorghum and Millet CRSP researchers were the first to isolate the germination stimulant exuded from sorghum roots that initiates the sorghum/Striga parasitic relationship. Research breakthroughs have demonstrated: a way to disrupt the host-parasite interaction; a new genetic screening technique for predicting Striga resistance; and a time saving laboratory method for wider genetic screening for resistance. Progress is now being made in the development of cultivars which combine Striga resistance, drought tolerance, food quality, and increased yield.

Control of parasites in sheep on U.S. rangelands has normally been done by the use of chemicals, which is both costly and time consuming. Small Ruminant CRSP research has introduced parasite-resistance in sheep that can save U.S. producers up to $39 million per year.

Natural Resource Management

Our natural resources must be wisely managed for sustainable food production. Pesticides, chemical fertilizers, and other external factors affect our ability to manage air, soil, and water resources. To help limit the use of external inputs, extensive CRSP efforts have been made to breed and adapt plants and animals to withstand environmental stresses, and fit into sustainable production systems. In addition, present plant, animal, and fish species are used in improved production systems.

Weeds are a serious problem in rubber tree plantations in Indonesia and are usually controlled with herbicides. The Small Ruminant CRSP has found that

grazing sheep under rubber trees reduces the need for herbicides and also reduces the pressure on pasture and forests by providing alternative forage. The Small Ruminant CRSP is working with the Rubber Tree Institute of Indonesia and smallholder farmers to increase the viability of this practice.

In Morocco, Small Ruminant CRSP researchers found that sheep can more effectively utilize cereal stubble through grazing as compared to traditional burning. This reduces potential air pollution and also recycles nutrients onto fields. Grazing cereal stubble also reduces pressure on pasture land by providing alternate forage for small ruminants. Cereal stubble grazing decreases residues that harbor diseases which carry over into following crops.

The Soil Management CRSP identified 17 million hectares of clay-loam soils across the Sahel region of West Africa that would be ideal for grain sorghum production. Farmer yields were found to be low and lands were abandoned because of low and uncertain yields. By planting on ridges and with small quantities of fertilizer, grain sorghum yields were increased by an average of 157% over four years, and cowpea yields were increased by an average of 123%. If these low risk management technologies can be used on clay-loam soils there is the potential to supply 56 million people with an additional kilogram of sorghum per day 365 days per year or 34 million people and additional 0.25 kilogram of cowpea per day.

When Indonesian families were being moved from overpopulated Java to West Sumatra little attention was given to the potential production capacity of soils under the burned remnants of tropical rainforests. These soils were found to be very acidic, and nutrient deficient, and would not support production of nutritious food crops. Families trying to earn their living on these soils suffered from malnutrition and other health problems because very few crops would grow. Soil Management CRSP researchers demonstrated that when lime was added with fertilizer, maize yields increased nearly six-fold and upland rice by two-fold. Yields of edible legumes were also greatly increased, peanut by 110%, mungbean by 600%, and soybean by 1000%, all demonstrated in farmers fields. These increases improved both the quantity and quality of food, thus improving nutrition and general health of these families.

Farmers in Niger face trying to support their families with limited and uncertain rainfall and badly degraded soil resources. Research by the Soil Management CRSP was organized as a farmer participation "Integrated Management of Agricultural Watershed" project. Farmer knowledge and plant and soil inventories served as the bases to incorporate improved food crop production and conservation practices. These interventions were introduced through full farmer participation so they would understand that what happens in one area of the watershed will effect all four villages in the watershed. The first year, sixteen farmers agreed to manage simple experiments in their fields. The recommended practices increased their yields of millet by over 500% and cowpea by over 600%. These farmers are excited because they now can feed their families on their limited, but more productive soils and can plant fast growing legume trees for fuel on their less productive soils. The watershed approach was quoted by a FAO scientist as a system that could lead to the "Greening of Sahelian Africa."

In Africa and South America, the Small Ruminant CRSP has made progress in finding new grass species and improving management practices to prevent over grazing by sheep, goats, llamas, and alpacas. These improved management systems help preserve vegetation and reduce soil erosion. They also provide food and income for farmers.

Aquaculture, valued at $5 billion per year, is the fastest-growing segment of the U.S. agriculture industry. Tilapia, the Biblical miracle fish, is on its way to becoming as common as catfish. Production has increased 60% in the last two years, and growth is expected to continue. Tilapia is now grown in almost every state in the U.S., including such unlikely spots as Idaho and North Dakota, as producers take advantage of geothermal resources and waste heat from power plants

and other industries. New producers can draw on the world's largest aquaculture database, created and maintained by the Pond Dynamics/Aquaculture CRSP, to help pond managers choose the most economically efficient combinations of organic or inorganic nutrient amendments, stocking densities, and length of growing time.

In Honduras, the Sorghum and Millet CRSP has worked through a national extension organization to protect fragile hillsides. Two new sorghum varieties were introduced for these hillside farms, which have increased farmer income by 15%.

The dual-purpose goat developed by the Small Ruminant CRSP in Kenya is being integrated into a maize grain-forage production system. Selective feeding of green plants and dry fodder after grain harvest can support two goats per hectare for 5 months. With careful management, a farmer can double net returns. Each dual-purpose goat generates an average of $52 additional income per hectare.

Aquaculture CRSP researchers have developed state-of-the-art regimes for recycling nutrients and water. As a result, Arizona farmers can now grow a crop of fish before they use the water, laden with nutrient-rich fish waste, to irrigate a crop of alfalfa or cotton. This practice conserves water and enhances system efficiency.

Fish are an extremely important food source worldwide with an annual catch greater than the combined production of beef and poultry. FAO estimates show that over half the population of developing countries obtain 40% or more of their total animal protein from fish. The U.S. fish import deficit is almost $7 billion a year. About 90% of the annual fish catch comes from marine fisheries. About half of the worlds fisheries harvest is from developing countries. Improved stock assessment and management of the world's fisheries are essential if we are to address the crucial issues of adequate nutrition in developing countries.

Fisheries Stock Assessment CRSP researchers from the University of Maryland and the University of Costa Rica developed a system that integrates fishery resource assessment, human resources development, and public and private sector activities. One of the major elements of the system is a fishery management tool called FISHMAP. Although designed for Costa Rica, FISHMAP was configured for Chesapeake Bay, which has an annual multi-million dollar budget for resource assessment. FISHMAP has provided significant improvements in abundance estimates and has resulted in at least a 50 percent reduction in the costs associated with fishery resource monitoring.

Fisheries Stock Assessment CRSP researchers from the University of Washington and The University of Costa Rica have developed techniques to measure the ageing of fish by examining "growth bands". As a result researchers are better able to establish growth characteristics to prevent overfishing.

As arable land becomes more scarce, Rwandan farmers are turning to aquaculture as a production alternative. Aquaculture CRSP researchers in Rwanda found that raising fish as a cash crop is more profitable for farmers than working for hire in other agricultural enterprises. Aquaculture also provides income opportunities for women, who comprise 25% of all fishfarmers in Rwanda. These activities increase family incomes by 14% or more, while improving household nutrition.

Food Delivery Systems

Sustainability in agriculture does not stop with crop and animal production. Production must be followed with an efficient system to deliver adequate supplies of quality food to prevent hunger and provide adequate nutrition.

Aflatoxin is a carcinogenic compound found in many food grains worldwide, including peanut. Peanut CRSP researchers working in Texas and Senegal used a

commercially modified clay to remove aflatoxin from contaminated peanut oil, and to block aflatoxin adsorption in the livers of chickens. The clay essentially eliminates the aflatoxins passing through goats into milk. Locally available clays in Senegal are being tested and promise to be useful substitutes for the commercial clays. The potential of this new technology for managing aflatoxin contamination in peanut, and other grains such as corn, is invaluable.

Collaborative efforts in food technology that have involved The University of Georgia and Kasetsart and Cheing Mai Universities in Thailand have transferred processing and marketing technology for higher quality and more efficiently produced peanut products to village women in North Thailand. Selling value-added products rather than raw peanut nearly doubles their income. A similar project will begin soon in the Philippines with partial support from the Women in Development Program at USAID.

In Nigeria, the Bean/Cowpea program developed a system to process cowpea flour that has resulted in two village mills being operational. In addition to producing a better and more consistent flour for traditional foods, the mill removes the drudgery from hand grinding done by village women.

Human Resource Development

Reverse technology transfer of sustainable agricultural strategies from developing countries is of increasing importance to the U.S. One way in which the CRSPs have accelerated reverse technology transfer is through strong international linkages, reinforced by our unique training programs.

Collectively, since the inception of the program, the CRSPs have trained over 600 Ph.D. students and over 700 M.S. students. Some 70% of these are from developing countries and the remainder are from the U.S.

In addition, the CRSPs have developed and conducted short-term training programs that have improved the technical skills of about 4,000 developing country scientists.

The impact of CRSP research is greatly magnified by the large number of students from developing countries who study under CRSP sponsorship. Often these students return to positions in their government or in industry where they can implement the improved technologies and production processes resulting from CRSP research.

For example, the Director General of the National Agronomic Research Institute in Niger, Dr. Mamadou Ouattara, is a Texas A&M University Ph.D. graduate sponsored by the Niger Soil Management CRSP program. The former Vice Minister of Agriculture of Bolivia, Dr. Jose Salinas, and now the Director General of The Bolivian national Institute of Research and Technology (similar to USDA) received a Ph.D. at North Carolina State University sponsored by the Soil Management CRSP. Dr. Moussa Traore, who's graduate program was sponsored by the Sorghum and Millet CRSP, is Vice Minister of Agriculture in Mali. Dr. Lucas Gakale, another Sorghum and Millet CRSP sponsored student is the Director of Agricultural Research Department in Botswana. Positive experiences in the collaborative training mode lead to requests to train other promising scientists from their countries. There are many other examples.

Experience received by Principal Investigators of CRSP projects in developing countries enables them to advance in their careers. For example, Dr. Amadou Ba of the Peanut CRSP in Senegal has been appointed Director of the Field Crops Section of ISRA. In Burkina Faso Peanut CRSP researchers have advanced; Dr. Alfred Traore is now serving as Rector of the University of Ouagadougou, and Dr. Philippe Sankara has been recently appointed Director of the Centre National de Recherches Scientifique et Technologique.

Training and technology transfer programs extend beyond the scientist level.

Small holder farmers are provided goat production training in Indonesia, while new veterinary techniques are being taught in Peru. Transfer of technology has occurred through numerous other workshops and short-courses, publications, and through the outreach programs of developing countries, private entrepreneurs, and non-governmental organizations.

Vision

The CRSPs have a vision that will lead us into the 21st Century as significant contributors to international development.

The CRSPs are mature programs based on a sound concept. They have demonstrated their ability to enhance sustainable productivity and income in developing countries and the U.S. The CRSPs were conceived as long-term efforts to solve problems of inadequate food production and availability, and to train scientists capable of addressing problems relevant to the challenges of the future.

CRSP impacts result from collaboration in 29 states and Puerto Rico, from 15 countries in Africa, 5 in Asia, and 12 in Latin America. Collaboration exists with the international agricultural research centers and other international institutions, private volunteer organizations, and non-governmental organizations.

U.S. impacts are magnified by students from developing countries, who are studying in the U.S. under CRSP sponsorship.

There is a dramatic change occurring in the world. In a decade, a population increase equal to another China will be demanding food and a quality life. New arable lands to support this population are no longer available, therefore improved technologies will be necessary to meet their needs on existing lands.

The CRSPs have proven to be a low cost, highly productive system that can be used as a model to solve some of the most complex problems facing everyone.

If properly supported, the CRSPs still present the greatest opportunity for the U.S. to have sustainable impacts on the National Agricultural Research Systems in developing countries. Collaboration with these systems can develop their public and private capacity to respond to the issues of environmental conservation, sustainable agriculture, and economic enhancement through private investment so essential for improving conditions in lesser income countries.

Resources are becoming marginal for maintaining the CRSPs efforts in environmental enhancement and sustainable food production. The world has come to a major juncture in the direction it will take in solving global environment and sustainable agriculture problems. If properly supported, the CRSPs can respond to the tremendously complex challenges of the 21st Century.

That concludes our presentation. Once again, thank you for coming. We will be glad to entertain any questions at this time.