

# Global Research for Sustainable Development

CRSP Council  
1993

- Bean/Cowpea CRSP
- Fisheries Stock  
Assessment CRSP
- Peanut CRSP
- Pond Dynamics/  
Aquaculture CRSP
- Small Ruminant CRSP
- Soil Management CRSP
- Sorghum/Millet CRSP
- Sustainable Agriculture  
and Natural Resource  
Management CRSP

United States Agency  
for International Development

Bureau for Research and Development

Board of International Food and Agricultural  
Development and Economic Cooperation



---

## **Contents**

Preface	4
Introduction	5
Soil Management CRSP	7
Peanut CRSP	13
Sorghum/Millet CRSP	17
Small Ruminant CRSP	21
Bean/Cowpea CRSP	25
Fisheries Stock Assessment CRSP	31
Sustainable Agriculture and Natural Resource Management CRSP	35
Pond Dynamics/Aquaculture CRSP	39

---

*This publication describes the CRSPs' collective strengths and accomplishments in order to encourage the maximum application of our resources to international development challenges.*

## **Preface**

The Collaborative Research Support Programs (CRSPs) were created in response to Title XII of the Foreign Assistance Act legislated in 1975. The main thrust of Title XII was to strengthen the capacities of Land-Grant and other U.S. universities to participate in programs of sustainable agriculture and natural resource management; the programs were to help developing countries produce adequate food, fiber, fuel, and shelter materials.

The United States Congress funds the CRSPs through the Title XII program. Participating U.S. and host-country institutions provide support for the programs as well. The CRSPs are implemented by the U.S. Agency for International Development.

The CRSP model has received widespread commendation and is recognized for its success in developing mutually beneficial collaborative research between U.S. and overseas institutions. The programs have been able to attract the most capable U.S. faculty into collaborative research for development because of the unique scientific challenge, mutual interests, and global benefits derived through this model.

The 1990s are significant for the CRSPs, which are entering their second decade of planned long-term research and developmental services. This publication describes the CRSPs' collective strengths and accomplishments in order to encourage the maximum application of our resources to international development challenges.

We invite you to call on the CRSP Council to collaborate in areas of common interest in our quest for sustainable development.

---

## Introduction

Innovative technologies are an important key to world development. When such technological advances result from collaborative activities between U.S. and developing-country scientists, institutional growth and human resource development also occur.

Collaborative research of this kind is carried out by the Agency for International Development (A.I.D.) in many of the scientific disciplines that contribute to development. The most important efforts are those which improve the sustainability of food production systems in the developing countries with an emphasis on enhancing the quality of life for small-scale crop, animal, and fish farmers and their families. The Agency's Collaborative Research Support Programs (CRSPs) are a long-term, multidisciplinary research and training initiative that capitalizes on the vast U.S. Land-Grant University and College of Agriculture system that works with developing-country research programs. The currently functioning CRSPs are:

- Bean/Cowpea CRSP
- Fisheries Stock Assessment CRSP (FSA CRSP)
- Peanut CRSP
- Pond Dynamics/Aquaculture CRSP (PD/A CRSP)
- Small Ruminant CRSP (SR CRSP)
- Soil Management CRSP (TropSoils)
- Sorghum/Millet CRSP (INTSORMIL)
- Sustainable Agriculture and Natural Resource Management CRSP (SANREM CRSP).

The productive activities of these eight programs directly support A.I.D.'s three-part agricultural goal of helping smallholders in developing countries to improve their incomes, alleviate hunger, and maintain and improve the natural resource base upon which they depend for food, fuel, fiber, and shelter.

The various CRSPs use similar methods to pursue this goal. All of the CRSPs carry out research that leads to the development of ecologically and environmentally sound technologies. The knowledge they disclose and the innovations they devise help developing-country farmers manage their food-producing resources for sustainable agricultural yields. Each CRSP has created collaborative linkages between the U.S. and developing-country research communities; these linkages foster institutional growth and encourage the education and training of scientists and technicians. CRSP

*All of the CRSPs carry out research that leads to the development of ecologically and environmentally sound technologies. The knowledge they disclose and the innovations they devise help developing-country farmers manage their food-producing resources for sustainable agricultural yields.*

*The over 70 Missions and Regional Offices through which A.I.D. directly assists developing countries are vital partners in the generation and distribution of CRSP technologies.*

innovations are being shared with international agricultural research centers, private industry, private voluntary organizations, and other nations beyond the developing countries and regions directly involved in the original research, including the agricultural community in the United States.

The over 70 Missions and Regional Offices through which A.I.D. directly assists developing countries are vital partners in the generation and distribution of these technologies. By means of basic ordering agreements, cooperative agreements, grants, contracts, and other collaborative arrangements, the A.I.D. Missions and Regional Offices involve themselves in the research, technical assistance, and educational activities of the CRSPs. These collaborations enhance the CRSP efforts and provide a broader base from which to share findings and technical expertise.

Through the CRSP Council, the CRSPs have renewed their dedication to providing services and backstopping to A.I.D. Missions, through the Regional Bureaus. The CRSPs are striving to integrate programs that enhance collaborative activities which serve the clientele in developing countries.

The following chapters delineate the Purpose, Program, and Accomplishments of the individual CRSPs. A complete list of each program's participants appears at the end of each chapter, and information on how to reach key individuals is given at the beginning of each chapter.

A.I.D. Missions and Regional Offices are encouraged to continue and to expand their CRSP contacts as they envision, plan, and expand their agricultural programs.

---

# The Soil Management CRSP

## **Purpose**

To improve the management of soil, water, and associated natural resources in ways that enhance the economic, nutritional, and social well-being of people in developing countries; and to integrate sustainable land-management practices and indigenous technologies through research, training, and related activities in order to increase productivity, profits, diversity of outputs, and intergenerational equity.

## **Program**

In general, the Soil Management CRSP works:

- To conduct demand-driven research aimed at increasing the productive capacity of the resource base.
- To integrate social, cultural, and economic information into our analysis of the physical, chemical, and biological constraints to sustainable land management—paying particular attention to the matching of land uses to land characteristics and carrying capacity.
- To collaborate with host-country peers, members of regional and international centers, other CRSPs, PVOs, and private entrepreneurs—thus ensuring that we use information wisely, adapt technologies to the user and the setting, and link programs to active networks. Such collaborations allow us to promote all the components of agroecosystem sustainability: productivity, stability, resiliency, and equitability.
- To provide technical assistance, as requested, on soil- and water-related projects where our research and development programs afford us a comparative advantage.
- To deploy our activities in agroecological regions with representative physical, climatic, and economic constraints, thus increasing the global impact of our program.
- To generate economic and environmental indicators that enable natural-resource planners to simulate and assess the long-term impacts of various technologies.
- To encourage the broadest possible exchange and use of our technologies by holding technical conferences, developing expert systems, publishing research information, and establishing private-sector linkages.

### **Management Entity:**

North Carolina State University

### **Program Director:**

Dr. Roger G. Hanson  
NSCU Box 7113  
209 Daniels Hall  
Raleigh, NC 27695-7113

Phone: (919) 515-3922  
Fax: (919) 515-3942  
CGNET: TropSoils  
BITNET: rghsl@NCSUVM

### **A.I.D. Project Officer:**

Dr. Raymond Meyer  
R&D/AGR/RNR  
Room 408, SA-18  
USAID  
Washington, DC 20523-1809

Phone: (703) 875-4122  
Fax: (703) 875-4186

### **Year of Inception:**

1981

*Research on high-input systems in Peru has shown that yields can be sustained for 43 successive crops (thus far) while also conserving the soil and enhancing fertility. By reducing the need to clear new land, every hectare placed under a sustainable system saves five to ten hectares of tropical rainforest.*

The Soil Management CRSP Global Plan focuses on researchable constraints and problems related to:

- Soil resource assessment and monitoring
- Managing soil biology
- Nutrient dynamics in low-input systems
- Soil organic-matter dynamics
- Solute transport processes
- Wind erosion
- Environmental protection
- Water erosion and sedimentation
- Soil crusting and amelioration
- Soil spatial variability
- Surface charge characteristics
- Soil water management—drought and waterlogging
- Plant-environment-ecology interactions
- Socioeconomic variables
- Private-sector linkages
- Human and institutional resource development

### **Accomplishments**

- Research on high-input systems in Peru has shown that yields can be sustained for 43 successive crops (thus far) while also conserving the soil and enhancing fertility.
- Researchers have developed a low-input system that can extend the slash-and-burn cycle from two or three crops with quickly declining yields to five or six crops with stable yields. Following this cycle with a legume cover crop promises to provide essential weed control, supply nitrogen, and permit further cropping without an extended natural fallow. By reducing the need to clear new land, every hectare placed under a sustainable system saves five to ten hectares of tropical rainforest.
- Research has revealed that liming is essential for high yields and full exploitation of soil water. Even in the humid tropics of Indonesia, drought may be a problem when roots cannot penetrate acid subsoils and the plant is dependent on the small amount of water in the thin topsoil.
- Agroforestry systems and perennial crops have improved soil management and enhanced natural resources in both the humid and semiarid tropics. Tree crops provide mulch and recycle nutrients; they also protect erodible soils in wet areas and conserve moisture in dry areas. Trees can provide food, oil, lumber, and firewood.

- Soil Management CRSP programs have identified readily available plant species that are well suited to low-input sustainable land-management systems.
- Pastures based on acid-tolerant legumes and compatible grasses increase per unit cattle-production area in the humid tropics, thus raising income and food quality while reducing the need to destroy more rainforests.
- A four-year experiment in Mali demonstrated that fertilization combined with various ridged tilling practices can increase sorghum and cowpea grain yields by 157% and 123%, respectively.
- Rapid screening techniques have been developed to test the release pattern of nitrogen-fixing legumes. One legume, mucuna, can fix up to 170 kg of nitrogen per hectare, enough for an excellent corn crop.
- Researchers have identified drought-resistant legumes that can become an important part of savanna cropping systems. Without displacing food or cash crops, such legumes would increase the N in the agricultural system through biological nitrogen fixation. They will also help prevent the progressive land degradation that occurs when neither legumes nor crops stabilize the dry-season landscape.
- Soil acidity and active aluminum have been identified as primary constraints to crop production at Niamey, Niger. Evidence suggests that this is a serious problem throughout the country, as well as in much of the Sahel. New techniques are being devised to assess the extent of the problem and measure the impact on farm and national food production.
- Researchers have developed an acidity decision support system (ADSS) that turns raw information into useful knowledge. Part of a new generation of computer programs called expert systems, ADSS lets extension agents and other technology-adoption personnel solve problems that would previously have required a specialist. Thus, valuable information need no longer be confined to the research site or circumscribed by the movement of a specialist. Expert systems also expose knowledge gaps and guide research priorities in ways that encourage the efficient use of funds: they help us avoid doing what has already been done and rediscovering what we already know.

*Pastures based on acid-tolerant legumes and compatible grasses increase per unit cattle-production area in the humid tropics, thus raising income and food quality while reducing the need to destroy more rainforests.*

*The Soil Management CRSP has trained 63 Ph.D.'s, 42 M.S.'s and 2 B.S.'s. Non-degree formal training has been provided to over 1,500 people, approximately half of whom have been women. Two graduates are now Director Generals of their respective country institutions.*

- The value of mulching has been demonstrated in natural forest reseedling, weed control, and plant nutrient conservation. The return of plant residues can be equivalent to a generous application of fertilizer. In agroforestry systems, nutrients in hedgerow residues can greatly increase the productivity of the primary food crops.
- Soil Management CRSP researchers have helped farmers maximize biological nitrogen fixation inputs, thereby increasing food production and reducing the need for expensive nitrogen fertilizers. Cost-efficient delivery systems have also been developed.
- Through national and regional workshops, on-site instruction programs, and a variety of training publications, the Soil Management CRSP has helped more than 55 countries improve their soil resource inventories, monitor resource degradation and rejuvenation, and apply consistent soil taxonomy criteria.
- Researchers are developing multi-disciplinary analytical methodologies that integrate soil data and agronomic, agroclimatic, and economic data as they relate to the long-term productive capacity of the resource base. Researchers are also clarifying the way that national policies on such variables as land use, agricultural prices, credit, and private enterprise influence soil management and environmental quality.
- The Soil Management CRSP has trained 63 Ph.D.'s, 42 M.S.'s and 2 B.S.'s. Non-degree formal training has been provided to over 1,500 people, approximately half of whom have been women. Two graduates are now Director Generals of their respective country institutions.

### **Soil Management CRSP Resources**

#### ***Collaborating U.S. Institutions***

Cornell University

North Carolina State University

Texas A&M University

University of Hawaii

Nitrogen Fixation by Tropical Agricultural Legumes Project  
(NifTAL/Univ. of Hawaii)

USDA/SCS Soil Management Support Services (SMSS)

USDA/Economic Resource Service

USDA/Agricultural Research Service

***Collaborating Host-Country Institutions***

Ain Shams University, Egypt  
Bureau of Soil and Water Management, Philippines  
Center for Soil and Agroclimate Research, Indonesia  
Department of Irrigation, Sri Lanka  
Forestry and Fuelwood Project, Thailand  
Indian Council for Agricultural Research  
Institut National de Recherches Agronomiques du Niger  
(INRAN), Niger  
Institut d'Economie Rurale (IER), Mali  
Instituto Nacional de Investigación Agraria y Agroindustrial  
(INIAA), Peru  
Instituto Boliviano de Tecnología Agropecuaria (IBTA),  
Bolivia  
Jamaica Agricultural Development Foundation  
Jamaica Agricultural Research Program (JARP)  
Kohn Kaen University, Thailand  
Ministry of Natural Resources, Honduras  
National Research Center, Egypt  
Philippine Council for Agriculture and Resource Research  
and Development  
Thailand Department of Agriculture  
Universidad Nacional, Costa Rica  
University of Costa Rica  
University of Ouagadougou, Burkina Faso

***Collaborating International Institutions***

Asia-Pacific Natural Agriculture Network (APNAN)  
Centro Internacional de la Papa (CIP)  
Centro Internacional de Agricultura Tropical (CIAT)  
Centro Internacional de Mejoramiento de Maíz y Trigo  
(CIMMYT)  
Centro Agricultura Tropical de Investigación y  
Entrenamiento (CATIE)  
Escuela Agrícola Panamericana (EAP)  
Institut National des Sols (INS)  
Institut de Recherches Agronomiques Tropicales (IRAT)  
International Phosphate and Potash Institute (INPOFOS)  
International Fertilizer Development Center (IFDC)  
International Board for Soil Research and Management  
(IBSRAM)  
International Rice Research Institute (IRRI)  
International Crops Research Institute for the Semi-arid  
Tropics (ICRISAT)  
International Centre for Research in Agroforestry (ICRAF)  
International Institute of Tropical Agriculture (IITA)

*The Soil Management  
CRSP has helped  
more than 55  
countries improve  
their soil resource  
inventories, monitor  
resource degradation  
and rejuvenation, and  
apply consistent soil  
taxonomy criteria.*

*The Acidity Decision  
Support System turns  
raw information into  
useful knowledge.*

Peanut CRSP  
Sorghum Millet CRSP (INTSORMIL)  
Tropical Soil Biology and Fertility (TSBF), Kenya

**Networks**

Red de Investigacion en Suelos Tropicales (RISTROP), a tropical soil management research network of scientists from 12 Central and South American countries.

---

# The Peanut CRSP

## **Purpose**

To enhance and coordinate the resources of U.S. and less-developed country institutions in a long-term research program to resolve common constraints on the production and utilization of peanut in an environmentally sound system.

## **Program**

In general, the Peanut CRSP works:

- To develop cultivars, cultural and pest management practices, and utilization processes that would lower costs and stimulate peanut utilization as a primary food resource.
- To support research programs in terms of equipment, supplies, travel, and personnel.
- To offer short-term and degree-oriented training programs for host country staff at U.S. institutions, and degree training for select U.S. students.
- To provide host countries with on-site consultations and research collaboration with U.S. scientists, which, combined with training and program support, improve research capability of host-country scientists and institutions.
- To increase the flow of technological information from the Peanut CRSP to the potential beneficiaries: small-scale farmers, processors, and rural and urban consumers.

The Peanut CRSP research focuses specifically on developing alternatives to low-yield cultivars that lack stress tolerance, ameliorating yield losses due to pests, reducing mycotoxin hazards, overcoming inadequate food supplies, and improving those resource management schemes that prevent efficient production and utilization.

## **Accomplishments**

- The improvement of genetic resources through the incorporation of disease resistance and tolerance to insects and abiotic stresses has led to the development and release of more than 15 improved peanut cultivars and several advanced experimental cultivars for West Africa, Southeast Asia, the Caribbean, and the United States.

### **Management Entity:**

The University of Georgia

### **Program Director:**

Dr. David Cummins  
Peanut CRSP Mgmt. Office  
Georgia Station  
Griffin, Georgia 30223-1797

Phone: (404) 228-7312

Fax: (404) 229-3337

CGNET: 157:AGS634

BITNET: CRSP-GRF

### **A.I.D. Project Officer:**

Dr. Phillip Warren  
R&D/AGR/AP  
Room 420, SA-18  
Department of State  
Washington, DC 20523-1809

Phone: (703): 875-4324

Fax: (703): 875-5344

CGNET: 157:CGI901

### **Year of Inception:**

1982

*More than 15 improved peanut cultivars and several advanced experimental cultivars have been developed for West Africa, Southeast Asia, the Caribbean, and the United States.*

- Good progress is being made in the adoption of biotechnological methods for genetic transformation and regeneration of peanut, which can speed up the development of stress-resistant cultivars. This technology can help to develop cultivars resistant to viruses and aflatoxin, which, to date, has been difficult to attain.

- Integrated pest management strategies to reduce insect damage and to reduce aflatoxin development caused by *Aspergillus* sp. invasion through insect-damaged pods were developed in Burkina Faso. IPM strategies decreased losses to rosette virus in West Africa (Nigeria). IPM strategies for southern corn rootworm control developed in North Carolina can eliminate chemical treatment on 17% of the Virginia-North Carolina peanut production area for a savings of 42 tons of chemicals valued at \$840,000.

- Researchers identified a highly adsorbent clay (Senegal and Texas) that binds and removes aflatoxin from village-processed peanut oil and peanut meal fed to animals (the clay has potential as a food additive). This discovery has incalculable potential to control aflatoxin, a compound reported to have carcinogenic properties.

- Researchers developed a peanut-based cheese-flavored spread in the Philippines and peanut-flour enriched noodles in Thailand, and conducted marketing studies that showed consumer acceptability. Peanut-sorghum flour blends in Africa produce weaning food, bread, and other products acceptable to consumers. Peanut added to traditional cereal foods increases protein and energy content.

- In Burkina Faso, inter-CRSP research between the Peanut and Soil Management CRSPs attributed lower-than-expected yields on certain sites to low soil pH and high soil aluminum content.

- Pilot-programs on farms in the Philippines and Jamaica have demonstrated the superiority of new peanut cultivars and integrated pest management practices.

- The Peanut CRSP sponsored or co-sponsored over 40 workshops to plan research and to disseminate technology.

- The Peanut CRSP has trained over 100 M.S. and Ph.D. graduate students and provided short-term, non-degree

training for about 200 individuals. U.S. scientists annually provide about 200 days of in-country consultations with host-country scientists.

- Research capabilities in the host countries have been strengthened. For example, in Thailand peanut research and development programs have been integrated, an annual planning conference is held, new technologies have been developed and introduced, and peanut scientists from other Southeast Asia countries are being trained in Thailand through workshops and short-term visits.

- In cooperation with ICRISAT, the Peanut CRSP publishes the *International Arachis Newsletter*, which provides an information resource base for peanut scientists worldwide.

### **Peanut CRSP Resources**

#### ***Collaborating U.S. Institutions***

Alabama A&M University  
The University of Georgia  
North Carolina State University  
Texas A&M University

#### ***Collaborating Host-Country Institutions***

Institut Senegalais de Recherches Agricoles (ISRA), Senegal  
Institut de Technologie Alimentaire (ITA), Senegal  
Universite de Ouagadougou Institut Superior Polytechnique,  
Burkina Faso  
Institut National de Recherches Agronomiques du Niger  
(INRAN), Niger  
Institute for Agricultural Research (IAR), Nigeria Ministry of  
Agriculture  
Institut d'Economie Rurale (IER), Mali  
University of the Philippines at Los Banos (UPLB),  
Philippines  
Institute of Plant Breeding (IPB), Philippines  
Philippine Council for Agriculture and Resources Research  
Development (PCARRD), Philippines  
Department of Agriculture (DOA), Thailand  
Kasetsart University (KU), Thailand  
Khon Kaen University (KKU), Thailand  
Caribbean Agricultural Research and Development Institute  
(CARDI), Caribbean  
University of the West Indies, Trinidad, Caribbean  
Food Research Institute, Ghana  
University of Science and Technology, Ghana

*Integrated pest management strategies for southern corn rootworm control developed in North Carolina can eliminate chemical treatment on 17% of the Virginia-North Carolina peanut production area for a savings of 42 tons of chemicals valued at \$840,000.*

*In cooperation with ICRISAT, the Peanut CRSP publishes the International Arachis Newsletter, which provides an information resource base for peanut scientists worldwide.*

**Networks**

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India  
ICRISAT Sahelian Center (ISC), Niger  
Centre de Cooperation Internationale en Recherche Agronomique Pour le Developpement—Departement des Cultures Annuelles (CIRAD-CA)  
Caribbean Agricultural Research and Development Institute (CARDI), Trinidad  
International Development Research Centre (IDRC), Canada  
Australian Centre for International Agricultural Research (ACIAR)  
Conference des Responsables Africains et Francais de la Recherche Agronomique (CORAF), France  
International Service for National Agricultural Research (ISNAR), Netherlands

# Sorghum/Millet CRSP (INTSORMIL)

## **Purpose**

To improve the production, marketing, and utilization of grain sorghum and pearl millet in less-developed countries, and to strengthen the capabilities of LDC institutions to generate, adapt, and apply improved technology to local conditions.

## **Program**

In general, INTSORMIL works:

- To address universal constraints to the production, availability, and improved utilization of sorghum and pearl millet. Environmentally sustainable agroecosystem constraints addressed by the program fall within disciplinary areas of germplasm improvement/conservation, integrated pest management (pathology and entomology), adaptation of plants to stress soils (physiology), ecologically sound production practices, utilization, economics and sociology.
- To improve research capability through collaboration between U.S. and host-country counterparts, through exchange of professional visits between the U.S. and the host country scientists, and by supporting LDC national research programs in terms of equipment, supplies, travel, and personnel.
- To provide both short-term and degree training programs for host-country staff at U.S. institutions. On-site technical assistance and training are provided by U.S. scientists.
- To disseminate the technologies developed by the INTSORMIL program through host-country organizations to the farmer information chain. These technologies can be shared with all A.I.D. missions and countries where sorghum and millet are important food crops.

In order to overcome constraints that continue to thwart the development of sound sorghum and millet systems, environmentally sustainable agroeco production systems are categorized by the CRSP under five global technical thrusts. These thrusts, oriented toward natural resource conservation and development, environmental protection, and sustainable agroeco production systems, are as follows:

### **Management Entity:**

University of Nebraska

### **Program Director:**

Dr. John Yohe  
54 NCCE, Univ. of Nebraska  
Lincoln, Nebraska 68583-0948

Phone: (402) 472-6032  
Fax: (402) 472-7978  
CGNET: 157:CG1025  
TELEX: 438087UN INTPRG

### **A.I.D. Project Officer:**

Dr. Phillip Warren  
R&D/AGR/AP  
Room 420, SA-18  
Department of State  
Washington, DC 20523-1809

Phone: (703): 875-4324  
Fax: (703): 875-5344  
CGNET: 157: CGI901

### **Year of Inception:**

1979

*The hybrid "Hageen Dura I" is now used exclusively in the irrigated areas of the Sudan, where it produces 150% more than traditional varieties. It also is demonstrably superior to varieties traditionally planted in the dryland, rainfed areas of that country. In 1989, 70,000 acres of the new hybrid were grown in Sudan.*

- Germplasm Enhancement & Conservation—9 projects
- Bio-Intensive Plant Protection Systems—6 projects
- Sustainable Production Systems—7 projects
- Crop Utilization and Marketing—2 projects
- Host-Country Program Enhancement—8 countries

#### **Accomplishments**

- Genetic materials from INTSORMIL have made a significant contribution to millet research efforts at ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) and elsewhere in India. A significant portion of the ICRISAT male-sterile breeding project now consists of selections derived from crosses of ICRISAT and INTSORMIL breeding lines. Commercial seed companies in India are using the INTSORMIL/Kansas 2221 line as a female parent in large-scale hybrid seed production.
- INTSORMIL scientists developed the sorghum breeding lines that ICRISAT/UIINDP used in developing the hybrid "Hageen Dura I" in Sudan. This hybrid is now used exclusively in the irrigated areas of the Sudan, where it produces 150% more than traditional varieties. It also is demonstrably superior to varieties traditionally planted in the dryland, rainfed areas of that country. In 1989, 70,000 acres of the new hybrid were grown in Sudan.
- INTSORMIL/Texas A&M Scientists and Honduran collaborating scientists have developed two new sorghum varieties and one new sorghum hybrid for Central America. Forty-seven on-farm trials in 1988 demonstrated that the improved cultivars increased yield over traditional cultivars by 23% to 38% on the steep hillsides of southern Honduras. When seed insecticide treatments and 60 kg/ha nitrogen were applied as inputs, yields were boosted 68% to 113% on farmers' fields. The participating farmers admire the productivity of the new cultivars and plan to continue using this new technology.
- INTSORMIL research in Niger demonstrated that an altered cowpea arrangement increased the light available to cowpea in the millet/cowpea canopy. This altered planting arrangement, which increased cowpea yields by 25% while maintaining millet yields, has been adopted by the Nigerian extension service and is being promoted to farmers.
- Sorghum researchers at INTSORMIL/Purdue University have identified an important striga seed germination stimulant exuded by plant rootlets. Striga is the major biological impediment to yield throughout Africa and Asia. The pro-

cess of identifying sorgoleone leads the way to a step-by-step breakthrough. INTSORMIL biotechnologists are cooperating with plant breeders to:

- devise a way to disrupt the host-parasite interaction,
  - use that knowledge to design a new genetic screening technique that consistently predicts striga resistance,
  - replace time-consuming field trials with the new laboratory method,
  - allow for much wider genetic screening.
- Collaborative research between INTSORMIL scientists and Food Research Center scientists in Sudan has yielded the technology for making bread from 20% sorghum/80% wheat composite flour. Effective January 1, 1990, the Government of Sudan issued a policy directive which requires all millers and bakers in Sudan to make and use composite flour for bread. This technology will create new internal markets for sorghum and ease foreign-exchange losses from wheat imports.
- The process of implementing collaborative research with host country institutions has annually increased and improved the cadre of LDC scientists and technicians available to conduct research on these two priority crops. As of mid-1992, the CRSP had trained 142 non-U.S. and 90 U.S. students with A.I.D. grant funds, and another 363 non-U.S. and 141 U.S. students received training in INTSORMIL projects with funds from other sources. Since the CRSP's inception, 736 students have been trained under its auspices including 318 Ph.D.'s., 292 M.S.'s., and 38 B.S.'s., along with 49 short-term and 39 post-doctoral scholar/visiting scientist recipients.
- Three of the LDC sites where INTSORMIL collaborates now have the technical capability to implement full multi-disciplinary research programs to improve the production and utilization of sorghum and millet. The result of these commitments is a network of strong collaborative linkages that has long-term potential for solving agricultural development problems involving sorghum and millet in each of the regions where INTSORMIL is involved.
- Headbugs, tiny sucking insects that feed on the developing grain, have blocked the introduction of high-yielding, food-quality cultivars. Headbugs pierce the sorghum kernel, sucking away the juices and often laying eggs in the outer endosperm layer of the seed. Host-country and U.S. plant

*Collaborative research in the Sudan has yielded a bread-making technology that will create new internal markets for sorghum and ease foreign-exchange losses from wheat imports.*

*Three of the LDC sites where INTSORMIL collaborates now have the technical capability to implement full multi-disciplinary research programs to improve the production and utilization of sorghum and millet.*

breeders, entomologists, and food scientists have cooperated to develop new methods to screen for headbug resistance and evaluate crop damage. These researchers have discovered a direct relationship between headbug resistance and resistance to mold damage. Innovations like this will speed the progress toward new income-generating opportunities for small LDC farmers. Malian scientists have developed Malisor 84-7, which combines kernel hardness, favorable seed color, processing ease and nutritional value. Headbug damage is localized to the area the insect pierces, whereas in more susceptible varieties, the entire kernel is open to molds and fungal damage.

### **INTSORMIL CRSP Resources**

#### ***Collaborating U.S. Institutions***

Kansas State University  
University of Kentucky  
Mississippi State University  
University of Nebraska  
Purdue University  
Texas A&M University

#### ***Collaborating Host-Country Institutions***

Department of Agricultural Research (DAR), Botswana  
Instituto Colombiano Agropecuario (ICA), Colombia  
Ministerio de Recursos Naturales (MRN), Honduras  
Institut Economie Rurale (IER), Mali  
Institut National de Recherches Agronomiques du Niger (INRAN), Niger  
Agriculture Research Corporation (ARC), Sudan  
Institut Senegalais de Recherches Agricoles, (ISRA), Senegal  
Institut de Technologie Alimentaire (ITA), Senegal  
Kenya Agricultural Research Institute (KARI), Kenya  
Agricultural Research Center (ARC), Egypt

#### ***Networks***

Consejo Latin Americana de Investigadores in Sorgho (CLAIS)  
SAFGRAD/East Africa  
SAFGRAD/West Africa  
SADCC/ICRISAT, Southern Africa  
EARSOM/ICRISAT, East Africa

---

# The Small Ruminant CRSP

## **Purpose**

To improve meat, milk, and fiber production from sheep and goats, and more recently from alpacas.

## **Program**

In general, the Small Ruminant CRSP works:

- To broaden the genetic base and gene pool available for improving small ruminant species.
- To develop reliable, economical vaccines with which farmers can control the most constraining small ruminant diseases.
- To apply biotechnology to animal health management systems.
- To develop more productive mixed-farming systems, especially those combining ruminants and tree crops.
- To develop sustainable agropastoral systems for marginal lands.
- To document and analyze the roles played by women and men in small ruminant production in order to ensure that research results are relevant and applicable, particularly to women.
- To increase the incomes and food supplies of subsistence-level small ruminant producers.
- To strengthen the research capacity of overseas and U.S. agricultural institutions through collaboration and training.

## **Accomplishments**

- In Kenya, the CRSP developed a composite breed dual-purpose goat (DPG) for milk and meat production in higher potential farming areas. While another three years are needed to "set" the breed genetically, the work has successfully combined into a single stock two locally adapted meat breeds and two imported dairy breeds. The introduction of dual-purpose goats and of improved forage production practices has resulted in a 66% increase in food yield from goats for smallholder families. Raising DPGs on marginal land generates an annual average of U.S. \$52 additional income

### **Management Entity:**

University of California, Davis

### **Program Director:**

Dr. John S. Glenn  
Small Ruminant CRSP  
University of California  
Davis, California 95616-8700

Phone: (916) 752-1721

Fax: (916) 752-7523

E-Mail: SRCRSP@UCDAVIS.EDU

### **A.I.D. Project Officer:**

Ms. Joyce Turk  
R&D/AGR  
4th floor SA-18  
USAID  
Washington, DC 20523-1809

Phone: (703) 875-4081

Fax: (703) 875-5344

### **Year of Inception:**

1978

*The introduction of dual-purpose goats and of improved forage production practices has resulted in a 66% increase in food yield from goats for smallholder families.*

per hectare. If only about 10% of the humid and subhumid area in Kenya was available for food crops and fallow, the potential annual benefits to farmers would amount to \$2.5 million.

- In Indonesia, the CRSP developed a highly prolific strain of Javanese Thin Tail sheep. This strain yields an average of 2.8 lambs per litter, nearly double the usual litter size in West Java. The producers of 3 million sheep in this province will annually gain 1.5 million sheep and \$18 million in revenue.

- In Morocco, the CRSP found that the D'Man breed of sheep readily transmits its high prolificacy. It is thus possible to use these local genetic resources to increase prolificacy in Moroccan sheep as needed to suit different management and feeding systems. If just 10% of Morocco's 10 million ewes are replaced with D'Man crosses, producers would earn an estimated \$5 million in additional income per year.

- In Kenya, the CRSP developed a new vaccine against contagious caprine pleuropneumonia (CCPP). This epidemic disease affects at least 48 million goats in Africa and Asia and, if untreated, has a mortality rate greater than 80%. The vaccine is safe, easily stored, economical to produce, and highly efficacious. When this vaccine is widely available, it will prevent an average of 82 annual local outbreaks involving an estimated 300,000 goats in Kenya alone.

- On Peruvian highland ranges, the CRSP documented the competitive and interactive grazing behavior of sheep, llamas, and alpacas. Llamas and sheep can be grazed together. Alpacas have the most opportunistic feeding strategy, compete directly with other grazing animals when range conditions vary, and are best managed alone.

- The CRSP verified that rural women in many countries play significant and often primary roles in the care, feeding, and management of small ruminants as well as in making major consumption and distribution decisions.

- In Indonesia, the CRSP developed a successful pilot network in which 100 smallholder farmers are following recommended methods for improved hair sheep production. The demand is already so great for SR-CRSP improved hair sheep that not enough sheep can be produced for the farmers who want them at the present.

- Many of the program's substantive results have been documented in more than 2,400 technical reports, journal articles, books, and abstracts, and in 210 verbal presentations. Many of these have been translated into the principal language of the host country. A summary of this documentation is available from the office of the Management Entity, the University of California, Davis.
- In 1986, the CRSP co-hosted a world conference on sheep genetics and reproduction and published a new, comprehensive reference book, *Genetics of Reproduction in Sheep*, with contributions from 50 scientists from 17 countries.
- The CRSP developed and validated computer simulation models for small ruminants that can have wide application in the United States and abroad. Social scientists also have designed a model for communicating SR-CRSP project results.
- More than 300 individuals from 28 countries have completed university training in fields related to small ruminant research, about 20% being women. More than 1,000 host country participants attended more than 20 short-term training programs.
- SR-CRSP scientists have moved into major research, education, or government positions (e.g., an SR-CRSP trained scientist working in Peru was appointed Dean of Veterinary Science at the National Veterinary Institute).

### **Small Ruminant CRSP Resources**

#### ***Collaborating U.S. Institutions***

University of California, Davis  
Colorado State University  
University of Missouri  
North Carolina State University  
Texas A&M University  
Texas Tech University  
Utah State University  
University of Wisconsin, Madison  
Washington State University  
Winrock International Institute for Agricultural  
Development

#### ***Collaborating Overseas Institutions***

Agency for Agricultural Research and Development  
(AARD), Indonesia  
Kenya Agricultural Research Institute (KARI), Kenya

*In Kenya, the CRSP developed a new vaccine against contagious caprine pleuropneumonia (CCPP). This epidemic disease affects at least 48 million goats in Africa and Asia and, if untreated, has a mortality rate greater than 80%.*

*If just 10% of Morocco's 10 million ewes are replaced with D'Man crosses, producers would earn an estimated \$5 million in additional income per year.*

Institut Agronomique et Vétérinaire (IAV), Hassan II University, Morocco

Instituto Boliviano de Tecnología Agropecuaria (IBTA) Bolivia

### **Networks**

#### *Asia*

The Indonesian Small Ruminant Network, established in 1988, participates in a Small Ruminant Production Systems Network for Asia initiated in 1980.

#### *Latin America*

The Andean Small Ruminant Network was formed in 1990 with La Paz, Bolivia, as the headquarters.

#### *Africa*

Preliminary discussions have taken place with respect to SR-CRSP participation in a small ruminant network with leadership coming from the International Livestock Center for Africa (ILCA).

---

# Bean/Cowpea CRSP

## **Purpose**

To overcome constraints to the production, distribution, storage, utilization, and marketing of bean and cowpeas, important sources of dietary protein.

## **Program**

In general, the Bean/Cowpea CRSP works:

- To identify, maintain, and improve available bean and cowpea germplasm.
- To employ human and physical resources across institutions and ecological zones to solve common problems associated with bean and cowpea availability.
- To integrate traditional resources with biotechnology in ways that are mutually reinforcing.
- To support and encourage multidisciplinary investigations.
- To sponsor integrated research and training in which U.S. and non-U.S. students work together to solve research problems.
- To focus on the needs of small-scale farmers, especially women.

This CRSP particularly addresses limitations caused by insects and diseases, and plant response to stress such as environmental extremes, e.g., heat and drought. CRSP researchers also study constraints that result from particular farming systems, socio-cultural factors, and the economics of the production-to-consumption cycle, as well as problems related to food storage and preparation, nutrition, and health regimens commonly practiced. The education, training, and research resources of the countries and regions are assessed to determine how they might be strengthened.

With a major concern for sustainability, research in traditional settings is emphasized, as is the integration of basic (especially biotechnology) and applied research to promote more rapid and appropriate response to critical agricultural problems. The research designers demonstrate particular sensitivity to the needs of small-scale farmers, especially women, who produce and handle the crops. The CRSP

### **Management Entity:**

Michigan State University

### **Program Director:**

Dr. Pat Barnes McConnell  
200 International Center  
Michigan State University  
East Lansing, Michigan 48824

Phone: (517) 355-4693

Fax: (517) 336-1073

TELEX: 263359 CRSP UR

### **A.I.D. Project Officer:**

Dr. Harvey Hortik  
AID/R&D/AGR/AP  
4th floor SA-18  
Washington, DC 20523-0219

Phone: (703) 875-4304

Fax: (703) 875-5344

CGNET: 157: CGI901

### **Year of Inception:**

1980

*Exposing cowpeas to temperatures around 57°C for one hour, or 65° for a few minutes, killed the cowpea weevil larvae and pupal in the seed as well as adults living among the seeds. A newly designed solar heater will thus have a dramatic impact on low-resource farmers. In West Africa alone, cowpea weevil losses are estimated at \$50 million/year.*

coordinates its work with other international research programs that have mutual interests and other countries that have common needs.

#### **Bean Projects and Collaborators**

- Disease Management Strategies and Adaptation of Dry Beans, with emphasis on Lowland Tropics—Dominican Republic
- Molecular Approaches for the Control of Bean-Infecting Geminiviruses and other Viruses—Caribbean Basin
- Improving the Symbiotic Nitrogen Fixation of Cultivars of *Phaseolus vulgaris* under Low-Resource Conditions—Ecuador
- Development and Implementation of Strategies for Breeding Beans with Enhanced Disease Resistance and Greater Tolerance to Heat, Drought, and Stress—Honduras
- Bean Improvement, Genetic Diversity and Host/Pathogen Co-Adaptation—Malawi
- Breeding Beans for Yield and Adaptation under Drought—Mexico
- Improvement of Digestibility and Nutritional Quality of Common Bean through Traditional Plant Breeding, Molecular Biology, Genetics and Food Technology—Costa Rica
- A Participatory Research Approach to Breeding and Evaluating High-Yielding Disease- and Insect-Resistant Beans for Low-Input Sustainable Farming Systems in which Women Are Major Contributors—Tanzania

#### **Cowpea Projects and Collaborators**

- Integrated Pest Management for Cowpea in Sub-Saharan West Africa—Ghana
- Preservation of Post-Harvest Cowpeas by Low-Resource Farmers—Cameroon
- Research Strategies to Increase the Utilization of Cowpea—Ghana
- Development of Improved Cowpea Varieties, Management Methods, and Storage Practices for Semi-arid Regions—Senegal

In keeping with the CRSP's emphasis on multi-disciplinary research, efforts are expanding to increase contributions from non-production fields such as agricultural economics, socio-cultural perspectives, and food science.

Both short-term and degree training offered by the program involve the participation of CRSP personnel and make available all relevant biological, social, and food science disciplines. To date, 211 graduate degrees have been earned through the CRSP and nearly 1,000 scientists have participated in short-term training in such areas as computer technology, on-farm testing, research management, and pest control. MSTAT, a computer program for agricultural research, has attracted particular worldwide interest.

The CRSP's substantial investments in host country equipment, facilities, and long- and short-term training of personnel have been cited by host country administrators as especially important contributions to their research programs.

### Accomplishments

- An economic impact study was conducted on the Senegal CRSP project (University of California-Riverside) covering the period 1985-87. Emphasis was placed on the impact to farming practices and production in Senegal as well as the training of research scientists. The rate of return analysis of this project was 63%. The major impacts of this CRSP project were:

- General increased cowpea yields and yield stability for Senegalese farmers.
- Preservation and enhancement of Senegalese cowpea germplasm.
- Improvement in household food security in Senegal.
- Strengthened Senegalese cowpea research capacity and increased international linkages.

- The Cameroon/Purdue project found that exposing cowpeas to temperatures around 57°C for one hour, or 65° for a few minutes, killed the cowpea weevil larvae and pupal in the seed as well as adults living among the seeds. A solar heater was designed which was cheap and easy to build. This new solar disinfestation of cowpea stocks will have a dramatic impact on low-resource farmers in developing countries. In West Africa alone, cowpea weevil losses are estimated at \$50 million/year. This technology is also adaptable to beans as well as other crops with insect storage problems.

- Women in Development (WID) has played an important role in our program achievements. Women in Agriculture

*Diverse bean and cowpea germplasm has been collected and is serving as a source of material for plant improvement programs in developing countries and the United States.*

*Cowpea production in Senegal was increased four-fold in 1985 and 1986. This unusually abundant harvest fed over a million people affected by a multi-year drought. It generated an average yearly gross-value increase of about \$35 million.*

Resource Guides have been produced for Cameroon, Guatemala, and Botswana and distributed widely to libraries, research programs and educational institutions. In addition, an annotated bibliography on Malawi was produced.

- California Blackeye #5 seed (CB5) increased cowpea production in Senegal four-fold in 1985 and 1986. This unusually abundant harvest fed over a million people affected by a multi-year drought. It generated an average yearly gross-value increase of about \$35 million.
- Four causal agents of bean golden mosaic virus (BGMV) have been cloned and three have been totally sequenced. In cooperation with private industry, foreign DNA have been blasted into beans with a particle gun. For the very first time, transformed bean plants have been produced. Bean landraces from the Dominican Republic identified to have BGMV resistance are expected to provide the resistant genes for this new technology.
- Diverse bean and cowpea germplasm has been collected and is serving as a source of material for plant improvement programs in developing countries and the United States.
- Bean varieties that fix up to 60 kilograms of nitrogen/ha have been identified and are being used by farmers and plant breeders. Already effective in Wisconsin, these varieties are reducing the need for applied nitrogen fertilizer, thus helping prevent nitrate water pollution and reducing costs.
- Bean and cowpea lines identified to have drought and heat tolerance are strengthening production in semi-arid areas of developing countries. The bean selections also are being used by U.S. bean growers whose productivity is increasingly affected by climatological changes (e.g., the "greenhouse effect").
- Strains of microbes pathogenic to cowpea insects have been isolated and are now available to the scientific community for biological insect control. Preliminary tests in Illinois and New York show that several insects can be controlled by this method which will reduce the use of toxic and costly insecticides.
- Bean cultivars have been identified showing resistance to bean fly, a major problem in Africa and Asia. This genetic material is being used by breeders.

- Selections have been made from a wild species of cowpea which has resistance to storage insects. In addition, simple solar heating and double-bagging technology is dramatically reducing insect losses during storage.
- New multiple-disease-resistant bean varieties have been developed and released to farmers and breeding programs. Bean lines combining resistance to common blight, rust, white mold, and bean common mosaic virus along with improved architecture and seed quality have been developed. These varieties reduce the need for farmers to use environmentally hazardous pesticides and fungicides.
- Development and use of bean common mosaic virus antisera and serodetection protocols have reduced the risk of transmitting viral diseases in imported beans and have enabled farmers to plant disease-free seed.
- Information gathered on farming systems in developing countries provides a firm basis for the introduction of new or improved sustainable agricultural technologies and methods.
- In 1988, bean harvest in Tanzania was up 70% from the previous year as a result of higher bean prices encouraged by CRSP socioeconomic research, increased rain, release by CRSP researchers of NITROSUA—a newly developed dry inoculant for biological nitrogen fixation—and CRSP collaboration with the CIAT/SADCC variety improvement team.

### **Bean/Cowpea CRSP Resources:**

#### ***Collaborating U.S. Institutions***

Auburn University  
Clemson University  
Michigan State University  
Purdue University  
University of California-Davis  
University of California-Riverside  
University of Georgia  
University of Idaho  
University of Minnesota  
University of Nebraska-Lincoln  
University of Puerto Rico  
University of Wisconsin  
Washington State University

*Bean and cowpea lines identified to have drought and heat tolerance are strengthening production in semi-arid areas of developing countries. The bean selections also are being used by U.S. bean growers, whose productivity is increasingly affected by climatological changes.*

*Strains of microbes pathogenic to cowpea insects have been isolated and are now available to the scientific community for biological insect control studies.*

**Overseas Collaborating Institutions**

Bunda College of Agriculture, Malawi  
Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias (INIFAP), Mexico  
Institut de Recherche Agronomique au Cameroon (IRA), Cameroon  
Institut Senegalais de Recherches Agricoles (ISRA), Senegal  
Instituto Nacional de Investigaciones Agropecuarias (INIAP), Ecuador  
Secretaria de Estado de Agricultura (SEA), Dominican Republic  
University of Costa Rica, Costa Rica  
University of Ghana-Legon, Ghana  
Sokoine University of Agriculture (SUA), Tanzania  
Crops Research Institute, Ghana  
Escuela Agrícola Panamericana (EAP), Honduras

---

# Fisheries Stock Assessment (FSA) CRSP

## **Purpose**

To promote the sustainability of small-scale multispecies tropical marine capture fisheries through development of new methodologies for stock assessment and management.

The FSA CRSP's final product will be a Stock Assessment Manual for fisheries managers in the developing countries. Associated microcomputer software will explain specific models, methods, techniques, and approaches to stock assessment and management of small-scale multispecies tropical marine capture fisheries.

Law of the Sea ratification by most nations gives them jurisdiction over living marine resources within 200 miles of their coasts. Development of methods for accurate assessment of fish stocks in these so-called Exclusive Economic Zones (EEZ) is extremely important, especially for the developing countries, which typically exhibit a tropical multispecies condition addressed only by this CRSP.

## **Program**

In general, the FSA-CRSP addresses:

- Population dynamics of multispecies fish stocks.
- Stochastic properties of tropical fisheries.
- Relationships among yield, fishing effort, species composition, and stability of multispecies fisheries.
- Appropriate sampling designs for small-scale fisheries.
- Aging of tropical fish.
- Age and size relationships of tropical fish.
- Hydroacoustic techniques for estimating fish abundance in shallow-water estuaries.
- Tropical fish reproduction and recruitment, particularly in mangrove and coral reef areas.
- Assessing biological productivity of coral reef fishery systems.
- Decision support systems for managing small-scale multispecies tropical fisheries.

**Management Entity:**  
University of Maryland

**Program Director:**  
Dr. Daniel Gustafson  
Office of International Programs  
1114 Symons Hall  
University of Maryland  
College Park, MD 20742

Phone: (301) 405-7778  
Fax: (301) 314-9692  
TELEX: 88-7294 COMM UNUD

**A.I.D. Project Officer:**  
Dr. Lamar Trott  
S&T/AGR  
4th floor SA-18  
USAID  
Washington, DC 20523-1809

Phone: (703) 875-4098  
Fax: (703) 875-4186  
CGNET: 157: CGI901

**Year of Inception:**  
1985

*Development of methods for accurate assessment of fish stocks in the so-called Exclusive Economic Zones (EEZ) is extremely important, especially for the developing countries, which typically exhibit a tropical multispecies condition addressed only by this CRSP.*

CRSP researchers are:

- Applying artificial intelligence, expert systems, and decision support systems to the study of population dynamics and management of multispecies tropical fisheries.
- Developing, testing, and validating modifications and extensions of standard fisheries models to account for the multispecies nature of tropical fisheries, the stochastic properties of these fisheries, and the relation of species composition to the economic value of the fish catch.
- Developing new sampling designs and field monitoring programs that take into account the realities of artisanal fisheries in order to provide local scientists and managers with catch and effort data needed for fisheries management.
- Developing and validating a general framework and methodology for understanding and predicting the abundance and growth of selected fish and invertebrate species in tropical environments.
- Developing methods of determining the age of tropical fish species and constructing age-size keys to draw inferences about recruitment, growth, and mortality.
- Developing hydroacoustic techniques for rapidly assessing the population size of fish stocks in shallow-water multispecies environments through field studies.
- Developing ways to obtain more and better management information from existing data; and constructing multispecies stock assessment models among yield, fishing effort, species composition, and stability data.
- Using visual, trap, and shoreline sampling techniques to assess the composition and variability of fish communities to monitor and assess recruitment dynamics through field experiments, and to estimate the productivity in reef and shoreline fisheries.

The relatively new field of fishery science involves scientists from a variety of fields including marine biologists, statisticians, oceanographers, ecologists, limnologists, economists, and others. Host-country researchers are intimately involved in developing the new methodologies and techniques for small-scale multispecies tropical fisheries stock assessment and management.

FSA CRSP investments in host-country equipment and facilities have been substantial. Personnel from the Department of Fisheries in Costa Rica and from the Bureau for Fisheries and Aquatic Resources in the Philippines are actively involved in the research projects, facilitating direct transfer of new methodologies and techniques, as well as data analysis, to host-country governmental institutions responsible for fishery management. Through FSA CRSP efforts a regional fish aging laboratory is being established in Costa Rica, and the FSA CRSP has made substantial contributions to the establishment of an extensive marine research laboratory in the Philippines.

Annual, short-term training workshops on specific techniques are being conducted in Costa Rica and the Philippines. Two lengthy regional workshops—one each in the Philippines and Costa Rica—on new methods of stock assessment and management of small-scale multispecies tropical fisheries are being planned for the spring of 1993.

#### **Accomplishments**

- Developed the first stage of an expert system for analyzing fishery data, predicting future harvests, and providing advice to fishery managers on optimal management strategies.
- Extended standard fishery models to give advice to fishery managers even when fishery data and information are limited.
- Developed new and innovative statistical methods for stock assessment sampling in small-scale fisheries.
- Developed improved length-based stock assessment analyses.
- Advanced the techniques for aging tropical fish.
- Demonstrated new techniques using hydroacoustics for fish detection in shallow waters.
- Developed methods of predicting changes in multispecies fish assemblages.
- Developed new techniques for studying fish community structures.
- Initiated the most extensive coral reef fishery productivity and ecological studies ever attempted.

*The FSA CRSP has extended standard fishery models to give advice to fishery managers even when fishery data and information are limited.*

*The FSA CRSP's final product will be a Stock Assessment Manual for fisheries managers in the developing countries.*

- Conducted numerous short-term training workshops in the Philippines and Costa Rica on various aspects of the developing research.
- Conducted two regional workshops in the Philippines on the management of tropical fisheries. Eight countries participated.
- Conducted a two-week workshop in Costa Rica on new methods of aging tropical fish.
- FSA CRSP collaborators have conducted several semester-long courses at the University of the Philippines on community structure analysis and fishery models.

**FSA-CRSP Resources**

***Collaborating U.S. Institutions***

University of Maryland—Center for Environmental and Estuarine Studies  
University of Rhode Island  
University of Washington  
University of Miami  
University of Delaware

***Collaborating Overseas Institutions***

University of Costa Rica-Centro de Investigacion en Ciencias del Mar y Limnologia  
University of the Philippines-Marine Science Institute  
University of the Philippines in the Visayas-College of Fisheries  
International Center for Living Aquatic Resources Management (ICLARM)  
Research Institute for Marine Fisheries, Indonesia  
Department of Fisheries, Thailand

***Networks***

AID/Association of Southeast Asian Nations (AID/ASEAN)  
Coastal Resources Management Project  
Argentine National Council for Scientific and Technical Research  
Costa Rican Department of Fisheries  
Los Angeles County Library  
National Marine Fisheries Service  
Philippines Bureau for Fisheries and Aquatic Resources  
Smithsonian Institute  
Tinker Foundation  
United Nations Food and Agriculture Organization (FAO)

---

# Sustainable Agriculture and Natural Resource Management CRSP (SANREM)

## **Purpose**

To implement a comprehensive, farmer-participatory, interdisciplinary research, training, and information exchange program that will elucidate and establish the principles of sustainable agriculture and natural resource management on a landscape scale in the tropics.

## **Program**

In general, the SANREM CRSP works:

- To identify and describe the problems relating to sustainability using farmers' and other end-users' goals and perspectives.
- To identify and collate existing biophysical and socioeconomic baseline data at each site, including relevant indigenous knowledge, and determine the need for additional baseline data collection.
- To collect and integrate additional physical, biological, and socioeconomic baseline data.
- To recognize and understand the cultural, socioeconomic, political, and institutional framework.
- To improve understanding of important ecosystem processes and critical ecosystem linkages in a landscape setting.
- To identify quantifiable "indicators of sustainability," measurable parameters that will indicate improvements in sustainability.
- To develop and evaluate viable management strategies for achieving sustainability in agricultural and natural ecosystems.
- To promote education, training, and information exchange in sustainability issues.
- To determine ways to influence decision-making processes.

## **Management Entity:**

University of Georgia

## **Program Director:**

Dr. William L. Hargrove  
Georgia Station  
1109 Experiment Street  
Griffin, GA 30223-1797

Phone: (404) 229-3338

Fax: (404) 229-3337

E-Mail: SANREM@Griffin.uga.edu

## **A.I.D. Project Officer:**

Dr. Jim Bonner  
R&D/AGR  
Room 403D, SA-18  
Agency for International  
Development  
Washington, DC 20523-1809

Phone: (703) 875-4337

Fax: (703) 875-4384

## **Year of Inception:**

August 1, 1992

*The SANREM CRSP seeks to implement a comprehensive, farmer-participatory, interdisciplinary research, training, and information exchange program that will elucidate and establish the principles of sustainable agriculture and natural resource management on a landscape scale in the tropics.*

The SANREM CRSP offers a new paradigm in international research and development activities. Key ingredients—including the landscape, putting people first, and emphasizing interdisciplinarity and inter-institutionality—make the Landscape Approach to Sustainability in the Tropics (LAST) model one that holds much promise for reaching environmental, social, and economic goals that will lead to sustainability. The nucleus of this activity is the user and the associated constraints to sustainability. The task of sustainability requires that individuals from a wide range of cultural, economic, political, educational, and disciplinary backgrounds work closely together to determine and promote practical solutions to the interwoven constraints of a landscape/lifescape.

The first implementation sites for LAST are the Philippines and Burkina Faso. The design phase for a third country site in Ecuador is under way and preliminary discussions have taken place with Honduras and Morocco. All sites have several characteristics that make them of keen interest in studying sustainable agriculture and natural resource management in a landscape setting. These include: 1) reserves of plant genetic diversity; 2) centers of both cultural and biological diversity; 3) high rates of soil loss and sedimentation; 4) significant downstream impacts; 5) zones of human migration; and 6) significant forest resources.

#### **Accomplishments**

- Established Cross-Cutting Working Groups in the areas of
  - Geographical Information Systems, Data Management and Modeling
  - Education/Training
  - Indicators of Sustainability
  - User/Gender Issues

to ensure congruity and efficacy between site activities located in various regions within the tropics.

- Established a specialized SANREM CRSP Training Program entitled Innovative Approaches to Sustainability. This effort has trained 42 individuals on the topics of Community Goal Setting, Landscape Ecology, Farmer Participatory Methodologies, Gender, Class, and Ethnicity Sensitivity and Analysis, Synthesis of Biophysical Data and Project Guidelines. This training program will continue for the duration of the CRSP for all collaborators.

• Completed Reconnaissance Activities and a Participatory Landscape/Lifescape Appraisal to identify research needs in the Manupali Watershed on Mindanao in the Philippines. This activity was followed by a participatory workshop of over 100 individuals representing government organizations, non-government organizations, international research centers, local government units, international voluntary organizations, farmer groups, tribal councils, and national and U.S. universities. The resulting documentation, a Participatory Landscape/Lifescape Appraisal and the Philippine SANREM CRSP Work Plan, will serve as the basis for research design and the project platform for the entire life of the project in the Philippines.

### **SANREM CRSP Resources**

The SANREM CRSP consortium members include the following institutions as well as many site-local non-government organizations, local government units, farmer groups, user groups, and tribal councils.

#### ***Collaborating U.S. Universities***

Auburn University  
Colorado State University  
University of Georgia  
Tuskegee University  
Virginia Polytechnic Institute and University  
Washington State University  
University of Wisconsin  
Center for PVO/University Collaboration in Development  
U.S. Department of Agriculture—Agricultural Research Service  
U.S. Geological Survey

#### ***Collaborating International Private Voluntary Organizations***

Heifer Project International (all sites)  
Christian Children's Fund (Philippines)  
Save the Children (Burkina Faso)

#### ***Collaborating International Research Centers***

Asian Vegetable Research and Development Center  
Centro Internacional de Mejoramiento de Maiz y Trigo  
Centro Internacional Potato (UPWARD)  
International Center for Research in Agroforestry  
International Crops Research Institute for the Semi-Arid Tropics  
International Rice Research Institute

*Sustainability requires that individuals from a wide range of cultural, economic, political, educational, and disciplinary backgrounds work closely together to determine and promote practical solutions to the interwoven constraints of a landscape/lifescape.*

*The SANREM CRSP offers a new paradigm in international research and development activities. The nucleus of this activity is the user and the associated constraints to sustainability.*

***Collaborating Host-Country Institutions***

*Southeast Asia*

University of the Philippines at Los Banos  
Central Mindanao University  
Department of Agriculture  
Department of Environment and Natural Resources  
National Power Company

*Central America*

Escuela Agricola Panamericana  
Ministry of Natural Resources

*West Africa*

University of Ouagadougou  
Institute National Etude de Recherche d'Agricole  
Institute Recherche Biologie Ecologie Tropical

---

# Pond Dynamics/Aquaculture CRSP

## **Purpose**

To define the principles underlying sound aquaculture management and improve practices that will provide increased employment and a dependable, inexpensive source of animal protein.

## **Program**

The Pond Dynamics/Aquaculture CRSP bases its work on a global concept and carries out the same experimental protocol at each site. The information thus obtained is compiled at Oregon State University into the world's largest standardized database on tropical aquaculture, which is used to develop aquaculture "expert systems." In each host country, U.S. researchers are also involved in activities other than the global experiment, including site-specific research.

### *General areas of related activity:*

- Multidisciplinary research
- Institution building and curriculum development
- Dissemination of information
- Creation and maintenance of sustainable aquacultural systems
- Women in development
- Natural resource management
- Socioeconomic analyses

### *Specific endeavors:*

- Aquaculture research is by nature multi-disciplinary. Experts in resource economics, limnology, aquatic ecology fisheries, computer science, fish culture, agricultural engineering, statistics, and genetics work with the PD/A CRSP, creating a wide network of professional linkages with many diverse national and international groups.
- The CRSP builds on existing host-country infrastructure to strengthen the capacity of host-country institutions to support aquaculture research. U.S. researchers in host countries arrange university training, mainly through networking with other programs, and provide on-the-job training of junior scientists and technicians. In addition, they teach short

### **Management Entity:**

Oregon State University

### **Program Director:**

Hillary Eгна  
Snell Hall 400  
Oregon State University  
Corvallis, Oregon 97331-1641

Phone: (503) 737-6415

Fax: (503) 737-3447

E-Mail: mcnamarm@ccmail.  
orst.edu

### **A.I.D. Project Officer:**

Lamarr Trott  
R&D/AGR  
Room 406E, SA-18  
USAID  
Washington, DC 20523-1809

Phone: (703) 875-4098

Fax: (703) 875-4186

### **Year of Inception:**

1982

*Tilapia harvest from CRSP ponds in both Indonesia and Thailand have reached levels that previously were attainable only with expensive supplemental feed.*

courses, advise students, work with extension agents, Peace Corps volunteers, and farmer-researchers.

- The CRSP publishes a wide array of information on its research activities and distributes these materials to over 500 people in the United States and overseas. CRSP publications are included in the USDA National Agricultural Library's CD-ROM data base, further increasing the accessibility of CRSP research. In addition, data from the CRSP Central Data Base have been provided for inclusion in the National Agricultural Library computer network. CRSP researchers create and nurture professional contacts with scientists in many developing countries through scientific conferences and workshops.

- Fish farming is an effective and sustainable way for women to earn income and produce household food. The CRSP actively supports efforts to develop women-owned and women-operated fish ponds. Women benefit from CRSP training in pond management strategies using low-cost agricultural waste to enhance productivity, helping to increase family income and improve household nutrition. Women from eleven countries have been involved in CRSP-related training or other educational activities since the inception of the program, and account for more than 25% of all training that has occurred because of the CRSP's existence.

- By studying highly eutrophic (highly productive and in some cases polluted) ponds, CRSP researchers have gained a better understanding of complex aquatic environments. Experiments on the use of locally available inputs (such as composts and green grass) help researchers offer sound advice on safer, sustainable management of pond systems, and by extension, aquatic systems. In every country where the CRSP works, it has opportunities to advise on ecologically sound sites for aquaculture development to prevent the further loss of fragile or sensitive environments.

- CRSP experiments in Honduras address water quality issues, which are of concern not only during the production cycle, but also as effluents leave ponds and are returned to the larger ecosystem. Experiments continue in both Honduras and Thailand to determine the most efficient level of nutrient input so farmers can manage fertilizer use to ensure optimal fish production without pollution.

**Accomplishments**

• CRSP researchers demonstrated that low-cost agricultural products such as soybean meal and by-products such as corn gluten can be successfully substituted for expensive pelleted fish feed, thus helping fish farmers to expand production and save money. This information had immediate practical application in Honduras, where the rapid growth in aquaculture led fish farmers to seek cost-effective inputs. Other studies on feeding behavior led to the conclusion that juvenile marine shrimp do not need to be fed until four weeks after hatching. This finding resulted in annual savings of 975,000 lempira for a single marine shrimp facility in Honduras.

• In Rwanda, CRSP researchers set out to find alternatives to high-priced inorganic fertilizers and scarce organic fertilizers. They found that compost can provide a sustainable fertilizing input to fish ponds. In a study of the effects of four types of organic fertilizer on fish production, the treatment using green grass resulted in greater pond productivity and fish growth than treatments using more energy-intensive materials.

• In Thailand, where acidic soils make fish ponds hard to manage, CRSP research led to the recommendation that ponds be constructed by diking rather than the conventional method of digging, and that organic fertilizers be used. Using these recommendations alone, 13 million hectares of acid-sulfate soils around the world can be made more useful for aquaculture.

• In Rwanda, U.S. field scientists have introduced fish culture and statistics courses into the National University curriculum, advised the Ministry of Agriculture in adopting an aquaculture development strategy for the country, and assisted the Mission in implementing a Natural Resources Conservation Program.

• In Indonesia, CRSP researchers played a major role in developing the aquaculture curriculum at the Institut Pertanian Bogor. Tilapia harvests from CRSP ponds in both Indonesia and Thailand have reached levels that previously were attainable only with expensive supplemental feed.

• In Rwanda, women fish farmers worked with researchers and extension workers to identify the constraints affecting women fish farmers and to develop strategies for increasing women's access to resources and training. The colloquium

*In Rwanda, researchers set out to find alternatives to high-priced inorganic fertilizers and scarce organic fertilizers. In a study of the effects of four types of organic fertilizer on fish production, the treatment using green grass resulted in greater pond productivity and fish growth than treatments using more energy-intensive materials.*

*U.S. researchers in host countries arrange university training, mainly through networking with other programs, and provide on-the-job training of junior scientists and technicians.*

attracted wide-based support from the Rwandan government, USAID Rwanda, and USAID Women in Development. CRSP efforts have directly contributed to the steadily increasing numbers of women fish farmers in Rwanda.

- The CRSP is collaborating with the International Center for Living Aquatic Resources Management (ICLARM) on a handbook of aquaculture research techniques. The handbook is an outgrowth of the CRSP's work plans, which scientists in developing countries find extremely useful, particularly because they have limited access to expensive texts on aquaculture techniques.

#### **CRSP Resources**

##### ***Collaborating U.S. institutions***

Auburn University

University of California, Davis

The Consortium for International Fisheries and Aquaculture Development (CIFAD)

- Oregon State University (also the Management Entity)
- Michigan State University
- The University of Michigan
- University of Arkansas at Pine Bluff
- University of Hawaii at Manoa and Hilo
- University of Oklahoma

##### ***Collaborating Host Country Institutions***

Royal Thai Department of Fisheries

Asian Institute of Technology, Thailand

National University of Rwanda

Department of Renewable Natural Resources (DIGEPESCA), Honduras

Freshwater Aquaculture Center (FAC), Central Luzon State University, Philippines

National Agricultural Research Center, Egypt

##### **Networks and Organizations**

Abbassa Fish Research Station, Egypt

National Association of Honduran Aquaculturists (ANDAH)

Aqua Farming Development Foundation, Inc., Philippines

Catholic University of Leuven (CUL), Belgium, Rwanda

Consultative Group on International Agricultural Research (CGIAR), Washington, D.C.

Escuela Agricola Panamericana, Honduras

Honduran Federation of Agricultural and Agroindustrial Producers and Exporters, Honduras

Fish Culture Research Institute, Szarvas, Hungary

Food and Agriculture Organization of the United Nations  
(FAO), Rome, Italy  
Gondol Research Station, Ensenada, Mexico  
Institut Pertanian Bogor (IPD), Indonesia  
International Development Research Centre (IDRC)  
of Canada  
International Rice Research Institute (IRRI), Philippines  
International Center for Aquaculture (ICA),  
Auburn University, Alabama  
International Center for Living Aquatic Resources  
Management, (ICLARM) Philippines  
Midwestern Regional Aquaculture Center, East Lansing  
Michigan  
National Agricultural Library, Washington, D.C.  
National Inland Fisheries Institute (NIFI), Thailand  
National Marine Fisheries Service (NMFS), La Jolla, California  
National Technical Information Services, Springfield, Virginia  
Oceanic Institute, Hawaii  
U.S. Peace Corps, Honduras, Thailand, Rwanda, Burundi  
Special Program for African Agricultural Research (SPAAR),  
Washington, D.C.  
The University of the Philippines in the Visayas  
Western Regional Aquaculture Consortium (WRAC),  
Seattle, Washington

*Research information is compiled at Oregon State University into the world's largest standardized database on tropical aquaculture, which is used to develop aquaculture "expert systems."*