Summary of Ongoing Research and Technical Assistance Projects in Agriculture

AGENCY FOR
INTERNATIONAL
DEVELOPMENT

DEPARTMENT
OF STATE

OCTOBER 1975

F O R E W O R D

Recognizing the urgent need for assistance to less developed countries in meeting their food requirements, the Agency for International Development (AID) has expanded the agricultural research and technical assistance program it has carried on for many years. This expansion reflects agriculture's key role in economic development and recognizes the need for a multidisciplinary, coordinated attack on the deep-rooted agricultural problems afflicting the developing nations.

Responsibility for coordinating the centrally-funded agricultural projects rests in the Office of Agriculture, Technical Assistance Bureau (TA/AGR). The projects may be in the research or technical assistance areas; they deal with production, processing, and marketing of field crops and livestock; management of water; soils and land use; seed improvement and multiplication; fertilizers; pesticides; machinery; economics; and agricultural policy. They are all summarized in this booklet and are grouped by key problem areas. Also listed are the 211(d) institutional grants which are designed to strengthen the capability of U.S. educational research institutions in dealing with critical social and economic problems in the developing countries, as well as their needs in the biological and physical sciences.

Recognition is given to the former and to the present members of this Office who participated in the initiation, development, evaluation, monitoring, and guidance in the operation of the projects. Acknowledgement is also given to AID Regional Bureaus, other government agencies, foundations, and the scientific community for their valuable contributions.

Leon F. Hesser, Acting Director
Office of Agriculture
Bureau for Technical Assistance
Agency for International Development

SUMMARY OF ONGOING RESEARCH AND TECHNICAL ASSISTANCE PROJECTS IN AGRICULTURE

Sponsored by the
Office of Agriculture
Bureau for Technical Assistance
(TA/AGR)

DEPARTMENT OF STATE

AGENCY FOR INTERNATIONAL DEVELOPMENT

Washington, D.C. 20523

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GLOSSARY OF ORGANIZATIONS AND TERMS

ADC	Agricultural Development Council 630 Fifth Avenue New York, New York 10020
AID	Agency for International Development U.S. Department of State Washington, D.C. 20523
ALAD	Arid Lands Agricultural Development Programs Ford Foundation P.O. Box 2379 Beirut, Lebanon
ARS	Agricultural Research Service U.S. Department of Agriculture Washington, D.C. 20250
AVRDC	Asian Vegetable Research and Development Center P.O. Box 42, Shanhua, Tainan Taiwan, 741, Republic of China
BSFW/USDI	Bureau of Sport Fisheries and Wildlife U.S. Department of the Interior Washington, D.C. 20240
CARIS	Computerized Agricultural Research Information Service (A pilot project with FAO) Via delle Terme di Caracalla Rome, Italy 00100
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture) Apartado Aereo 67-13 Cali, Colombia
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center) Apartado 6-641, Londres 40 Mexico, 6 D.F., Mexico
CIP	Centro Internacional de la Papa (International Potato Center) Apartado 5969 Lima, Peru
EAAFRO	East African Agriculture and Forestry Research Organization P.O. Box 30148 Nairobi, Kenya

ERS	Economic Research Service U.S. Department of Agriculture Washington, D.C. 20250
FAO	Food and Agriculture Organization of the United Nations Via delle Terme di Caracalla Rome, Italy 00100
FF	Ford Foundation 320 East 43rd Street New York, New York 10017
IACP	Inter-Asian Corn Program The Rockefeller Foundation G.P.O. Box 2453 Bangkok, Thailand
IBPGR	International Board for Plant Genetic Resources Mr. Robert J. Pichel, Secretary, FAO Via delle Terme di Caracalla Rome, Italy 00100
IBRD	International Bank for Reconstruction and Development (World Bank) 1818 H Street N.W. Washington, D.C. 20433
ICARDA	International Center for Agricultural Research in the Dry Areas World Bank 1818 H Street, N.W. Washington, D.C. 20433
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics 1-11-256 Begumpet Hyderabad, 500016, A.P. India
ICTA	Instituto de Ciencias y Technologia Agricola Galerias Espana 5° Piso 7a Av. 11-59, Zona 9 Guatemala City, Guatemala
IDRC	International Development Research Center P.O. Box 8500 Ottawa, Canada
IFDC	International Fertilizer Development Center 402 First Federal Building Florence, Alabama 35630

IITA	International Institute of Tropical Agriculture Oyo Road P.M.B. 5320 Ibadan, Nigeria
ILCA	International Livestock Center for Africa P.O. Box 5689 Addis Ababa, Ethiopia
ILRAD	International Laboratory for Research on Animal Diseases P.O. Box 47543 Nairobi, Kenya
INIA	Instituto Nacional de Investigaciones Agropecuarias Apartado 7069 Guayaquil, Ecuador
INFC	International Nutrition Feed Center Dr. L. Mayer, Director (FAO) Via delle Terme di Caracalla Rome, Italy 00100
IRRI	International Rice Research Institute P.O. Box 583 Manila, Philippines
LDC(s)	Less Developed Countries
NAS/NRC	National Academy of Sciences National Research Council Washington, D.C. 20418
PASA	Participating Agency Service Agreement
PCCMCA	Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios Instituto Interamericano de Ciencias Agricolas-Zona Norte Apartado 1688 - Sucursal 1 San Salvador, El Salvador
RAC	Research Advisory Committee (External to AID)
R&DC	Research and Development Committee (Internal AID)
RF	Rockefeller Foundation 111 West 50th Street New York, New York 10020

TDY	Temporary Duty
TVA	Tennessee Valley Authority Muscle Shoals, Alabama 35660
UNDP	United Nations Development Program 799 United Nations Plaza New York, New York 10017
UNIDO	United Nations Industrial Development Organization P.O. Box 707 A-1010 Vienna, Austria
USAID	U.S. Agency for International Development (AID posts overseas)
USDA	U.S. Department of Agriculture Washington, D.C. 20250
WARDA	West African Rice Development Association E. J. Royce Building P.O. Box 1019 Monrovia, Liberia

INTRODUCTION

KEY PROBLEM AREAS

The Agency for International Development (AID) places high priority on agricultural assistance programs in developing countries. AID involvement through the Office of Agriculture, Technical Assistance Bureau (TA/AGR) includes financial support to international research centers and central funding for agricultural contracts with U.S. universities or government agencies to provide technical assistance to USAID Missions in developing countries, as requested.

To maximize its contribution to the developing nations, AID's Technical Assistance Bureau has identified several key problem areas. These are not only areas where AID has the experience and competence to make significant contributions, but also areas given priority by the developing countries. They include:

1. International agricultural research network. Through financial support, the Office of Agriculture is helping establish a worldwide network of international agricultural research institutes.

2. Food crop production, including improvement of protein content and quality in basic food crops.

3. Management of tropical land, soil, and water resources to support programs which conserve and develop these resources for increased agricultural development consistent with ecological objectives.

4. Livestock production to promote more effective utilization of land resources unsuited to cropping. Livestock production augments supplies of meat, milk, and eggs to help provide the high-quality proteins seriously deficient in human diets in tropical and subtropical countries.

5. Economic analysis institution building to assist individual nations in effectively analyzing their economic status and selecting alternative programs that foster agricultural development.

ROLE OF THE OFFICE OF AGRICULTURE IN RESEARCH AND TECHNICAL ASSISTANCE

The following sections discuss Fiscal Year 1975 projects which are centrally funded by TA/AGR. These projects relate to problems important to several developing nations. TA/AGR, in cooperation with the AID Regional Bureaus, undertakes basic

research and provides technical assistance on these problems to support programs in individual countries or regions.

Each project is assigned to a highly competent research institution which operates both overseas and in the United States, with the continuing counsel and guidance of TA/AGR. Yearly progress and other substantive reports are made by the contractor and transmitted to USAID Missions in countries where the information may be useful. It is clearly recognized that additional applied research may be needed in each country to adapt the new information to local conditions, and that country education and assistance programs will be needed to put new research findings into actual use.

The TA/AGR research and technical assistance objectives are: to identify biological, physical, economic, and social constraints impeding agricultural development; to develop programs for applying known technologies to LDC (less developed country) problems; and to formulate research competence and adopt research findings. These objectives serve recognized needs of increasing food production and productivity, improving the dietary quality of foods, and improving farm income distribution and rural employment opportunities.

In collaboration with the international research centers, university contractors, national research institutes, AID Missions, and other donor agencies, TA/AGR is helping to develop a worldwide research network to focus on key problems in the areas of high-protein crops, livestock, water management, agricultural economics, and tropical soil management.

TA/AGR contracts with land-grant colleges and universities as well as scientific organizations and foundations for work, both in the United States and overseas on key development problems. In addition, agreements are developed with other government agencies under Participating Agency Service Agreements (PASAs).

TA/AGR also identifies requirements and formulates programs under the 211(d) grant legislation to develop competency and build effective and lasting links between U.S. and LDC institutions.

SUPPORT TO INTERNATIONAL AGRICULTURAL RESEARCH INSTITUTES

INTERNATIONAL AGRICULTURAL RESEARCH INSTITUTES

Assistance to international research institutes and related programs forms a major part of AID's support to the international agricultural research network. These international institutes and programs are not only a significant source of new technology, but also provide a key link between research in developed and developing countries. The international centers focus principally on major food sources for domestic consumption in the developing nations.

The concept of international agricultural research on food production originated in a cooperative program of wheat and corn improvement begun by the Rockefeller Foundation and the Mexican Government in the 1940's.

During the 1950's, it was realized that little was being done to improve the yield of rice, the principal food crop of Southeast Asia. There were no prospects for each Asian nation to have a team of scientists like the Mexican model. There were too few trained scientists in Asia, and the cost of bringing them in from the outside would have been prohibitive.

The Rockefeller and Ford Foundations, after discussions with the Government of the Philippines, agreed to create a totally new type of institution to be located at Los Banos. This was to be an international, nonprofit research center with an international staff, whose objectives were rice research, extension of results to other nations, and training. IRRI first produced the high-yielding IR-8 rice and, every year since, a number of newer and better strains.

With the aid of the Ford and Rockefeller Foundations, an international center for the improvement of maize and wheat (CIMMYT) was established in Mexico to continue the work of Mexican and Foundation scientists. Later, again with the Foundations' assistance, an institute for tropical agriculture was established in Nigeria (IITA), followed by an international center for tropical agriculture established in Colombia (CIAT). AID began to participate in the funding of CIMMYT in 1969, and then IRRI, IITA, and CIAT in 1970. Today, these and other international research centers are supported by the Consultative Group on International Agricultural Research (CGIAR).

The CGIAR is a group made up of donor countries, development banks, and foundations or agencies who provide funds for international agricultural research. The sponsors of the Group are the World Bank, the Food and Agriculture Organization of the United Nations, and the U.N. Development Program. Besides the sponsors, the membership of the Group includes 14 governments, three regional

development banks, the U.N. Environmental Program, three private U.S. foundations, and the International Development Research Center--an autonomous Canadian organization. Members meet semi-annually. Each member is free to support some centers and not others. Most centers attract funds from several donors. AID supports all centers with up to 25 percent of the core budget.

The Group is advised by a Technical Advisory Committee (TAC) consisting of 13 eminent scientists drawn from the developing and developed nations. TAC advises the Group on research priorities, special proposals, and the effectiveness of existing programs. It considers not only technical requirements, but the ecological, social, and economic factors as well.

The United States, represented by AID, was a "charter member" of the CGIAR and is the major donor member. It contributes up to 25 percent of the total funding of each center on the condition that the remainder will be provided by other donors. AID has encouraged the CGIAR to raise its level of funding in the future and to broaden its base of support. AID has also encouraged increased attention to the problems of the small farmer.

Through its TA/AGR Office, AID fosters cooperation of the centers through relay links whereby one center undertakes research either in support of another center's program or with U.S. universities engaged in overseas development programs to accomplish mutual goals.

PROJECT TITLE: IRRI (INTERNATIONAL RICE RESEARCH INSTITUTE)

CONTRACTOR: IRRI, Post Office Box 583
Manila, Philippines

CONTRACT COORDINATOR: Dr. Nyle C. Brady, Director

PROJECT DURATION: Started in 1968; Termination Date Indefinite

PURPOSE AND PROGRAM: IRRI was the first of the international centers to be organized; its initial goal was to concentrate on the development of only one crop--rice. Recently, the work has been broadened to include a farm cropping system research program, built around rice as the main monsoon season crop. In addition to carrying out research, it develops strong linkages with national and regional research institutions and trains research scientists and production workers from rice-producing countries.

ACCOMPLISHMENTS AND UTILIZATION: The technological improvements which resulted in the remarkable strains of IR-8 and IR-5 were developed by interdisciplinary teams of agronomists, physiologists, plant pathologists, entomologists, and geneticists. Working closely, they produced the shorter, stiff-strawed, disease-resistant, high-yielding varieties which triggered a rice revolution in Asia. The quick-maturing new rice strains often permitted double plantings in a single year. This technology came about through collecting, logging, and screening thousands of rice varieties. Today, IRRI's genetics resources bank counts more than 30,000 accessions whose descriptions and significant traits are being recorded.

Each year, IRRI supplies new lines to rice breeders worldwide and, to date, 33 genetic lines have been tested and released. Early in 1975, IRRI named three new early-maturing rice varieties: IR-28, IR-29, and IR-30. These are the only known varieties highly resistant to grassy stunt virus. The first two mature in 105 days, while IR-30 matures in 115 days. IR-29 is the first IRRI variety with glutinous or waxy grains which cook soft and "sticky," a preferred form of rice in some parts of Asia. In a typical year, more than 10,000 seed samples are sent to scientists in 69 countries.

More than 700 man-years of training have been provided by IRRI since its inception; its graduates are carrying their knowledge to Asia, Africa, and Latin America. In its international assistance linkages, IRRI is moving toward a program of

placing its scientists in those regions and now has 20 scientists in seven country outreach programs. It has assisted in the development programs of Sri Lanka, India, Indonesia, Bangladesh, Thailand, South Vietnam, Korea, Burma, Malaysia, and Pakistan.

During its first 10 years, IRRI focused on paddy or irrigated rice; but, plans for the next decade include research on the problems of rainfed lowland and upland rice production. IRRI will continue research on breeding more nutritive strains of rice to raise the level of protein from the current (approximate) 7 percent up to 9 percent on a milled basis.

ROLE OF AID: AID expects to continue providing up to 25 percent of the core and new capital financing through its TA/AGR office. AID Regional Bureaus and Missions overseas will continue to support IRRI's outreach programs. Until recently, AID funded a 5-year research project on the development of small-scale farm machinery which would enable rice farmers to shift to mechanized farming. The success of this undertaking was the basis for establishing a new project (described elsewhere in this publication) in which IRRI engineers will introduce selected models of these machines into two neighboring rice-producing countries. Besides helping farmers shift into mechanized farming, the project aims to develop a small-scale, farm machine production industry in these countries.

PROJECT TITLE: CIMMYT (CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO, OR THE INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER)

CONTRACTOR: CIMMYT, Londres 40
Mexico, 6, D. F. Mexico

CONTRACT COORDINATOR: Mr. Haldore Hanson, Director General

PROJECT DURATION: Started in 1969; Termination Date Indefinite

PURPOSE AND PROGRAM: Founded by the Rockefeller Foundation more than 20 years ago, CIMMYT was originally a Mexican Government agricultural program designed to share its technology with neighboring Latin American countries. It was reorganized in 1966 as the International Maize and Wheat Improvement Center, with the goal of helping LDCs develop corn and wheat technology to increase production of these crops. AID support for this program began in 1969. Research includes increasing the protein content of maize and the development of triticales, a cross between wheat and rye. CIMMYT has limited programs on barley and cold-tolerant sorghum as well.

ACCOMPLISHMENTS AND UTILIZATION: Since developing high-yielding, semidwarf wheat, CIMMYT has become the focal point of an effective, worldwide research network on wheat and corn. Two new bread wheat varieties, Jupateco 73 and Torim 73, were released by Mexico in 1973 from materials developed by CIMMYT. In the same year, CIMMYT scientists made 1,350 successful crosses between spring-wheats and winter bread wheats; 4,000 crosses of durum wheats; and 7,500 crosses of spring bread wheats.

Recent work culminating in the development of shorter-statured, higher-yielding corn varieties will likely have a major impact in countries where this crop is an important dietary staple. The new lysine strains now have about three times the nutritional value of ordinary corn varieties. Today, CIMMYT has more than 12,000 accessions in its maize varieties collection, the largest in the world. Researchers use this resource in their work on open-pollinated varieties (as opposed to hybrid maize) because of the local farmers' financial and supply problems in obtaining hybrid seeds each year.

In more favorable growing environments, triticales promise nutritious grains with yields comparable to the best wheat varieties. In barley research, sources for four lines were found to have 20 percent protein, about double that of wheat and almost as high as grain legumes.

For the various courses of study at CIMMYT in 1973, 99 students came from 35 different LDCs and three came from the USSR. In that same year, three workshops were held with a total of 125 participants, and CIMMYT provided a total of 1,117 man-days of senior scientist consultant services to LDCs. In addition, 21 CIMMYT advisors were based in various LDCs in nine country outreach programs. The CIMMYT pathologist assigned to Lebanon in 1973 is organizing an early-warning system for wind-borne diseases of wheat and barley in the Mediterranean and Near East area.

ROLE OF AID: As a member of CGIAR, AID continues the support of the core and capital budget (up to 25 percent) for research and training. In bilateral arrangements, it also supports CIMMYT outreach programs, and through a centrally-funded research budget it supports related work being carried on at the University of Nebraska (wheat) and at Purdue University (corn).

PROJECT TITLE: IITA (INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE)

CONTRACTOR: IITA, Oyo Road, P.M.B. 5320
Ibadan, Nigeria

CONTRACT COORDINATOR: Dr. William Gamble, Director

PROJECT DURATION: Started in 1968; Termination Date Indefinite

PURPOSE AND PROGRAM: IITA was established to improve the quantity and quality of food grown in the lowland humid tropics, particularly in Africa. It now has four main research programs: 1) farming systems--an integrated and in-depth examination of the physical, biological, economic, and engineering problems of agriculture; 2) cereal improvement--primarily rice and maize research closely linked with IRRI and CIMMYT programs; 3) grain legume improvement--international responsibility for cowpeas and limited work on lima beans, pigeon peas, and soybeans; and 4) root and tuber improvement--international responsibility for yams and sweet potatoes, and a strong cassava program.

ACCOMPLISHMENTS AND UTILIZATION: In farming systems research, mulching and minimum tillage patterns were found which would keep topsoil in place more effectively, retain moisture in upper topsoil levels, and reduce soil temperatures, heretofore the major deterrents in maize seed germination and survival. In cooperation with WARDA (a 13-nation West African Rice Development Association), promising lines of rice bred from IRRI and local stocks are being tested in different ecological zones. Mini-kits of upland rice are also being tested through the Nigerian Accelerated Food Production Program.

Two years of maize breeding has resulted in a 50-percent yield improvement, and the Nigerian composites having the Opaque-2 genes (some with hard kernels) have been developed.

Since most of the world's production of cowpeas are grown in Africa, IITA has assumed world responsibility for that crop. IITA's germ plasm collection of food legumes numbers between 8,000 and 9,000 entries--over 6,000 varieties of cowpeas, 1,600 of pigeon peas, 600 of soybeans, and 200 of lima beans have been screened, in addition to numerous other pulses.

Cowpeas with high levels of protein have been grown at IITA, with yields six times as great as the average African yield of 370 kilograms per hectare. Sweet potato research has

brought about high-yielding clones which can produce 40 tons per hectare in the rainy season and more than 30 tons in the dry period. Yams grown in the humid tropics do not readily lend themselves to genetic improvement because they rarely flower or set seed, but IITA's breeding team has managed to grow 600 seedlings which will make hybridization possible.

Outreach programs include a team of scientists who went to Zaire to identify the cause of a disease which ruined the cassava crop. The team works there with CIMMYT in Zaire's maize program. IITA's personnel are now posted in Liberia, Nigeria, Sierra Leone, and Tanzania. Several levels of training are now being provided at IITA, ranging from short courses to opportunities for degree candidates to conduct research. In 1973, a 22-week course on rice production was given by IITA for WARDA and for agricultural extension leaders from 11 West African countries. And 239 participants from 29 countries attended eight seminar/workshops. The total participants to date number more than 750.

ROLE OF AID: Through the Africa Bureau, AID currently provides up to 25 percent of the Center's operating and capital budget. A number of TA/AGR centrally-funded U.S. university research projects (described elsewhere in this publication) complement IITA work. AID's Africa Bureau and overseas Missions further support IITA's outreach programs.

PROJECT TITLE: CIAT (CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL, OR THE INTERNATIONAL CENTER FOR TROPICAL AGRICULTURE)

CONTRACTOR: CIAT, Apartado Aereo, 67-13
Cali, Colombia

CONTRACT COORDINATOR: Dr. John Nickel, Director General

PROJECT DURATION: Started in 1969; Termination Date Indefinite

PURPOSE AND PROGRAM: CIAT focuses on general crop and farm systems research for the tropical lowlands of the Western Hemisphere. Some of its programs are commodity centered; others deal with farming systems on terrain that varies from savannahs and harsh slopes to infertile low-lands and rich river valleys and marshy deltas. CIAT has four food crop programs: cassava, field beans, rice, and maize, as well as a livestock program dealing with beef cattle and swine.

ACCOMPLISHMENTS AND UTILIZATION: Cassava yields are generally low (14 tons per hectare in Latin America) but experiments suggest that yields of 50 tons per hectare in farm fields are possible through proper selection and good agronomic practices. CIAT is screening its germ plasm collection of 2,000 accessions and materials coming out of breeding programs for strains that are low in cyanide, a contributing factor in goitre and other health problems. The library at CIAT has assembled most of the world's literature on cassava. In field bean research, CIAT has assembled a germ plasm collection of 10,180 accessions and knows sources for another 5,000. Screening for 23 characteristics has been carried out; this activity is being duplicated in three other ecological zones.

CIAT's bean team is producing inoculant strains that can survive storage and transport in the tropics; it is also studying the adverse effects of acid soils on seed inoculation. Cooperating with CIMMYT, CIAT is exploring the sturdy dwarf varieties of maize which are especially practical for the bean-maize association pattern practiced by small farmers where the maize stalks serve as beanpoles and the beans enrich the soil with their nitrogen-trapping mechanisms.

CIAT has developed rice varieties, capitalizing on improved germ plasm provided by IRRI, and is promoting the development of agronomic practices. Research is being strengthened on upland rice, since 70 percent of the rice grown in Central and South America is upland rice.

In Colombia, Venezuela, Ecuador, Bolivia, and Paraguay, there are approximately 300 million hectares of under-utilized grassland and scrub timber tracts unsuitable for cropping. With proper management, this land might support a profitable beef cattle industry. CIAT's program will concentrate on producing feed through improved upland pastures; will work on control of diseases and parasites; and will improve nutrition through mineral and protein supplementation. It has assembled about 160 genotypes of a tropical legume for forage. A key project involves observation of nine beef herds over an extended period of time to determine the effects on productivity of the various forages. A swine-feeding program based on waste bananas, cassava, rice bran and polishings, sugar, and high-lysine, high-protein, Opaque-2 maize has been started in an effort to close the gap between the small farmer's profit and the commerical operator's profit in swine-raising enterprises.

Each year, CIAT enrolls 200 trainees for a 12-month course and it also provides facilities for postgraduate work. In 1973, it conducted four workshops with 228 LDC participants, and it has established an outreach program in Guatemala.

ROLE OF AID: Through TA/AGR, AID currently provides about 25 percent of the Center's operating and new capital budget. Several TA/AGR centrally-funded U.S. university research projects (described elsewhere in this publication) complement CIAT's research program. Of particular note are the cooperative projects by Texas A&M University on blood parasites of cattle and by the University of Florida on mineral nutrition of cattle.

PROJECT TITLE: CIP (CENTRO INTERNACIONAL DE LA PAPA, OR THE INTERNATIONAL POTATO CENTER)

CONTRACTOR: CIP, Apartado 5969
Lima, Peru

CONTRACT COORDINATOR: Dr. Richard L. Sawyer, Director

PROJECT DURATION: Started in 1972; Termination Date Indefinite

PURPOSE AND PROGRAM: The white or Irish potato, the world's fourth most important food crop after rice, wheat, and maize, has made little progress in the world's hunger belt where it could add substantially to world food supplies with its high yield per acre, ample carbohydrate content, well-balanced protein, and high levels of vitamins B and C. CIP is a one-crop institute with a mandate to improve potatoes and potato-growing, and to extend the potato's range of adaption to new territories.

CIP dates back to Rockefeller/CIMMYT days and, more recently, to AID-financed North Carolina University contract projects. These projects gave CIP a legacy of research results, on-going projects, trained people, and valuable biological materials on which to build its programs.

ACCOMPLISHMENTS AND UTILIZATION: CIP's approach is three-pronged: 1) research in major problem areas; 2) outreach activities; and 3) research projects carried out by its staff and other scientists under contract to CIP. Research is conducted at CIP near Lima; at another post 10,000 feet in altitude; and at a third site near sea level in a hot and humid environment. Adaptive research will be carried out in the developing countries through the outreach programs.

Periodic planning conferences and workshops are held under the Center's auspices, where the pooled data of scientific knowledge and expert judgement are translated into action programs. These planning programs have dealt with key problems such as potato blight, bacterial wilt, potato quality, resistance to nematodes, and the utilization of genetic resources.

Accessions to the germ plasm collection now number more than 6,000; more than 8,000 samples from the collection have been sent to scientists in 31 countries. Genetic material is being converted to disease-free botanical seed for storage over periods of 20 to 25 years. Research in breeding techniques is coordinated with projects at North Carolina State

University, Cornell University, and the University of Wisconsin. The goal is to produce populations with traits of frost-resistance; resistance to diseases, insects, and nematodes; and adaptation to day-lengths. There are 20 known virus diseases of potatoes, and to date 2,500 clones from the germ plasm collection have been evaluated to detect the presence of the major viruses.

In 1972, an international symposium was held on "Key Problems and Potentials for Greater Use of the Potato in the Developing World." More than 100 scientists from six continents participated. In 1973 there were three regional training courses involving 34 trainees from 11 countries.

CIP now has two regional training projects underway--one in Mexico and the other in Lebanon. Courses are given annually in Mexico, Peru, Kenya, and Egypt. Instruction concentrates on seed production and provides first-hand, planting-to-harvest experience in growing a potato crop.

ROLE OF AID: Through TA/AGR, AID currently provides up to 25 percent of the core and capital budgets. Support for outreach activities (LDC requests for CIP senior scientists and consultants) may be provided from Regional Bureaus and country Missions as required.

PROJECT TITLE: ICRISAT (INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMIARID TROPICS)

CONTRACTOR: ICRISAT, 1-11-256 Begumpet
Hyderabad, 500016, A.P., India

CONTRACT COORDINATOR: Dr. Ralph W. Cummings, Director

PROJECT DURATION: Started in 1972; Termination Date Indefinite

PURPOSE AND PROGRAM: A major part of the food supply of some 400 million persons rests on the success of the dryland farmer who tills unproductive soils with human or animal power, using seeds known to his forebears, and facing a limited supply of water. ICRISAT is rapidly mobilizing high-level scientific resources in a major effort to improve the productivity of semiarid lands, concentrating on the small farmer with limited means. It has three main objectives: 1) to serve as a world center for the genetic improvement of sorghum, pearl millet, pigeon peas, chickpeas, and groundnuts (peanuts); 2) to develop farming systems which will help increase and stabilize agricultural production by optimizing the use of natural and human resources in the seasonally dry, semiarid tropics; and 3) to assist national and regional research programs.

ACCOMPLISHMENTS AND UTILIZATION: Field research was initiated in mid-1972. ICRISAT had about 25 senior international staff members on board by January 1975.

An available world collection of sorghum germ plasm now numbers more than 16,000 accessions. Sorghum traits now being sought include high yields, shorter stature, nitrogen responsiveness, higher lysine levels, and tolerance to drought. ICRISAT is multiplying the lines developed by Purdue University researchers, who spotted lines bearing up to 17 percent protein with a high percentage of lysine. It is also tying into a high-altitude sorghum research program started at CIMMYT.

The Center has a germ plasm collection of pearl millet, with 6,000 entries from a number of countries. It is concentrating on that crop because of its widespread acceptance as food. In addition to its ability to tiller profusely and produce two or three ratoon crops in succession, pearl millet has shown superior performance under adverse conditions.

The world's average yield for pigeon peas is around 600 kilograms per hectare, yet experimental plantings have demonstrated a much higher yield potential. Up to 5,000 kilograms per hectare and more have been grown under controlled conditions using local varieties. Furthermore, high-yielding experimental plantings have been grown in 150 days instead of the usual 300 days. The average yield of chickpeas runs between 300-400 kilograms per hectare, whereas yields of 3,000 kilograms per hectare have been obtained in experimental plots.

In its farming systems program, ICRISAT research deals with experiments on small watersheds, using terracing, contour plowing, catchment ponds, and grassed waterways, and comparing the effects of various practices on major types of soils. In ICRISAT's early stages, agriculture students from the Punjab Agricultural University received practical training by helping to lay out farms and land development patterns. Forty scientists from 14 countries attended a workshop on farming systems in 1974. Another workshop on grain legumes was held early in 1975.

ROLE OF AID: AID will assist and support ICRISAT in the production of outputs being made available to LDCs. In addition to its core and capital budget financing (about 25 percent), AID will assist in financing outreach activities of particular relevance to Regional Bureau and country Mission programs. Complementing this are the other centrally-funded university research projects described elsewhere in this publication. Particularly noteworthy are the projects at Purdue University on high-lysine sorghum, and the project at the University of Puerto Rico on the diseases of legumes.

PROJECT TITLE: ILCA (INTERNATIONAL LIVESTOCK CENTER FOR AFRICA)

CONTRACTOR: ILCA, Post Office Box 5689
Addis Ababa, Ethiopia

CONTRACT COORDINATOR: Dr. Jean Pagot, Director

PROJECT DURATION: Started in 1972; Termination Date Indefinite

PURPOSE AND PROGRAM: On behalf of CGIAR the World Bank signed an agreement in 1974 with the Ethiopian Government. It permits establishment of ILCA, with the aim of introducing change into production and marketing systems in tropical Africa that will increase the yield and output of livestock products. The growing population, with its economic development and urbanization, demands more meat and milk than can now be supplied. ILCA's aims are to improve the feed base and grazing lands for cattle and to upgrade current livestock management practices.

ACCOMPLISHMENTS AND UTILIZATION: Many organizations and governments have carried out campaigns in Africa on specific aspects of cattle raising. However, no attempt was made to assemble results of such extension work, training, or research into a collective document. Nor was any attempt made to use this information base to develop improved livestock systems to undergird national policy or action programs. ILCA will fill this need for a coordinating research and outreach agency to assist national livestock programs; strengthen ongoing projects without duplicating previous work; stimulate research and action where there is promise for improved performance; and make a systematic effort to identify areas with good potential. ILCA's central research organization has been defined and has been divided into teams. One team will deal with animal production techniques; the second with physical environmental conditions, including climate and soil; the third with biological environment, pasture, epidemiology, and wildlife; the fourth with human environment, sociology, and anthropology; and the fifth with economic conditions such as macro- and micro-economic marketing.

ROLE OF AID: AID will contribute to the core and capital budget needs (about 25 percent), and is expected also to support training and country outreach programs.

PROJECT TITLE: WARDA (WEST AFRICA RICE DEVELOPMENT ASSOCIATION)

CONTRACTOR: WARDA, E.J. Royce Building
Post Office Box 1019
Monrovia, Liberia

CONTRACT COORDINATOR: Mr. Jacques Diouf
Executive Secretary

PROJECT DURATION: Started in 1971; Termination Date Indefinite

PURPOSE: The primary aim of WARDA is to make West Africa self-sufficient in the production of rice; to foster the exchange of information among its members; and to establish linkages with other international agricultural research institutions.

DESCRIPTION OF ACTIVITIES: WARDA was established in December 1971. It submitted its first research proposal to the Technical Advisory Board of CGIAR in 1973. Its scientists and staff then began work on problems of rice production in the five categories of rice cultivation in West Africa: a) upland conditions; b) irrigated conditions (controlled); c) deep flood conditions; d) floating conditions (water above 100 centimeters); and e) mangrove swamp conditions. Two types of research are being carried out: Coordinated Field Trials and Special Projects, with CGIAR-sponsored activities in the former and bilaterally-sponsored activities in the latter.

ACCOMPLISHMENTS AND UTILIZATION: In the first varietal tests conducted, 60 varieties were sent to seven coordinated field trial sites in 12 participating nations. Results will be tabulated and published for distribution to member nations. Rice production seminars are being scheduled on a regular basis. To date, three have been held in Monrovia (in 1973) on Rice Breeding, Soil Fertility, and Plant Protection. Plans are being finalized for training sessions in cooperation with national extension services.

ROLE OF AID: AID is providing grant funding to WARDA in two ways: 1) through the CGIAR for the Coordinated Field Trials; and 2) through the Africa Bureau for research and training in swamp and tidal rice improvement. Some AID Missions in African countries are establishing program links with WARDA.

PROJECT TITLE: ILRAD (INTERNATIONAL LABORATORY FOR RESEARCH ON ANIMAL DISEASES)

CONTRACTOR: ILRAD, Post Office Box 47543
Nairobi, Kenya

CONTRACT COORDINATOR: Dr. James B. Henson, Director

PROJECT DURATION: Started in 1974; Termination Date Indefinite

PURPOSE AND PROGRAM: Two diseases, trypanosomiasis and East Coast fever, afflict livestock in over 4 million square miles across Africa. Both are blood-borne parasitic infections; the first is carried by the tsetse fly and the latter by ticks. It is estimated that the territory occupied by the tsetse fly could support 200 million head of cattle. Control of the disease could make a radical difference to the lives of thousands of people and to the economies of the 30 nations in the infected area.

In 1973, CGIAR concluded an agreement with the Government of Kenya, establishing a laboratory to develop immunological procedures for the prevention of trypanosomiasis and East Coast fever. Although research is underway in different parts of the world, it would be greatly facilitated if a coordinated, multidisciplinary, intensive program were carried out by a single institute in the endemic area.

ACCOMPLISHMENTS AND UTILIZATION: ILRAD will conduct basic and applied research, test the results in the field, publish and disseminate research findings, and establish contact with other laboratories and research groups in order to exchange information, avoid duplication of effort, and determine priorities in animal health problem studies. Training at the post-doctorate level is proposed. The combined efforts of ILRAD and the International Livestock Center for Africa (ILCA) are expected to improve Africa's livestock production through a sustained assault on major production barriers. Plans are well advanced for the construction of the facilities required by ILRAD, and recruitment of staff is underway.

ROLE OF AID: AID will provide up to 25 percent of the core and capital budget for ILCA, support for outreach activities and training as required, and support for complementing centrally-funded or other research requirements. Currently, AID supports a related project of the U.S. Department of Agriculture on the elimination of the tsetse fly through the male sterilization technique.

PROJECT TITLE: ICARDA (INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN DRY AREAS)

CONTRACTOR: ICARDA, c/o World Bank
1818 H Street, N.W.
Washington, D.C. 20433
(Pending establishment of ICARDA and naming its Director)

CONTRACT COORDINATOR: Executing Agent, World Bank
(Pending establishment of ICARDA and naming its Director)

PROJECT DURATION: Started in 1975; Termination Date Indefinite

PURPOSE AND PROGRAM: This center is expected to be established by late 1975 or early 1976, with headquarters in Lebanon and an associated facility in Syria. One or more additional associate centers may also be established in the region. ICARDA is designed to meet the needs of the countries in the Near East and North Africa. This important ecological area is not adequately served by any of the research centers. The major thrust of ICARDA will be improved farming systems for the region, with emphasis on crop improvement, soil and water management, and animal husbandry.

The center will have international responsibility for maintaining research on barley (and possibly later durum wheat), broadbeans, and lentils. It will have strong links with other centers, particularly CIMMYT and ICRISAT, both of which are working on crop and farming systems of common interest.

ACCOMPLISHMENTS AND UTILIZATION: After agreement by the CGIAR in 1974 to establish ICARDA, a subcommittee was set up to proceed with all arrangements.

ROLE OF AID: AID has contributed to the preparatory fund and plans. After the center is established, AID will contribute to its budget on the same basis as it supports other centers under the aegis of the CGIAR--up to 25 percent of the core budget. AID also supports relevant research through other centers (e.g. CIMMYT and ICRISAT), as well as through several contracts with U.S. universities. Research includes the work on barley improvement at Montana State University and the work on wheat improvement at the University of Nebraska. Through 211(d) grants and research contracts, additional supporting dryland farming research at U.S. universities is anticipated. The Near East and South Asia Bureau also supports relevant work through AID Missions in the region.

PROJECT TITLE: AVRDC (ASIAN VEGETABLE RESEARCH AND DEVELOPMENT CENTER)

CONTRACTOR: AVRDC, Post Office Box 42, Shanhua, Tainan, Taiwan 741, Republic of China

CONTRACT COORDINATOR: Dr. James Moomow, Director

PROJECT DURATION: Started 1971; Termination Date Indefinite

PURPOSE AND PROGRAM: The purpose of AVRDC is to contribute, through an intensive research and training program, to an increase in the yield and nutritional value of vegetable crops in the humid tropics and subtropics of Asia. Such increases will, in particular, supplement the diet and improve the incomes of the Asian small farmer, who often depends almost entirely on rice. AVRDC plans to develop improved varieties and better cultural practices to increase the resistance of certain vegetable crops to insects and diseases and to the hot, humid climate during the monsoon season. Six major crops have been selected for initial attention: mungbeans, soybeans, tomatoes, sweet potatoes, Irish potatoes, and the Chinese cabbage. Mungbeans and soybeans are receiving relatively more attention than the others. Work on each crop is carried out by interdisciplinary teams whose members are specialists in breeding, pathology, entomology, physiology, soil science, chemistry, and economics.

ACCOMPLISHMENTS AND UTILIZATION: AVRDC was formally established in 1971. Building construction began in early 1972 and research work was initiated in late 1972. By mid-1973, 11 principal scientists were at work. The major initial approach was to tap the world's genetic germ plasm resources, followed by thorough screening programs to identify varieties with desired characteristics. The individual varieties selected were then utilized as parents in intensive breeding programs. To date, the world germ plasm collections have provided varieties of six crops with heat tolerance and resistance to the major insects and diseases, or both. Breeding programs using these varieties are underway. The major problems of Chinese cabbage may be resolved first. Economic studies pertaining to the six crops are also underway. With the completion of an essential training facility (a cafeteria-dormitory building) in late 1974, a training program is expected to develop rapidly in 1975.

ROLE OF AID: AID originated the idea of an international vegetable center in 1963. Thus, the United States was

one of the major original contributors to AVRDC when it was established--along with the Asian Development Bank, the Government of Taiwan, and five other Asian nations. Although AID initially contributed more than 25 percent of the funding, its contribution is expected to drop to this level (the same as for other centers). An AID economist is a member of the AVRDC board. AVRDC is not sponsored by the CGIAR. Several AID-sponsored programs complement the work of AVRDC; these include projects with INTSOY (described elsewhere in this report) on soybeans, and the University of Missouri on mungbeans. AVRDC also cooperates closely with other international centers--such as its work with CIP on potatoes.

PROJECT TITLE: IFDC (INTERNATIONAL FERTILIZER DEVELOPMENT CENTER)

CONTRACTOR: IFDC, 402 First Federal Building
Florence, Alabama 35630

CONTRACT COORDINATOR: Dr. Donald L. McCune, Managing Director

PROJECT DURATION: Started 1974; Termination Date Indefinite

PURPOSE: This project creates an organization to develop new and improved fertilizers; introduces and promotes their use in tropical and subtropical agriculture; studies and assists in solving fertilizer marketing problems; and serves as both a training center and a focal point for information on fertilizer production, trade, and use.

DESCRIPTION OF ACTIVITY: Most fertilizers have been developed for temperate zone soils and crops; new technology is needed for the tropics and subtropics. IFDC will address itself to the problem of developing chemical fertilizers suited to tropical environments and/or fertilizer plants adapted to LDC needs. Research and development will focus on: a) improving efficiency of applied nutrients, including controlled release of chemical fertilizer components; b) reducing soil tie-up of nutrients and taking steps to reduce reactions in soil that rapidly convert nutrients into forms unavailable to plants; and c) expanding and improving use of raw materials found in LDCs. While IFDC will not undertake basic research in nitrogen-fixation technology, it will maintain close liaison with such work done worldwide.

ACCOMPLISHMENTS AND UTILIZATION: IFDC was organized in 1974 and began operations in 1975. It now presently uses facilities at TVA's National Fertilizer Development Center in Alabama. Several research officers have been hired and others identified. Recruiting will be paced to the rate of development of facilities. Staff will be international. Work is underway on evaluation of phosphate rock and on field test-demonstrations of sulfur-coated urea.

ROLE OF AID: AID was instrumental in establishing the Center and, with the International Development Research Center, provided planning funds in 1974. AID will make an additional substantial grant for initial operations in 1975. The Center may eventually become part of an international plant nutrition program being considered by CGIAR.

PROJECT TITLE IBPGR (INTERNATIONAL BOARD FOR PLANT GENETIC RESOURCES)

CONTRACTOR: IBPGR, FAO
Rome, Italy

CONTRACT COORDINATOR: Robert J. Pichel, Secretary (IBPGR)

PURPOSE AND PROGRAM: The basic function of the Board is to establish an international network of plant genetic resources and to further the collection, evaluation, and utilization of plant germ plasm. Specifically, the program of the IBPGR will include: collecting, conserving, and evaluating plant genetic resources, especially those of species having major economic importance; ensuring the availability of materials for plant breeding activities, as required; arranging for storage of germ plasm of related donations; promoting technical meetings and training; strengthening programs of existing institutions and, where necessary, encouraging the establishment of new institutions and programs; promoting dissemination of information; and making recommendations on developing a computerized informating storage and retrieval system on plant germ plasm.

ACCOMPLISHMENTS AND UTILIZATION: IBPGR had its first meeting in June 1974. Activities planned for 1975 include work on developing a computer-based system on communication, information, and documentation; a symposium on wheat; and several review papers. The budget proposal for 1976 principally centers on (a) further support to the communication, information, and documentation system, and (b) support of germ plasm activities at genetic resource centers. The Board also helps coordinate bilateral support for genetic resource centers.

ROLE OF AID: As with other centers and related activities sponsored by the CGIAR, AID contributes up to 25 percent of the operating budget of IBPGR. Six other donors contributed to the Board in 1975.

FOOD CROP PRODUCTION

RESEARCH PROJECTS

PROJECT TITLE: INHERITANCE AND IMPROVEMENT OF PROTEIN QUALITY AND CONTENT IN *SORGHUM BICOLOR*

CONTRACTOR: Purdue University
Lafayette, Indiana 47907

CONTRACT COORDINATOR: Dr. John D. Axtell, Professor
Department of Agronomy

PROJECT DURATION: Started 6/30/66; Termination Date 6/30/78

PURPOSE: The objective of this project is to produce more nutritious sorghum for the LDCs. Because sorghum is an important item in the diet of more than 300 million people over wide areas of the tropics, the improvement of its protein quality and amino acid balance is extremely important. (This is one of four AID research projects on sorghum; others are Texas A&M University, University of Nebraska, and the University of Puerto Rico projects.) Purdue's research is aimed at improving the nutritional value of the grain.

DESCRIPTION OF ACTIVITY: The world sorghum collection is being screened for genetically controlled factors which could improve protein content and quality; these factors can then be bred into promising varieties for the tropics. The higher yielding and more promising selections are evaluated for disease and insect resistance, local adaptation, and other factors by cooperating plant breeders at selected worldwide locations. Biological as well as *in vitro* and chemical evaluations are being made.

ACCOMPLISHMENTS AND UTILIZATION: Three high-lysine sorghum genes have been isolated which could triple the protein quality of normal sorghum strains. Superior materials, including the high-lysine genes, are being used in crosses at Purdue, ICRISAT, ALAD, and other locations. Collections of high-lysine material have been made in Ethiopia; this material is under study at ALAD and ICRISAT. Inbred and hybrid derivatives from these crosses have been selected and assessed for yield, protein, and amino acid composition. Nutritional quality is being evaluated in small-animal feeding trials. Tannin-containing sorghums, although resistant to bird damage, are much less useful as food than those containing little or no tannins. The implications of tannin content and the means for confronting the problem are being studied.

FUTURE PLANS: The search for high-lysine, high-protein sorghum with hard endosperm is being continued. Indexing, selecting, breeding, and testing will continue until su-

perior varieties have been produced which incorporate high protein, desirable amino acid balance, and improved nutritional values. Purdue University personnel will help local breeders incorporate these superior traits into breeding programs, and will also conduct special workshops and training programs for the LDC cooperators.

PROJECT TITLE: DEVELOPMENT OF IMPROVED, HIGH-YIELDING SORGHUM CULTIVARS

CONTRACTOR: University of Nebraska
Lincoln, Nebraska 68503

CONTRACT COORDINATOR: Dr. J. D. Eastin
Professor of Agronomy

PROJECT DURATION: Started February, 1974: Termination Date 6/30/76

PURPOSE: The objective of this contract is to develop high-yielding cultivars of sorghum incorporating improved tolerance to environmental stress, improved nutritional value, and multiple resistance to diseases and insects. (This is one of four AID sorghum research projects working cooperatively towards this goal; others are University of Puerto Rico, Texas A&M University, and Purdue University projects.) The special contribution of the University of Nebraska is research on the physiology of yields and the crop's tolerance to environmental stress.

DESCRIPTION OF ACTIVITY: Research is being conducted on the morphological and physiological factors affecting yield, and on factors affecting the ability of the plant to withstand various types of stress, such as heat and drought. Methods for speeding the screening of germ plasm for stress factors are being developed. Plant material is being exchanged with other universities, the USDA, and the international research institutes. Populations incorporating desirable factors are being developed.

ACCOMPLISHMENTS AND UTILIZATION: This is a new activity. Nevertheless, the research is well advanced, and valuable insights into the components of yield in sorghum are already available. A new screening technique for heat tolerance looks promising for accelerating the selection of desirable cultivars.

FUTURE PLANS: Both laboratory and field research will continue on the characterization of individual physiologic processes as they affect yield under both favorable and stress conditions and also the interactions among these. The interchange of information and germ plasm among the AID sorghum contractors, USDA, and the international research institutes will continue.

PROJECT TITLE: DEVELOPMENT OF IMPROVED, HIGH-YIELDING SORGHUM CULTIVARS

CONTRACTOR: Texas A&M University
College Station, Texas 77843

CONTRACT COORDINATOR: Dr. Richard A. Frederiksen
Professor of Plant Pathology

PROJECT DURATION: Started 2/15/74; Termination Date 6/30/76

PURPOSE: The objective of this contract is to develop high-yielding cultivars of sorghum with improved nutritional value and multiple resistance to diseases and insects. (This is one of four AID sorghum research projects; others are University of Nebraska, Purdue University, and University of Puerto Rico projects.) The special contribution of the Texas A&M University is research on the diseases and insect pests of sorghum.

DESCRIPTION OF ACTIVITY: Sorghum germ plasm is screened for resistance to several diseases and insects. Breeding of resistant material with lines having other desirable characteristics is carried out. Advanced material is entered in disease nurseries at numerous locations in the United States, and also in the International Disease Nursery (IDN) at 18 locations in seven countries in 1974. Germ plasm and information is exchanged with other universities, USDA, ICRISAT, ALAD, as well as with other international and national research institutions.

ACCOMPLISHMENTS AND UTILIZATION: This is a relatively new activity. Screening of material for disease and insect resistance is, however, well advanced, as is breeding work. Personnel of the contract participated in the International Sorghum Workshop held in Mayaguez, Puerto Rico, in January 1975.

FUTURE PLANS: The search for multiple disease and insect-resistant germ plasm will continue and, with the cooperation of other AID sorghum research contractors and the international research institutes, will be combined into populations having improved yield, stress tolerance, and improved nutritional quality.

PROJECT TITLE: DEVELOPMENT OF IMPROVED, HIGH-YIELDING SORGHUM CULTIVARS

CONTRACTOR: University of Puerto Rico
Mayaguez, Puerto Rico 00708

CONTRACT COORDINATOR: Dr. Abad Morales
Professor of Agronomy

PROJECT DURATION: Started 2/15/1974; Termination Date 6/30/1976

PURPOSE: The objective of this contract is to develop high-yielding cultivars of sorghum incorporating improved tolerance to environmental stress, improved nutritional value, and multiple resistance to diseases and insects. This is one of four AID sorghum research projects. (Others are University of Nebraska, Texas A&M University, and Purdue University projects.) The special contribution of the University of Puerto Rico is the adaptation of germ plasm to the tropical environment.

DESCRIPTION OF ACTIVITY: Taking advantage of several ecological situations in the tropical environment of Puerto Rico, research is being conducted on weed control, population density, use of fertilizers, and other cultural practices. Material received from many promising sources is being tested for adaptation to the tropics and surveyed for incidence of diseases and insect pests.

ACCOMPLISHMENTS AND UTILIZATION: This is a relatively new activity. However, field experiments have been planted, and disease nurseries and evaluation of germ plasm for tropical adaptation are underway. Close cooperation is maintained with the USDA sorghum conversion program carried out at the Mayaguez Institute of Tropical Agriculture (formerly Federal Experiment Station). The University hosted the International Sorghum Workshop during January 1975.

FUTURE PLANS: Research will continue on the development of improved cultural practices and the screening of material for the tropics. In cooperation with the other AID sorghum contractors and the international institutes, sorghum populations will be developed incorporating improved disease and insect resistance, high yield and tolerance to stress, and improved nutritional quality for release to the LDCs.

PROJECT TITLE: INHERITANCE AND IMPROVEMENT OF PROTEIN QUALITY AND CONTENT IN MAIZE

CONTRACTOR: Purdue University
Lafayette, Indiana 47907

CONTRACT COORDINATOR: Dr. D. V. Glover, Professor of Agronomy

PROJECT DURATION: Started 6/30/70; Termination Date 6/30/78

PURPOSE: This project will isolate genes to further improve quality and content of the protein in maize and increase grain yield while still retaining market acceptability. Substitution of such new varieties for those currently grown in LDCs will help improve human diets.

DESCRIPTION OF ACTIVITY: This project is designed to develop open-pollinated lines and, to a lesser extent, maize hybrids with improved protein quality and content. Maize breeding work is being conducted at Purdue in conjunction with work at CIMMYT, the University of Vicosa in Brazil, CIAT in Colombia, USDA, and other research centers conducting maize research. The work in plant breeding is linked to a systematic evaluation program for protein quality and content, and to adaptability trials performed under various climate and soil conditions.

ACCOMPLISHMENTS AND UTILIZATION: Double mutants, with special emphasis on the combination of the Opaque-2 gene with the Sugary-2 gene, show promise for elimination of the soft endosperm problem, as well as improvement of nutritional efficiency. The Sugary gene makes kernel starch crystalline at maturity, giving it field and storage qualities resembling flint and dent types; these qualities are now being incorporated into otherwise agronomically acceptable varieties. Feeding trials have shown that yellow crystallines are essentially equal to standard Opaque-2. High-lysine (Opaque-2) maize is already established in commercial production in Brazil, and progress is being made in other countries. A simple colorometric test for high lysine, usable in laboratory or field, has been developed. This test can be used on other grains.

FUTURE PLANS: The project will focus on locating additional genes to boost protein quantity and quality without reducing yields. Further development of double mutants is stressed and a search is underway for the high-lysine character in hard endosperm maize.

PROJECT TITLE: THE ADEQUACY OF HIGH-LYSINE MAIZE AS A MAJOR DIETARY COMPONENT DURING GROWTH AND SUBSEQUENT REPRODUCTION

CONTRACTOR: Cornell University
Ithaca, New York 14850

CONTRACT COORDINATOR: Dr. D. E. Hogue
Department of Animal Sciences

PROJECT DURATION: Started 2/28/1975; Termination Date 2/28/1976

PURPOSE: To evaluate high-lysine maize as the major dietary component during growth and subsequent reproduction of the rat, in order to ascertain whether the improvement in protein nutrition may bring about changes in other nutrients, such as vitamins and minerals.

DESCRIPTION OF ACTIVITY: Rats will be fed experimental diets from weaning through two reproductive cycles and the young produced will be studied during the growing period. Several experimental diets will be used: two samples of high-lysine maize from different geographic areas and one sample of ordinary maize (Dent #2). Each of these three diets will be fed, with and without supplemental vitamins and minerals. One commercial laboratory rat diet will serve as a positive control.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project and no results are, as yet, available.

PROJECT TITLE: DEVELOPMENT OF CULTIVARS OF OATS WITH RESISTANCE TO MAJOR DISEASES AND WITH HIGH NUTRITIONAL QUALITY FOR USE IN LESS DEVELOPED TROPICAL COUNTRIES

CONTRACTOR: University of Wisconsin
Madison, Wisconsin 53706

CONTRACT COORDINATOR: Dr. H. L. Shands
Professor of Agronomy (Ret.)

PROJECT DURATION: Started 11/1/1974; Termination Date 12/31/76

PURPOSE: The objective of this project is to develop populations of oats agronomically suitable for tropical areas, carrying resistance to potential diseases and maintaining high grain quality.

DESCRIPTION OF ACTIVITY: An oat disease nursery is being established at several locations in the United States and overseas, and data are being collected on susceptibility of oats to various diseases and insects and on general performance. The project intends to determine the parameters of Avena germ plasm and to assess parental possibilities of oats for yielding desirable recombinants after hybridization.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project. The first national disease nursery has been carried out successfully, and valuable lines of cooperation have been established with international research centers and national research programs in LDCs.

FUTURE PLANS: The screening for disease and insect resistance will continue, and oat populations will be developed for the purpose of incorporating multiple disease and insect resistance with other desirable characteristics. These populations will be distributed to breeders in the LDCs.

PROJECT TITLE: IMPROVEMENT OF THE PRODUCTIVITY AND NUTRITIONAL QUALITY OF WHEAT

CONTRACTOR: University of Nebraska
Lincoln, Nebraska 68503

CONTRACT COORDINATOR: Professor Virgil Johnson, Geneticist (USDA)
Professor Paul J. Mattern, Biochemist
Department of Agronomy, U. of Nebraska

PROJECT DURATION: Started 6/29/66; Termination Date Indefinite

PURPOSE: The purpose of this project is to develop lines and varieties of wheat of improved productivity and nutritional quality adaptable to the wheat-growing areas of the LDCs.

DESCRIPTION OF ACTIVITY: The world wheat collection has been screened for high-protein germ plasm, and new collections continue to be evaluated. Selected material is evaluated biologically and chemically for nutritional quality. An International Winter Wheat Performance Nursery (IWWPN), in which new material is evaluated around the world, is conducted each year. Research on the nitrogen metabolism of the wheat plant is being conducted systematically.

ACCOMPLISHMENTS AND UTILIZATION: The University of Nebraska and the USDA have identified a number of wheat varieties with high potential value as genetic sources of superior protein and lysine levels. Crosses among these and other varieties have produced experimental lines with levels significantly higher than the parental varieties and much higher than ordinary varieties. More than 100 lines have averaged 17 percent protein and 3.5 percent lysine. This represents about a 40 percent increase in protein and a 20 percent increase in lysine. Two hundred eighty high-protein, high-lysine lines have been distributed to breeders at 26 different sites in LDCs and other countries for agronomic evaluation and use in breeding programs.

A rapid *in vivo* laboratory screening test involving nitrate reductase is being perfected for efficient early identification of cultivars with genetic potential for high grain production. This test can be used equally well on other crops. A highly important spinoff was the discovery of the mechanism by which herbicides kill plants, and the associated development of a rapid technique for identification of chemicals with herbicidal properties. The method has been patented.

FUTURE PLANS: This research has been coordinated with wheat research activities in USDA, FAO, CIMMYT, and Oregon State University. Effective cooperative relationships have been established with the ministries of agriculture and national research organizations in some 40 cooperating countries. There will be emphasis on exploitation of already identified genes for high protein and lysine in the development and use of productive, agronomically acceptable varieties in LDCs. The research will be broadened to study basic physiological processes that contribute to improved nutritional value and productivity, including nitrogen metabolism, photosynthetic efficiency, and associative symbiotic nitrogen fixation.

PROJECT TITLE: IMPROVEMENT OF THE NUTRITIONAL QUALITY AND PRODUCTIVITY OF BARLEY FOR THE SEMI-ARID REGIONS

CONTRACTOR: Montana State University
Bozeman, Montana 59715

CONTRACT COORDINATOR: Dr. L. P. Carter
Associate Dean of Agriculture

PROJECT DURATION: Started January 1974; Termination Date Indefinite

PURPOSE: This project develops barleys of superior protein content and quality, high yield, and improved agronomic characteristics for semiarid regions in the tropics. Because of the adaptability of barley to cooler and drier regions, its improvement and development can assure production of food and feed of superior nutritional value for certain LDCs.

DESCRIPTION OF ACTIVITY: LDC barley-producing areas will be studied to determine the major factors limiting production, and germ plasm will be collected for use in the improvement program. The maximum recombination method will be used to develop improved barley populations with early maturity; photoperiod insensitivity; resistance to insects, diseases, drought, drying winds, and temperature extremes; high yield with broad adaptation; high protein and improved amino acid balance; and consumer acceptance.

ACCOMPLISHMENTS AND UTILIZATION: The University of Montana has germ plasm of high-protein and high-lysine barley lines on hand. Also, the variety "Hiproly," selected by Swedish workers, has 14-20 percent protein content and contains 20-30 percent more lysine per unit of protein than average barley. A Middle East survey trip was made in 1974 to evaluate problems, investigate possibilities for collaboration, and collect breeding materials.

FUTURE PLANS: Close collaboration is being established with CIMMYT, ALAD, and other international organizations as well as LDC agricultural programs. One of the international centers will likely assume leadership in uniform evaluation of new varieties in LDCs, as well as training of research and production personnel and outreach activities. Workshops, seminars, and training programs will be developed at Montana State and cooperating locations.

PROJECT TITLE: DEVELOPMENT OF IMPROVED VARIETIES OF SOYBEANS, THEIR UTILIZATION AS FOOD, AND SUPPORTING CULTURAL PRACTICES FOR PRODUCTION IN THE TROPICS

CONTRACTOR: University of Illinois at Urbana-Champaign
Urbana, Illinois 61801

CONTRACT COORDINATOR: Dr. W. N. Thompson, Director
International Soybean Program (INTSOY)

PROJECT DURATION: Started 4/1/73; Termination Date 3/31/76

PURPOSE: The project is directed toward the reduction of the worldwide protein gap by developing improved soybean varieties for tropical and subtropical conditions and promoting their direct use as human food.

DESCRIPTION OF ACTIVITY: The contractor screens and breeds high-yielding food soybean varieties with broad adaptation to tropical and subtropical conditions; develops supporting cultural practices required to achieve and maintain high yields under these conditions; provides technical assistance, research linkages, and back-stopping to LDC institutions cooperating in adaptive research in soybean improvement; furnishes formal and practical training in soybean culture; and demonstrates processes for using soybeans directly as human food at the home and village level. A Basic Ordering Agreement has been signed with the University of Illinois, enabling any AID Mission to obtain the services of experts in any facet of a soybean development program.

ACCOMPLISHMENTS AND UTILIZATION: This project builds on experience gained in a previous technical assistance contract which demonstrated that selected high-yielding U.S. commercial soybean varieties could produce acceptable yields under tropical and subtropical conditions. The earlier project also identified some critical cultural practices required to achieve and maintain yields. In the project, 125 planting trials using 15 U.S. and selected local varieties have been established in 50 countries. Data from these trials form the basis for a breeding program in Puerto Rico. Two regional conferences of soybean scientists from Latin America, Africa, the Middle East, and South Asia have been held.

FUTURE PLANS: The project will: 1) intensify uniform varietal testing and breeding activities, particularly at the University of Puerto Rico and LDC research centers; 2)

identify and develop germ plasm with resistance to the most serious diseases; 3) conduct research on seed-borne diseases; 4) develop commercial insect management programs for tropical and subtropical conditions; 5) develop processing methods adapted to home and village conditions; 6) evaluate varieties for nutritive value and cooking qualities; and 7) provide graduate level and practical training in soybean culture.

PROJECT TITLE: EVALUATION OF THE POTENTIAL FOR IMPROVEMENT OF MUNGBEAN AS A MAJOR FOOD GRAIN LEGUME

CONTRACTOR: University of Missouri
Columbia, Missouri 65201

CONTRACT COORDINATOR: Dr. J. M. Poehlman
Department of Agronomy

PROJECT DURATION: Started May 1973; Termination Date May 1975

PURPOSE: This project compares mungbeans with other food grain legumes as a potential crop for LDCs.

DESCRIPTION OF ACTIVITY: This project will accumulate and screen mungbean plasm for desirable characteristics in cooperation with AVRDC and IRRI. IRRI considers the mungbean a major possibility in rice crop rotation. Linkages are also being established with other international institutes, as well as ministries of agriculture and universities in cooperating countries. This research project proposes: 1) to examine genetic potential within the species and to identify characteristics of the plant important for its genetic improvement; 2) to develop a mungbean screening nursery in cooperation with interested research workers in other countries and at selected international research institutes in order to discover the climatic adaptation of selected strains; and 3) to research breeding problems to help evaluate the potential for improving mungbeans.

ACCOMPLISHMENTS AND UTILIZATION: In 1974, 195 strains of mungbeans were grown in replicated trials at Columbia, Missouri. More than 1,200 new introductions were grown in single rows. Seeds for the third International Mungbean Nursery were distributed to 39 cooperators in 18 countries during 1974. Duplicate strains from some 2,688 different accessions have been identified. Collected data are being tabulated and distributed to mungbean research workers. High-yielding and disease-resistant strains have been identified. Further research relates to other characteristics such as temperature-photoperiod response, inheritance and nature of seed color, identification of virus insect vectors, and embryo culture techniques to be used in following up interspecific crosses. Results are being sent to mungbean workers all over the world. Five publications were distributed in 1974.

FUTURE PLANS: Reports will be disseminated to cooperators and workers in mungbean research.

PROJECT TITLE: IMPROVING THE QUALITY AND YIELD OF BEAN SEED PROTEIN AND THE DEVELOPMENT OF SUPERIOR POPULATIONS FOR USE IN BREEDING PROGRAMS

CONTRACTOR: University of Wisconsin
Madison, Wisconsin 53706

CONTRACT COORDINATOR: Dr. Frederick A. Bliss
Professor of Genetics

PROJECT DURATION: Started November 1974; Termination Date November 1977

PURPOSE: This project will identify strains of *Phaseolus vulgaris*, the common bean, that have enhanced levels of protein and limiting amino acids in the seed. And, it will develop breeding populations of these strains that will also combine high yield and other desirable characteristics for use in breeding programs in the LDCs.

DESCRIPTION OF ACTIVITY: Bean strains having enhanced levels of seed protein and methionine have been identified. Screening, selection, and breeding work will be carried out to identify promising material for use in breeding populations. The best selections will be intermated to form advanced populations for recurrent selection. Germ plasm is being received from various sources in the United States and abroad, and cooperative arrangements are being made with research institutions in LDCs and the international research institutes.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project and no results are as yet available.

PROJECT TITLE: IMPROVEMENT OF TROPICAL PRODUCTION OF BEANS AND COWPEAS THROUGH DISEASE AND INSECT CONTROL

CONTRACTOR: University of Puerto Rico
Mayaguez, Puerto Rico 00708

CONTRACT COORDINATOR: Dr. J. H. Lopez Rosa
Department of Phytopathology

PROJECT DURATION: Started May 1973; Termination Date March 1978

PURPOSE: Grain legumes are important food crops throughout the tropics, but production is low because of serious insect and disease problems. This project studies insect and disease problems affecting grain legumes in the tropics and develops control measures, with special emphasis on varietal resistance. Puerto Rico's climate is especially favorable for this work.

DESCRIPTION OF ACTIVITY: Studies being conducted in Puerto Rico and throughout the tropics are identifying and characterizing disease, insect, and nematode problems of beans and cowpeas. Disease-resistant germ plasm is also being collected. Collaboration has been established with CIAT, IITA, and PCCMCA, as well as with LDC ministries and universities.

ACCOMPLISHMENTS AND UTILIZATION: As a result of work already in progress at the University of Puerto Rico, techniques for detecting and identifying five whitefly-transmitted bean viruses, using 18 "classical" bean varieties as differentials, have been perfected. Resistance to other diseases, nematodes, and insects is being evaluated. Thirteen lines of disease-resistant cowpeas and 19 lines of disease-resistant beans have been released. An International Workshop on Grain Legume Diseases was held on June 24-26, 1974, in Puerto Rico.

FUTURE PLANS: Study of diseases and insect pests will continue, with emphasis on developing control measures through use of resistant varieties, improved management practices, and conventional chemicals. New varieties will be tested in Puerto Rico and abroad through uniform field trials carried out in cooperation with international institutes and national research organizations. Varieties will be evaluated for protein content, quality, and nutritional value, as well as disease and insect resistance, yield, and other agronomic qualities. Plans also include training LDC technicians, holding seminars in Puerto Rico and abroad, and publishing appropriate reports.

PROJECT TITLE: RESEARCH ON INTEGRATED CROP PROTECTION SYSTEMS WITH EMPHASIS ON THE ROOT-KNOT NEMATODES (MELOIDOGYNE)

CONTRACTOR: North Carolina State University
Raleigh, North Carolina 27607

CONTRACT COORDINATOR: Dr. Joseph N. Sasser
Department of Plant Pathology

PROJECT DURATION: Started 4/1/75; Termination Date 3/31/77

PURPOSE: This project is directed to the reduction of food crop losses in certain LDC areas caused by root-knot nematodes (Meloidogyne), the training of personnel, and improvement of laboratory facilities in these areas for continuing research on this problem.

DESCRIPTION OF ACTIVITY: The project will carry out research in five geographic areas (Central America, South America, Central and West Africa, East Africa, and Southeast Asia) on control of root-knot nematodes. It will determine the species and biotypes of the root-knot nematodes present in each of these areas; ascertain the susceptibility and/or resistance of the staple food crops to the root-knot nematodes present; and establish a bank of information on cultivars which display resistance to the nematodes identified in the five regions. The successful completion of these goals will provide the reservoir of information required to devise effective and economical control strategies.

ACCOMPLISHMENTS AND UTILIZATION: Research capability in areas where it is most needed will be developed by: selecting laboratories and regional coordinators; conducting a workshop at NCSU for regional coordinators; holding intensive workshops in each region; starting the collection of populations of the pathogen and conducting host range and pathogen variability studies; developing economical control programs in each region; operating a training program consisting of workshops, seminars, and degree programs; conducting a midpoint progress conference; and assisting host country personnel in the initiation of control strategies to utilize research findings and to indicate problem areas where additional information is needed.

FUTURE PLANS: Field linkages will be established with other TA/AGR research projects dealing with food

crops; close liaison will be maintained with the on-going pest management project between TA/AGR and the University of California at Berkeley. Foreign linkages will be forged with the international research centers, with definite coordination with three regional areas, specifically around Kenya, Costa Rica, and the Philippines.

SOIL AND WATER MANAGEMENT RESEARCH PROJECTS

PROJECT TITLE: WATER MANAGEMENT RESEARCH IN ARID AND SUBHUMID LANDS OF THE LDCS IN LATIN AMERICA

CONTRACTOR: Utah State University
Logan, Utah 84321

CONTRACT COORDINATOR: Dr. Howard Peterson, Project Director
Management Research Programs

PROJECT DURATION: Started 6/28/68; Termination Date 6/30/76

PURPOSE: This project is a companion to a Colorado State University project for similar research in the Near East and South Asia. The purpose is to improve on-farm water management practices, integrating these with other essential management and cultural practices necessary for effective agricultural development.

DESCRIPTION OF ACTIVITY: USU is adapting known techniques to the on-farm water management problems of arid and subhumid agricultural lands in Latin America. Research is being conducted in: 1) determining the most efficient means of supplementing soil moisture with limited amounts of irrigation water; 2) developing data which can be used for on-farm design and construction of inexpensive water conveyance, delivery, application and drainage systems; and 3) developing management systems to minimize salinity hazards. Problems of farmers with small holdings and limited employment opportunities are examined. Special effort is made to cooperate with local institutions.

ACCOMPLISHMENTS AND UTILIZATION: Research plots in Brazil, Colombia, and El Salvador are relating crop yields to interaction of water with fertilizers, crop varieties, plant spacing, and land preparation. Increases of 40 to 100 percent over traditional yields are being achieved. Procedures for estimating irrigation requirements have been improved, and methods for increasing water infiltration rates and underground drainage in tight soils have been developed. Computerized hydrological model simulation methods predict effect of alternative land uses on the underlying ground water table, and the economics of alternative levels of water use technologies have been determined. Legal constraints on agricultural water use have been catalogued for five countries. Research has been iniitated in Peru, Guatemala, and Ecuador.

FUTURE PLANS: Assistance to USAIDs and LDCs on water management research will continue.

PROJECT TITLE: WATER MANAGEMENT RESEARCH IN ARID AND SUBHUMID LANDS OF THE LDCS, NEAR EAST AND SOUTH ASIA

CONTRACTOR: Colorado State University
Fort Collins, Colorado 80521

CONTRACT COORDINATOR: Dr. W. D. Kemper
Project Director

PROJECT DURATION: Started 6/28/68; Termination Date 6/30/76

PURPOSE: This project for water management research in the Near East and South Asia (with emphasis in Pakistan) is a companion to the Utah State University/Latin America water management project. Its aim is to improve on-farm water management practices. These practices will be integrated with other essential management and cultural procedures basic to producing more food for the growing populations of developing countries.

DESCRIPTION OF ACTIVITY: CSU is developing new technology and adapting known technologies to on-farm water management problems in developing countries. Research continues in: 1) developing data which can be used for on-farm design and construction of inexpensive water conveyance, delivery, application, and drainage systems; and 2) developing management systems to minimize salinity hazards. The focus is on problems of farmers with small holdings and limited employment opportunities. Cooperation with local institutions on research projects is emphasized.

ACCOMPLISHMENTS AND UTILIZATION: Most of the research is being carried out on actual farms on several watercourse areas. A watercourse area comprises 40-60 farmers who manage their water from a commonly owned channel from the main canal. Watercourse channel improvement, land leveling, and irrigation scheduling are all being studied to determine the economic and social feasibility of developing better water delivery systems to serve properly designed fields.

FUTURE PLANS: The AID Mission to Pakistan and the Pakistan Government are jointly planning a major program based on the Colorado State University water management research. Several hundred watercourse areas will be improved with properly designed ditch systems and leveled farms. Benefits of the technology will be assessed further as the program progresses.

PROJECT TITLE: AGRONOMIC-ECONOMIC RESEARCH ON TROPICAL SOILS

CONTRACTOR: North Carolina State University
Raleigh, North Carolina 27607

CONTRACT COORDINATOR: Dr. C. B. McCants, Head
Soil Science Department

PROJECT DURATION: Started 6/30/70; Termination Date 6/30/78

PURPOSE: The overall objective of this project is to obtain and utilize new and relevant information on tropical soils in developing a system for making fertilizer and crop management recommendations that will yield the best return from available resources and will be generally adaptable to the LDCs.

DESCRIPTION OF ACTIVITY: The contractor has an active field research program in Brasilia, Brazil; Yurimaguas, Peru; and Turrialba, Costa Rica. Work in Brazil deals with aluminum, phosphate, and lime interactions in the soil and also with the possible limiting role of zinc in plant nutrition. In Peru, methods of land clearing, subsequent crop sequences, and associated fertility maintenance practices are being studied and tested. In Costa Rica, multiple-cropping is being examined with emphasis on identifying the factors which limit its use.

ACCOMPLISHMENTS AND UTILIZATION: Corn yields in Camp Cerrado, Brazil, have been raised to commercially acceptable levels through coordinated management. In Peru, a program of hand clearing of land, combined with moderate application of soil nutrients, holds promise for a continuous cropping pattern of rice, soybeans, cassava, and pasture. Tests being carried out indicate that multiple cropping can be more profitable than monoculture for small farmers in some parts of Latin America.

A decade of research was evaluated with the publication of "A Review of Soil Research in Tropical Latin America," which was also published with a Spanish translation. From this base, new field and laboratory work has been initiated to provide a better understanding of soil chemistry and management, as well as the practical economics of more intensive use of tropical soils. Data for selected crops in Costa Rica, Peru, Colombia, Bolivia, and Brazil have been collected and collated. Analytical models will be made based on available computer equipment. Linkages have been established with 14 countries, five universities, and five international institutions, as well as with TVA.

FUTURE PLANS: The contractor will continue to work on organizing data in files, in books, or in computer storage, and will also continue the review of more than 1,000 publications on soils in the English and Spanish languages. Direct contact with 350 soil scientists will be maintained and worldwide cooperators identified. Collaborative studies and exchange of information with LDCs will be increased and liaison with host governments will be strengthened.

PROJECT TITLE: SOIL FERTILITY IN THE HUMID TROPICS

CONTRACTOR: Cornell University
Ithaca, New York 14850

CONTRACT COORDINATOR: Dr. Madison Wright, Chairman
Department of Agronomy

PROJECT DURATION: Started 6/30/69; Termination Date 6/29/77

PURPOSE: The goal of this project is to develop improved, economically sound, and reliable food production systems for the deep, well-drained, acid soils of the humid tropics. Under present management methods, these soils are not extensively cultivated or are only marginally productive.

DESCRIPTION OF ACTIVITY: These studies are undertaken to determine the most effective amounts and methods of application of nitrogen, phosphorous, potassium, liming materials, and micro-nutrients and soil moisture requirements to achieve the production potential for food crops on acid soils of the tropics. Ultimate objective is to provide recommendations for improved soil, water, and crop management practices within the capabilities and resources of cultivators.

ACCOMPLISHMENTS AND UTILIZATION: Field research began in Puerto Rico in 1970 and Brasilia in 1972. While the original objectives are still relevant, research emphasis has shifted toward water management and its relation to soil fertility work--an approach suggested by the Brazilian experiment. Deep placement of lime (60 centimeters) in highly acid subsoils raised corn production from 88 bushels to 126 bushels per acre. Results of research have been disseminated by seminars (200 participants attended one given in Cali, Colombia); presentations in Brazil (in Portuguese in Recife and Brasilia, and in English at Campina Grande, Paraiba); publications; experimental site visits; undergraduate and graduate work; and outreach consultation visits. Research linkages have been established with IITA, CIAT, CIMMYT, and the U.S. University Consortium for Soils of the Tropics.

FUTURE PLANS: Level of effort will be reduced in Puerto Rico, with more emphasis on soybeans and plantains. Work in Ghana will initiate simple on-farm experiments to supplement station experiments. Plant breeding will develop varieties which will utilize nitrogen, phosphorus, and other nutrients and at the same time tolerate acid soil conditions. Experiments to make use of residual soil nitrogen from previous plantings will continue.

PROJECT TITLE: CROP PRODUCTION AND LAND CAPABILITIES OF A NETWORK OF TROPICAL SOIL FAMILIES

CONTRACTOR: University of Hawaii
Honolulu, Hawaii 96822

CONTRACT COORDINATOR: Dr. L. D. Swindale
Department of Agronomy and Soil Science

PROJECT DURATION: Started 5/31/74; Termination Date 5/30/79

PURPOSE: This project correlates food crop yields on a network of benchmark tropical soils, and assess transferability of technology among tropical LDCs.

DESCRIPTION OF ACTIVITY: The contractor expects to establish a network of benchmark soils, crop production levels, and soil management experiments in two countries in tropical Asia, one in Africa, and in Hawaii. This project seeks to determine relationships between production and land management capabilities. Benchmark soils will belong to soil families of related subgroups as defined by the new U.S. Soil Taxonomy, since the family level in the classification is the level at which transference of agrotechnology is proving possible in the temperate zones and in Hawaii.

ACCOMPLISHMENTS AND UTILIZATION: Government agencies of both Indonesia and the Philippines have agreed in principle to cooperate. Soil samples from sites in Indonesia were collected, analyzed, and classified according to the U.S. Soil Taxonomy. Correspondence between the contractor and organizations in Nigeria, Kenya, Cameroon, Rwanda, Ethiopia, and Tanzania have been initiated to obtain an expression of interest. Site investigations and negotiations to lease lands for experimental sites in Hawaii have also been initiated.

FUTURE PLANS: Project personnel will go to the Philippines, Indonesia, and Africa to collect soil samples for comparative analysis and verification of classification according to the U.S. Soil Taxonomy; to survey land areas for experimental sites; and to open negotiations for those sites. Local personnel will be trained in management and operation of the experimental sites. Linkages will be established with AID Missions, international organizations, universities, and government agencies. A seminar, "Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics," will be held at ICRISAT in January 1976.

PROJECT TITLE: CROP PRODUCTION AND LAND POTENTIAL OF BENCHMARK SOILS OF LATIN AMERICA

CONTRACTOR: University of Puerto Rico
Mayaguez, Puerto Rico 00708

CONTRACT COORDINATOR: Dr. F. H. Beinroth
Department of Agronomy

PROJECT DURATION: Started 1/1/75; Termination Date 12/31/79

PURPOSE: This project seeks to establish 1) that soil potential for crop production under various levels of management inputs can be predicted on the basis of soil classification, and 2) that soil management experience can be transferred via soil classification. The research aim is to develop a methodology for mobilizing and utilizing existing soil management knowledge through direct transfers of information among tropical countries in order to accelerate agricultural development in LDCs.

DESCRIPTION OF ACTIVITY: The contractor will concentrate on benchmark soils of tropical Latin America; a parallel University of Hawaii project will focus on African and Asian soils. The soils of this worldwide network will belong to similar soil families as defined in U.S. Soil Taxonomy. Agrotechnology has already been successfully transferred at this level of classification in the temperate zone, but this has not been scientifically substantiated for the tropics. To this end, a series of identical crop production and soil management experiments will be conducted at all of the experiment sites, with the objective of correlating soil taxonomic units with crop yields. The uncontrolled and uncontrollable yield-affecting variables will be quantified as far as possible to allow proper adjustments in the production functions. The red upland soils, identified as Oxisols in Soil Taxonomy, will be used in the experiments. These are inadequately used in most tropical countries but have proven to be highly productive under efficient management in Puerto Rico and elsewhere.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project, but local personnel have established linkages with LDC institutions to expedite site selection. In collaboration with the University of Hawaii, a workshop was held to devise the experimental design and research methodology best suited to provide a valid scientific test of agrotechnology transfer and efficient generalization of results.

FUTURE PLANS: The specific soil families to be used will be identified and the corresponding soils will be selected in two or three LDCs in tropical Latin America. Agronomic experiments will be established at these locations and in Puerto Rico. Future efforts will be directed to expanding this network to satellite sites and to indigenous agricultural research stations.

PROJECT TITLE: IMPROVED FERTILIZERS FOR DEVELOPING COUNTRIES

CONTRACTOR: Tennessee Valley Authority
Muscle Shoals, Alabama 35660

CONTRACT COORDINATOR: Dr. Paul J. Stangel, Director
International Staff

PROJECT DURATION: Started 3/1/73; Termination Date 6/30/75

PURPOSE: The goals of the project are to develop fertilizers to meet the nutrient needs of specific crops and soils which are not being met with conventional fertilizers; test the value of these improved materials to insure they will increase farmers' incomes; develop commercial production technology for the new fertilizers; and, through agricultural organizations, educate farmers in the use of these new fertilizers.

DESCRIPTION OF ACTIVITY: As an expansion of the former project (which was restricted to the use of fertilizers for rice), the present project will evaluate the effectiveness of sulfur-coated urea (SCU) on additional crops such as sugar cane, corn, cassava, cotton, bananas, and cocoa. Additional studies are planned with rock phosphate to evaluate its effectiveness, alone or in combination with granulated mixtures of other materials.

ACCOMPLISHMENTS AND UTILIZATION: The project will continue the tests started on cropping systems where the fertilizer nitrogen may be applied in a slow-release form at a convenient time in the cropping system. The nutrient elements are thereby released for utilization by succeeding crops. Samples of phosphate rock will be collected from LDCs to test and evaluate them in local pilot programs. Sulphur-coated urea will be tested as a source of nitrogen for pasture forages and for tree crops in the high-rainfall areas of Latin America.

FUTURE PLANS: Plans call for TVA to have in operation by 1976 a demonstration-scale plant capable of producing 10 tons of SCU per hour. In preparation for this program, SCU will be used in research and demonstration work with government and industry personnel in selected countries. This will prepare the way for full-size demonstrations as soon as commercial sources of SCU become available. Linkages established with international institutions, universities, and government agencies abroad have fostered a growing exchange of research data and information. These linkages should provide solid economic evaluations of the new fertilizers throughout the world. This research will be taken over by IFDC after the TVA agreement terminates.

PROJECT TITLE: BIOLOGICAL NITROGEN FIXATION - LEGUME RHIZOBIUM SYMBIOSIS RESEARCH

CONTRACTOR: University of Hawaii
Honolulu, Hawaii 96822

CONTRACT COORDINATOR: Dr. A. Sheldon Whitney
Dr. Burton L. Koch
Department of Agronomy and Soil Science

PROJECT DURATION: Started April 1, 1975; Termination Date March 31, 1978

PURPOSE: This project is directed at one of the more important phases of the work proposed for the International Plant Nutrition Institute, which has been suggested to CGIAR for its sponsorship. The work will be coordinated with that proposed to be undertaken by the Institute to ensure there is no duplication of effort. The purpose of this project is to identify nitrogen-fixing bacteria which grow in symbiosis with tropical legumes in a relationship which will supply enough nitrogen to produce acceptable yields of the legume and associated or subsequent crops. The findings will be made available to farmers in LDCs.

DESCRIPTION OF ACTIVITY: Recent price increases for chemical fertilizers have further restricted their usefulness for food production in many LDCs, especially by small farmers. The most feasible alternative nitrogen source is symbiotic N-fixation by legumes. At the same time, the supply of protein in the LDCs continues to lag behind the protein requirements, and much of the requirement will have to be met by increased production of pulses and other legumes. A program to increase protein production must depend on an efficient legume/rhizobium symbiotic relationship which relies on the legume to fix carbon and the rhizobium to use that carbohydrate to fix nitrogen. Poor nodulation and low efficiency of indigenous strains is a common factor limiting crop yields in tropical LDCs. Furthermore, there are presently very few trained legume bacteriologists in the tropics. This project will address itself to both these problems.

ACCOMPLISHMENTS AND UTILIZATION: The project will enhance possible future International Plant Nutrition Institute programs and enable LDCs to promote symbiotic N-fixation research and development programs by: a) compiling a world collection of rhizobium strains, and publishing an annotated catalogue; b) characterizing many of these strains as to effective host ranges, and tolerance

to adverse soil conditions; c) distributing superior strains to agriculturalists throughout the tropics; d) developing more dependable inoculation techniques for use in LDCs; e) developing cultural systems to exploit rhizobium/legume symbiosis as a source of N for food production; f) training biologists in research and production technology; and g) establishing links with other international institutes for the exchange of information and consultants.

PROJECT TITLE: DEVELOPING ALUMINUM TOLERANT CROP VARIETIES FOR THE ACID SOILS OF THE TROPICS

CONTRACTOR: Washington State University
Pullman, Washington 99163

CONTRACT COORDINATOR: Dr. C. F. Konzak
Professor of Agronomy and Genetics

PROJECT DURATION: Started April 1974; Termination Date June 30, 1976

PURPOSE: This project will develop populations and varieties of several crop plants which will tolerate the aluminum toxicity in many acid soils of the tropics, thus making agriculture more feasible on large tracts of land now of limited use.

DESCRIPTION OF ACTIVITY: A technique for screening wheat germ plasm for tolerance to aluminum toxicity has been developed. This technique is being refined and adapted for use on other crop plants, including corn and soybeans. Promising material detected by this screening will be further tested and made available for use in breeding programs in the LDCs.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project and no results are available, as yet.

LIVESTOCK PRODUCTION

RESEARCH PROJECTS

PROJECT TITLE: RESEARCH ON HEMOPROTOZOAL DISEASES OF FOOD-PRODUCING LIVESTOCK

CONTRACTOR: Texas Agricultural and Mechanical College
College Station, Texas 77843

CONTRACT COORDINATOR: Dr. Fred Maurer, Associate Dean
Veterinary Faculty

PROJECT DURATION: Started 6/30/68; Termination Date 6/30/78

PURPOSE: This research, centered at CIAT and ICA (Colombian Institute of Agriculture) in Colombia, is aimed at developing immunizing agents or other controls for the reduction of blood parasite livestock disease losses in tropical countries. These diseases, a major reason for low animal productivity in LDCs, are caused by blood parasites transmitted by insects or ticks. Added to the original purpose of the research is an effort to control or eliminate the vectors (i.e., the transmitting insects or ticks). Red blood cell destruction leads to severe anemia in livestock; secondary effects cause high mortality and morbidity rates, with consequent loss of animal protein supplies for human nutrition.

DESCRIPTION OF ACTIVITY: The contractor is 1) developing methods for controlling hemoprotozoal diseases by livestock immunization and other preventive procedures; 2) determining ecological factors which contribute to the perpetuation of vectors of hemoprotozoal organisms; 3) studying the interaction of certain blood parasite organisms in relation to pathogenicity and immunity; 4) studying species' resistance to specific hemoprotozoal organisms; 5) training host-country specialists in methodology and organization of problem-oriented research; and 6) conducting workshops to demonstrate research accomplishments and to exchange research and technological developments with participants from five continents.

ACCOMPLISHMENTS AND UTILIZATION: Tests in zones with high hemoprotozoal diseases showed that, at 6 months of age, vaccinated calves had gained an average of 102 pounds on pasture while control calves had gained only 6 pounds. This also reflected a 50 percent death loss in the control group. At 10 months, the vaccinated calves had gained 255 pounds, compared to 75 pounds for the controls. Inexpensive vaccination gives the small farmer a cheaper method of controlling tick vectors than the costlier spray or dipping-vat equipment. Research is now centered at the CIAT laboratories in Palmira, Colombia, with the field program also on ICA stations. Private cooperators are helping expand the immunization program. Additional data on tick ecology have been accumulated and will be related to future field control experiments. The training program,

involving Texas A&M graduate students, has been accelerated. Project specialists assisted Peru, Ecuador, and Guatemala in 1973, and the service is being extended to Panama and countries in the South Pacific on request. In addition, Texas A&M has undertaken a separate 3-year utilization project consisting of field-scale demonstrations of immunization techniques in Colombia, and possibly Brazil, in conjunction with CIAT and the veterinary services of these two countries. The demonstrations will aim at providing factual evaluation of the economic benefits of immunization. The data will help AID Missions, Regional Bureaus, and developing countries establish animal health programs that will contribute to the increased efficiency in the production of animal products.

FUTURE PLANS: The project will continue to exchange data with researchers in East Africa and Australia. Research emphasis will be shifted toward immunochemistry and advances in tissue culture techniques. A workshop on the vectors of blood parasitic diseases will be held at CIAT in August 1975. In addition, workshops on the blood parasites and on the vectors of these diseases, to be held in tandem, are planned for East Africa in 1976.

PROJECT TITLE: RESEARCH ON THE STERILITY METHOD OF TSETSE FLY CONTROL

CONTRACTOR: Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C.

CONTRACT COORDINATOR: Dr. David Dame, Florida-Antilles Area Insect Attractants and Biological Research Laboratory
Post Office Box 14565
Gainesville, Florida 32604

PROJECT DURATION: Started 6/14/63; Termination Date 6/30/77

PURPOSE: Because the tsetse fly transmits disease to men and animals, infestations now hamper the use of over 4 million square miles of productive land in Africa. This project, now in Phase II, is to validate the Phase I findings that the tsetse fly can be eliminated through male sterilization. Phase II expands the limited initial field test to a full-scale trial. Sterilized males will be released on 164 square miles of infested land to determine whether such releases will permanently eradicate the natural fly population, and to compare the cost of this approach with other methods of fly clearance.

DESCRIPTION OF ACTIVITY: Initially, Phase II establishes the fly colony needed for the release of the sterile males in suitable numbers. An area near Tanga, Tanzania, has been selected for fly rearing and fly testing. Fly rearing in colonies is now successfully underway and it is no longer necessary to collect pupae in the field to maintain the colony at Tanga. Periodic fly counts in the control area determine the sequential releases required; the area will be monitored for 12 months after the release. The barrier to isolate the 164-square mile Mzeri Hill Ranch site is now being established to assure that no re-infestation occurs from outside the test site.

ACCOMPLISHMENTS AND UTILIZATION: Cage rearing of flies under laboratory conditions was achieved in Phase I. New techniques have increased pupae survival, and a new membrane feeding technique to supply blood meal promises to reduce operational costs. Within 1 1/2 years, the Tanzania station will produce enough sterile male flies for field trials on the 164-square mile test site. Laboratories in Bristol, England; Lisbon, Portugal; Maisson-Alfort, France; and Siebersdorf, Austria, have also established successful rearing colonies. Consultant services have been established with the laboratory in Bristol, England, and with the International Atomic Energy Agency in Vienna.

The fly colony is now self-sufficient. After the field exercise, it will probably supply flies to other fly-eradication projects and to laboratories such as ILRAD and ICIPE (International Center for Insect Physiology and Ecology) for further research on tsetse flies or on trypanosomiasis.

It should be noted that this research has resulted in the development of high quality goat and rabbit breeding animals. Tanzania's Ministry of Agriculture is interested in establishing colonies of these animals as models for commercial development of food for human consumption.

FUTURE PLANS: Ties with the new International Laboratory for Research on Animal Diseases (ILRAD) in Kenya will be established. More emphasis will be placed on research in membrane feeding techniques. Cage rearing of flies will be accelerated toward a goal of doubling the fly colony annually through FY 1977.

PROJECT TITLE: CONTROL OF VERTEBRATE PESTS--RATS AND NOXIOUS BIRDS

CONTRACTOR: Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Washington, D.C. 20240

CONTRACT COORDINATOR: John DeGrazio, Wildlife Biologist
Denver Wildlife Research Center
Denver, Colorado 80225

PROJECT DURATION: Started 4/5/67; Termination Date 6/30/77

PURPOSE: Rodents and noxious birds take a heavy toll on food supplies in the LDCs. This project is designed to develop pest control methods that are safe, effective, economical, and adaptable to LDC social and economic conditions.

DESCRIPTION OF ACTIVITY: The project now includes regional research at 1) Laguna, Philippines--emphasis on rats; 2) Cali, Colombia--emphasis on birds; and 3) East Africa--a new Quelea bird control project. A Denver back-up base provides technical support and correlated data from the field. Staff also respond to AID Regional Bureau and Mission requests on a TDY (temporary duty) basis for advisory assistance in any aspect of vertebrate pest control.

ACCOMPLISHMENTS AND UTILIZATION: A recent breakthrough in the vampire bat research program is greatly reducing losses in cattle production without endangering desirable bat species and the environment. Under the project, seven vampire bat control workshops have trained 400 technicians from 10 Latin American countries. Bat research has been phased out and only an advisory service using nonresearch funds remains.

A team studying bird damage losses to African crops has assisted noxious bird control programs in some 20 countries; most of the work was done in collaboration with FAO. Of particular interest is the Quelea bird, noted as the most destructive bird in the world. It seriously damages millet, sorghum, rice, and wheat in 25 African nations. Preliminary crop protection trials against the Quelea bird in Africa, prior to the inauguration of formal research, indicate that crops can be protected against damage. The project agreement has now been signed with the East African Community; further research, including biological reproduction control, is underway.

The rat control project in the Philippines found that 90 percent of the 1,693 paddies sampled had tillers (stems) cut by rats. The average tiller loss was 2.5 percent, but 5.4 percent of the sample had over 10 percent of the tillers cut and some paddies went as high as 40 percent loss. To improve field control programs, the project developed new techniques for determining rodent populations and their seasonal changes and for determining the optimum baiting periods for maximum rat kills and the most effective types of bait and baiting techniques. Rat control workshops, proven an effective training device in the Philippines, have been extended to other Asian countries. As a result, six Southeast Asian countries have established rodent control programs. In addition to Philippine personnel, a number of Southeast Asians have been trained at technician and advanced academic levels. Research on improved baiting techniques and improved bait placement has proven effective in reducing crop damage.

Another approach is application of a hypersensitivity reaction in which antigen extracts of normal parasites are applied in bait stations or as aerosols to rodents in predation areas. This may result in acute gastro-intestinal or systemic anaphylaxis reactions and shock leading to death. This system is species target specific and poses no danger to other animal species or humans.

FUTURE PLANS: New bird control programs for Africa are being developed, as well as additional workshops. A large-scale bat control program is now in operation in Nicaragua. Others are planned for Bolivia and Brazil. Assistance to other Latin American nations will be provided from non-research funds on request. The Quelea bird research is underway in East Africa (in Tanzania and Kenya), with close linkages to the ongoing FAO/UNDP bird control programs in Ethiopia, Sudan, and West Africa. Rodent control research will continue in the Philippines and Southeast Asia over the next 2 years; it is anticipated that the Rodent Research Center at Los Banos, Philippines, will be absorbed in a multidonor-supported Crop Production Center at the same location.

PROJECT TITLE: RESEARCH ON MINERAL ADEQUACIES, DEFICIENCIES, AND TOXICITIES FOR GRAZING RUMINANTS IN LATIN AMERICA

CONTRACTOR: University of Florida
Gainesville, Florida 32601

CONTRACT COORDINATOR: Dr. Lee R. McDowell
Department of Animal Sciences

PROJECT DURATION: Started December, 1974; Termination Date June, 1977

PURPOSE: The goal of this project is to determine mineral deficiencies, inadequacies, and toxicities in selected areas of Latin America where grazing livestock predominate; to evaluate the biological response and economic benefits of mineral supplements for grazing animals; and to publish and distribute information designed to stimulate widespread use of appropriate mineral supplements. Increased attention is being directed to trace element deficiencies and the toxic effects of excess trace elements on plants and animals.

DESCRIPTION OF ACTIVITIES: Working primarily in Brazil, Colombia, Ecuador, and Costa Rica, the contractor is obtaining livestock tissue and forage samples from selected farms. Livers are also being analyzed for trace mineral content. Blood serum is being analyzed for calcium, phosphorous, and magnesium concentrations and interactions are being evaluated. Forage samples are being analyzed for these and other minerals as well as inorganic sulphate. Test animals will receive mineral supplements for one year, and their performance will be compared with that of a control group. Project personnel will work closely with CIAT in Colombia. As information becomes available, it will be disseminated through Latin American and U.S. journals, special publications, and workshops.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project, but the contractor is already operating related projects in all of the countries. The research also complements a 211(d) grant for strengthening the University's capacity for research in ruminant livestock development. Other AID projects interlock with this work, including a Utah State/Latin American feed composition project; agroeconomic research in tropical soils by North Carolina State; and a Cornell project on soil fertility evaluation. The project also provides a research element neglected in the original feed composition project.

FUTURE PLANS: This is designed as a four-phase project. Phase I was concerned with establishing a collaborative research effort between the University of Florida and Latin American research institutions; Phase II covers investigation and research; Phase III will bring about distribution and application of results; and Phase IV will involve outreach activities.

PROJECT TITLE: RESEARCH ON ARTIFICIAL PROPAGATION OF MILKFISH

CONTRACTOR: Oceanic Foundation
Waimanalo, Hawaii

CONTRACT COORDINATOR: Dr. Colin E. Nash, Director

PROJECT DURATION: Started 1/13/75; Termination Date 1/12/78

PURPOSE: The project goal is to artificially propagate milkfish in captivity. Milkfish are raised in brackish water ponds throughout southeast Asia but production is limited by the number of juvenile fish that can be collected by hand in coastal areas. Successful artificial propagation will greatly increase the production of milkfish; the development of effective distribution systems will increase the availability of protein food for the people.

DESCRIPTION OF ACTIVITY: The primary goal is to develop the artificial propagation of milkfish in the shortest possible time. In addition to efficient milkfish production, which will be evaluated by the cost effectiveness of juvenile production each year, a number of specific research targets must be met to supply the detailed scientific information needed to reach the final goal. These include collecting and holding broodstock; developing techniques for induced breeding; determining egg and sperm quality; improving egg incubation and larval survival; and improving hatchery distribution procedures. Reviews will be made at the project's 18th month interval to determine program direction in the third year, and at the 32nd month to evaluate the need for a project extension.

ACCOMPLISHMENTS AND UTILIZATION: This is a new project but the Oceanic Foundation has begun the training of technical staff from the SEAFDEC Aquaculture Center in the Philippines in the practice of induced spawning of mullet. Upon the completion of training, the staff will apply the techniques of mullet propagation to milkfish in a research program in the Philippines, under the guidance of the Oceanic Foundation.

FUTURE PLANS: The foundation of the project is to establish a broodstock in captivity. This will involve the collection of mature fish at sea, the collection of juvenile fish from brackish-water ponds, and the collection of migratory fish. These fish will provide a basis for the development of broodstock husbandry. Work will include setting up procedures for holding, handling, and sampling large fish, and identifying broodstock individuality. Natural spawning conditions will be identified, followed by a laboratory

simulation of the spawning conditions. Attempts will then be made to induce spawning without hormone treatment. A definition of optimum induced spawning procedures using hormone injection will be made, followed by a determination of the cost effectiveness of readily available hormones.

Work will be undertaken to improve the survival of larvae in the laboratory in order to reduce mortality rates and develop rearing procedures. After larvae survival proportions are increased, research will be conducted to increase the hardiness of fish from larvae to juvenile stages with emphasis on the low cost production of juveniles. Procedures will then be developed to improve the handling and husbandry of juvenile fish.

AGRICULTURAL ECONOMICS

AND

SECTOR PLANNING

RESEARCH PROJECTS

PROJECT TITLE: ANALYSIS OF THE DIRECT AND INDIRECT EFFECTS OF TECHNOLOGICAL CHANGE IN AGRICULTURE

CONTRACTOR: Cornell University, Ithaca, New York

CONTRACT COORDINATOR: Dr. John Mellor
Department of Agricultural Economics

PROJECT DURATION: Started 5/74; Termination Date 5/76

PURPOSE: This project helps LDC governments make better agricultural policy decisions. Research will relate to direct and indirect effects that new technology might have on income and employment goals. A simulation model will be developed to show how the effects of technological change are distributed through the economy.

DESCRIPTION OF ACTIVITY: In this project, the new technologies are broadly defined as: a) biological innovations--such as new crop varieties with high-yield potential; b) irrigation and mechanical innovations--including machinery; and c) changes in cropping patterns--particularly as stimulated by research results. One phase of the study will compare outputs to inputs, and returns to various inputs, for both traditional and modern techniques. A second phase will explain and measure indirect effects of changes in productivity analyzed. The third phase will involve an improved methodology to trace the chain of impacts of new technology through the agricultural sector and the rest of the economy. Finally, the fourth phase will develop a working relationship with AID Regional Bureaus on small-farm cropping systems and make new agricultural technology available to the traditional farming sector.

ACCOMPLISHMENTS AND UTILIZATION: Research to date has emphasized collection and use of data. The principal effort has been in the Philippines in collaboration with the economists at IRRI. The analysis of data from a set of farm surveys will provide a clear basis for recommending the types of technology that should be emphasized in agricultural research institutions and the types of policies that will be most effective in molding technologies to society's income distribution objectives.

FUTURE PLANS: Supportive, exploratory work relates crop patterns and working time to income and welfare. Work is proceeding. Preliminary findings and future work plan will be available later.

PROJECT TITLE: ADAPTING SIMULATION MODELS TO AGRICULTURAL SECTOR ANALYSIS

CONTRACTOR: Michigan State University
East Lansing, Michigan 48823

CONTRACT COORDINATOR: Dr. George E. Rossmiller
Department of Agricultural Economics

PROJECT DURATION: Started FY 1971; Termination Date FY 1976

PURPOSE: The basic objective of this project is to test, apply, and further develop, under actual LDC conditions, the computerized systems-simulation model approach to agricultural sector analysis. This is an extension of the previous project, which applied all or significant parts of an agricultural simulation model to the analysis of agricultural development options in Nigeria and South Korea.

DESCRIPTION OF ACTIVITIES: During the previous project, the usefulness of the systems-simulation approach for sector planning in Korea was demonstrated. The model was based on an earlier model developed for Nigeria. The application of the model revealed problems in theory, technique, data, and institutional capacity which would have to be overcome if the approach is applied to practical development programming. Work in Korea will be organized to add to and improve components of the existing model and to apply the model components to policy analysis problems. The components are: 1) input-output; 2) price adjustment and demand; 3) recursive linear programming; 4) population; 5) livestock numbers; 6) grain management; and 7) crop yield. Within the overall plan of work, emphasis will be given to the use of the model as a basis for preparing the Fourth Five-Year Development Plan for the agricultural sector, and to the utilization of the grain management component as a policy decision tool by the Republic of Korea Government.

ACCOMPLISHMENTS AND UTILIZATION: MSU has experimented with training involving three distinct sub-programs which, in combination, could be used to produce a range of capabilities. They are a basic study program, an orientation course, and a computer programmer study program. This study program was designed to meet the urgent need to develop competence in the Korean National Agricultural Economics Institute staff and to find and train talented people. At MSU, a number of models (production and processing; demand and consumption; and demographic processes as applied to human, cattle, and tree populations) have been built and computerized. These models are useful in the developing world, and generalized models could be

documented and made available to help analyze similar problems in other countries. A Simulation Library Working Conference was held in 1973, during which guidelines were established for such a library; another meeting scheduled for mid-1975 would identify potential library users.

FUTURE PLANS: The most important objective of the project is to build up Korean staff competence to develop and apply the agricultural sector simulation models as quickly as possible. To establish and strengthen credibility with Korean Government policymakers, the project will focus on several special-purpose submodels and on the use of overall model structures for sector planning.

PROJECT TITLE: RURAL EMPLOYMENT IN TROPICAL AFRICA: A NETWORK APPROACH

CONTRACTOR: Michigan State University
East Lansing, Michigan 48823

CONTRACT COORDINATOR: Dr. Carl Eicher
Department of Agricultural Economics

PROJECT DURATION: Started 6/16/72; Termination Date 6/30/76

PURPOSE: Unemployment in Africa, spurred by increasing population, is expected to rise during the latter part of the 1970's. Urban centers cannot employ significant numbers of the labor force, which is steadily increasing due to rural-urban migration. To date, unemployment has not been given priority in the development plans of all African nations. The aim of this project is to develop and refine a conceptual framework for analyzing rural employment and the related issue of food production in tropical Africa.

DESCRIPTION OF ACTIVITY: The project links Ethiopia, Nigeria, and Sierra Leone into a research network concerned with critical employment, population, and food issues. It will: 1) produce a conceptual framework and workplan for analyzing employment problems and policies; 2) conduct rural employment studies; 3) formulate agricultural policy guidelines; and 4) stimulate the development of a community of scholars by means of seminars, workshops, and joint research efforts.

ACCOMPLISHMENTS AND UTILIZATION: The methodology for analyzing rural employment problems has been reported in 10 African Rural Employment Papers which have been published to date and distributed in over 70 countries. They are used as textbooks in some African universities and are widely cited. One publication has stimulated correspondence with researchers in Ghana, the Gambia, Kenya, North Africa, and Asia. Some have become standard reference texts, and recommendations have been made to translate them into French for distribution in French-speaking areas of Africa. The network countries are actively engaged in collecting data and training its specialists. A library has also been started.

FUTURE PLANS: The African Rural Employment Study was initiated through a 3-year contract ending in mid-1975. However, due to research delays and major content changes, the time limit has been extended until mid-1976 in order to finish the analyses and write up the research results.

For Nigeria, the field work is scheduled for completion early in 1975, and a report will be completed later in the year. For Sierra Leone, the data collection will be completed in mid-1975; a series of papers and monographs will follow. The Ethiopian program involved a weekly poll of 150 farmers in the Ada District over a 15-month period starting in January 1975. Due to the political changes in Ethiopia and the shifts in government approaches and priorities, all work after June 1975 will be financed by the AID Mission.

PROJECT TITLE: AGRICULTURAL DIVERSIFICATION AND TRADE--ASIA

CONTRACTOR: Economic Research Service
U.S. Department of Agriculture
Washington, D.C. 20250

CONTRACT COORDINATOR: Dr. William A. Faught, Director
Foreign Development Division

PROJECT DURATION: Started 5/28/71; Termination Date 6/30/76

PURPOSE: This is an extension of the original project. The purpose is to provide support for the refinement and utilization of research completed during the first 3 years of the project. This includes consideration of a wider range of agricultural policy alternatives than initially contemplated and their implications for developing a viable diversified agricultural sector in the Philippines.

DESCRIPTION OF ACTIVITY: The project will continue to accumulate, organize, and analyze data on costs, supply responses, domestic demands, and export opportunities to assist decisionmakers in strengthening the mechanism for continuous analysis and re-evaluation of opportunities and alternatives as production and marketing conditions change.

ACCOMPLISHMENTS AND UTILIZATION: Several publications have been released: a seven-volume annotated bibliography with over 10,000 titles covering six disciplines; four Working Papers dealing with basic problem material; a report on the Green Revolution; a literature review; and a paper on fertilizer. Two more Working Papers, one on an analysis of agricultural patterns and the other on agricultural machinery, are in the final stages of preparation. Significant progress has been made in developing frameworks and data inputs for linear programming models to be used for continual updating and re-evaluation of alternatives.

FUTURE PLANS: An analytical economic model has been started. It will be used with a rice production-distribution model which will provide information about overall resource use and employment in the rice sector. Incorporation of corn and sugar cane into the rice model is planned. It will be followed by work on livestock, poultry, and fisheries. Plans call for the increased involvement of national institutions, personnel, and resources to accelerate data collection, processing, and analysis. Given a national agricultural policy model, the country's policy planners and economic leaders will be able to cope with changes in agricultural markets and conditions which would assure continued benefits to the national economy.

TECHNICAL ASSISTANCE PROJECTS

PROJECT TITLE: PEST MANAGEMENT AND RELATED ENVIRONMENTAL PROTECTION

CONTRACTOR: University of California
Berkeley, California 94720

CONTRACT COORDINATOR: Dr. Ray F. Smith
Department of Entomology

PROJECT DURATION: Started 7/1/71; Termination Date 12/31/78

PURPOSE: This project appraises major pest and disease problems and their economic effects on LDC agricultural production. It provides technical assistance in the field of pest and pesticide management to maximize food production consistent with environmental and ecological considerations.

DESCRIPTION OF ACTIVITY: The contractor continues to provide technical assistance in the evaluation, procurement, and safe and economic use of pesticides. It trains crop protection and pest and pesticide management specialists and provides for the education of farmers and the general public in crop protection matters and the safe use of pesticides. It is developing implementation techniques for crop protection systems and is conducting adaptive research on a collaborative multicountry basis to develop crop protection solutions suitable for farm-level use.

ACCOMPLISHMENTS AND UTILIZATION: Seven multidisciplinary teams have determined major crop production problems around the world. Several countries and AID Missions have begun programs to solve these constraints to food production. The Ad Hoc Pest Management Advisory Group advises AID on pesticide procurement and the safeguards and regulations for the importation, manufacture, formulation, distribution, and use of pesticides in the LDCs. Three pesticide management seminar-workshops have been conducted, with adequate follow-up provided.

A basic crop production library has been started. Materials published to date include a three-volume "Pesticide Manual," a "Directory of Plant Pathologists," and numerous reports on pest problems in Central and West Africa, Central and South America, the Mediterranean and the Near East, and the Southeast Asian countries. More than 80 scientists attended the seminar in El Salvador in 1973 on "Management of Pesticides and Protection of the Environment."

FUTURE PLANS: The contractor will continue to assist LDCs with pest and pesticide problems and to develop a response capability where emergency situations arise. Pesticide management seminars and workshops will be continued as requested by LDCs, with continued backstopping and follow-up provided.

PROJECT TITLE: WEED CONTROL SYSTEMS FOR LESS DEVELOPED COUNTRIES

CONTRACTOR: Oregon State University
Corvallis, Oregon 97331

CONTRACT COORDINATOR: Dr. Stanley F. Miller, Director
International Plant Protection Center

PROJECT DURATION: Started 1966; Termination Date 1977

PURPOSE: The major goals of the project are to reduce crop losses due to weeds; develop new weed control methods with special emphasis on small farms; train counterparts in research methodology; promote practical, safe, and economical usage of herbicides; and continue to develop a worldwide communications network for weed control researchers.

DESCRIPTION OF ACTIVITIES: Research priorities established under this contract are: a) development of basic information concerning economical weed control; b) evaluation of weed losses, and the costs/benefits of existing methods and systems of weed control for major crops at the farm level; c) where feasible, the development of sound methods of manual, mechanical, cultural, chemical, and biological weed control, singly or in combination and integrated with other management practices such as improved seed, fertilizer, lime, pest control, irrigation, planting date, and crop density; and d) evaluation of control methods in terms of economic efficiency. In addition, the contractor will develop weed research capabilities in local institutions and train local agronomists in research and demonstration techniques.

ACCOMPLISHMENTS AND UTILIZATION: In the El Salvador project, counterparts have been located in Guatemala, Honduras, Nicaragua and Costa Rica. They will establish experimental trials as previously designed. A senior technician will visit these trials to advise and assist in collecting data. Colombia and Ecuador are now becoming self-sufficient in weed control research. Brazil will continue its work on the control systems for small and medium-size farmers. Active linkages were established and maintained with research entities worldwide, and OSU participated in a 5-week weed science course in Indonesia. A full-color identification manual for nearly 300 weed species has been completed and will be published soon. Drafts have been prepared for a proposed "Weed Science Research Field Manual" for inexperienced personnel in LDCs engaged in

designing, conducting, and maintaining weed research programs. The publication "Tropical Weeds" was reprinted, and arrangements were made for a second printing of "Aquatic Weeds," in co-operation with the Colombian Plant Physiology and Weed Control Society.

OSU has finalized plans for a regional workshop on control systems for Latin America in mid-1975. An OSU consultant delivered a technical paper at a Rice Conference in Liberia. OSU also participated in a CIAT workshop, and one man-month of OSU team time was spent at CIMMYT, helping design a newsletter which CIMMYT now publishes. Since initiation of the contract, OSU has also published a newsletter, with a distribution of 3,500 copies.

FUTURE PLANS: The present program will continue to publish research results for worldwide dissemination. A research team will be established to collaborate with ROCAP (AID's Regional Office for Central American Programs) on multiple-cropping systems. Another team has been proposed to help the Thai Government design and place into operation a Weed Research Institute. A weed scientist will be assigned to Africa to work with WARDA and/or IITA. A subcontract is being considered with the University of Florida to develop a capability to conduct research and technology transfer of aquatic weed science.

PROJECT TITLE: FERTILIZERS, TECHNICAL ASSISTANCE (MANAGEMENT, MARKETING, SURVEYS, TRAINING, AND ENGINEERING)

CONTRACTOR: National Fertilizer Development Center
TVA, Muscle Shoals, Alabama 35660

CONTRACT COORDINATOR: Dr. Paul J. Stangel, Acting Director
International Fertilizer Development Staff

PROJECT DURATION: Started 11/16/65; Termination Date Indefinite

PURPOSE: This project identifies, assesses, and helps remove deficiencies in LDC fertilizer programs, solving problems of inefficient fertilizer factories, resource development, process engineering, market research, product distribution, and field use. It also serves as the nerve center for basic data on world fertilizer production and use, and as a center for demand studies and training services in the basics of fertilizer production, marketing, and use.

DESCRIPTION OF ACTIVITY: Because ample supplies of fertilizer are necessary to meet food production goals, more LDC requests for technical assistance are being answered this year than ever before. TVA is providing technical assistance to LDCs to increase fertilizer production, and provide data for decisionmaking and training. A joint TVA/FAO study on fertilizer marketing in 34 countries is providing information for marketing manuals and training materials for regional and country seminars on infrastructure and policy matters in LDCs.

ACCOMPLISHMENTS AND UTILIZATION: Project publications include 34 country studies and 120 technical or regional reports. There have been 77 technical teams in 42 countries, working on more than 110 projects. TVA has shown that bulk handling of urea is practical, with considerable savings in cost and labor. More than 400 foreign fertilizer specialists have been trained at NFDC. TVA has completed indepth fertilizer marketing studies in five Central American countries, South America, Ghana, and Asia, and is developing a regional study for South Africa.

FUTURE PLANS: Plans are underway for a high-level fertilizer demand seminar in Honolulu in June 1975. A major fertilizer conference, covering all elements of production, marketing, and use of fertilizer, is planned in cooperation with the Asian Development Bank in January 1976. Data collection and engineering studies will be continued, with specific emphasis on computerizing the basic methodology necessary to compute capital requirements and production costs.

Emphasis in 1975/76 will be given to the growing number of requests for technical help in fertilizer marketing, particularly on distribution as new capacity comes on-stream in response to the present fertilizer shortage. Beginning July 1, 1975, the coordination of much of this technical assistance will be taken over by the International Fertilizer Development Center (IFDC). TVA will remain a very active technical participant. It will continue to advise AID on matters of U.S. interest and will provide representatives with technical qualifications for U.S. delegations to international conferences.

PROJECT TITLE: SEED PROGRAM AND INDUSTRY DEVELOPMENT

CONTRACTOR: Mississippi State University
State College, Mississippi 39762

CONTRACT COORDINATOR: Dr. James C. Delouche
Professor of Agronomy

PROJECT DURATION: Started 3/18/1957; Termination Date Indefinite

PURPOSE: Poor seed continues to limit agricultural production in LDCs in spite of the introduction and development of the high-yielding crop varieties. This project is a continuation of previous contracts for the development and use of improved seed. Greater emphasis will be placed on assistance with managerial problems in all phases of developing a seed industry that will reach the small farmer.

DESCRIPTION OF ACTIVITY: MSU responds to requests from AID Missions, host countries, and international organizations for technical assistance, information, or consultative services in all aspects of seed multiplication, processing, drying, storage, certification, and distribution; the planning, design, and construction of seed-handling facilities; and the establishment of seed-testing programs. The present MSU assistance activities involve all the major aspects of agribusiness.

ACCOMPLISHMENTS AND UTILIZATION: Seed processing, handling, and testing facilities have been installed and are operating in 22 countries, and plans have been developed for such facilities in eight other countries. More than 500 seed program administrators, technologists, and specialists from 33 countries have been trained in their own countries and/or at MSU, and some 500 others have had 2- or 3-day programs with MSU staff. Research on special seed-drying facilities and methods has been adapted to LDC conditions. The project has generated some 185 reports, 155 bulletins for LDC distribution, and 51 M.S. or Ph.D. dissertations.

FUTURE PLANS: Technical assistance activities will be continued. They have been expanded to meet the rapidly increasing demand for MSU assistance, especially in the African countries. Special attention will be paid to the development of certain new technologies that are crucial for resolution of technical problems in the seed subsector in the LDCs, especially those with humid, tropical, or subtropical climates. Training schools and seminars, private sector seed industry development, and planning of seed programs to reach the small farmer will be emphasized.

PROJECT TITLE: PLANT AND SEED MATERIALS FOR DEVELOPMENT OF POTENTIAL CROPS IN LDCS

CONTRACTOR: Agricultural Research Service
U.S. Department of Agriculture
Beltsville, Maryland 20705

CONTRACT COORDINATOR: Dr. Howard L. Hyland
Plant Introduction
New Crops Research Branch

PROJECT DURATION: Started June, 1955; Termination Date Indefinite

PURPOSE: This project uses existing research facilities and capabilities of USDA's Agricultural Research Service (ARS) to improve the yield and quality of agricultural crops, fruits, and fibres in the LDCs. On request, selected plant and seed materials and supporting technical assistance are supplied to key countries and regional organizations. The aims of the project are to help recipient countries develop high-yielding, nutritious, disease-resistant cultivars adapted to the tropics, and to improve practices for their cultivation.

DESCRIPTION OF ACTIVITY: ARS provides AID Missions with technical advisory services and experimental quantities of improved seed and vegetative and fruit stocks. This broadens the germ plasm base available for plant introduction, collection, screening, and maintenance of varieties.

ACCOMPLISHMENTS AND UTILIZATION: In crop-year 1973, a total of 91 shipments of seeds and plant materials of 5,393 varieties/selections were made to 28 countries worldwide from the laboratory at Beltsville, Maryland. Some 310 new accessions of yams were obtained last year, with distribution to 17 cooperators to date. This makes a total of 689 accessions in the yam collection, representing more than nine distinct species available from Mayaguez, Puerto Rico.

FUTURE PLANS: The Resources Support Services Agreement (RSSA) will continue to provide technical advisory services, and new studies as requested, and continue to disseminate plant and seed materials. However, because of the paucity of information coming from the recipient countries, little is known about the use of these materials. It is hoped the situation will improve by the publication of a report spanning a 10- or 20-year period of materials distribution and that the report will generate interest and elicit information from the LDCs on their use of the materials.

PROJECT TITLE: INTERNATIONAL AGRICULTURAL ECONOMICS SEMINAR

CONTRACTOR: Agricultural Development Council
630 Fifth Avenue
New York, New York 10020

CONTRACT COORDINATOR: Dr. Abraham M. Weisblat, Director
Research and Training Network

PROJECT DURATION: Started 6/30/70; Termination Date 6/30/75

PURPOSE: The project provides a mechanism whereby personnel with U.S. universities and private and public technical aid agencies can meet with LDC colleagues to discuss substantive issues related to agricultural and rural development problems; pool their knowledge; and use such information to improve training programs for U.S. and LDC personnel.

DESCRIPTION OF ACTIVITY: Seminars, workshops, and conferences facilitate the interaction and cooperation between agricultural economists and other social scientists. These contacts should strengthen the participants' professional capacities to analyze agricultural and rural development problems, and keep them posted on policy changes and emerging research needs. The RTN (Research and Training Network) program gives young professionals an opportunity to increase their participation in economic development programs. In addition, the program assists in improving curricula of both U.S. and LDC educational institutions on such agricultural policy issues as production incentives, land use, administration of agricultural programs, and the interrelationships of population, employment, and economic development.

ACCOMPLISHMENTS AND UTILIZATION: Some 80 seminars, involving about 600 people working on agricultural development, have been held. Topics covered included agricultural sector analysis, farm credit, marketing problems of small farmers, resource utilization, technological change, and nutrition. New course material has been prepared on production incentives, land policies, administration of agricultural programs, employment, and agricultural policy.

FUTURE PLANS: Extension of the Research and Training Network program has been proposed. The contractor would continue the seminar program, with greater involvement of LDC participants and more intensive treatment of rural development problems identified as priority areas by AID. Development of teaching materials and rapid distribution of seminar reports will be emphasized.

PROJECT TITLE: IMPROVED FEED NUTRITION INFORMATION TO ASSIST LIVESTOCK PRODUCTION IN THE LDCs

CONTRACTOR: Utah State University
Logan, Utah 84321

CONTRACT COORDINATOR: Dr. L. E. Harris
Department of Animal Science

PROJECT DURATION: Started FY 1974; Termination Date Indefinite

PURPOSE: This project serves as the channel for establishing the International Network and Feed Information Center (INFIC) through which information concerning the nutritive value of feed formulas will be made available.

DESCRIPTION OF ACTIVITIES: This is a comparatively new project, and work to date has been chiefly organizational. Utah State University is the site of the International Feedstuffs Institute (IFI), which in turn is a member of the International Network of Feed Information Centers (INFIC). USU is one of two centers worldwide with computer capability (the other is in Hohenheim, Germany). USU has been selected to correlate international terminology and feed name files and to transfer all data, names, and abstracts into master tapes for an "International Nutrition Bank" for exchange of information among centers. The university will also help each center instruct its staff members on: a) collecting data and filling in source forms; b) coding the source forms; c) preparing cards or tapes to enter information into the computer; d) writing and executing computer programs for summarizing the data; e) making formats for printing or retrieving data directly from the computer; and f) using the data to prepare diets or rations for animals that will increase the yields of milk, meat, eggs, and fiber.

ACCOMPLISHMENTS AND UTILIZATION: The work initiated at the University of Florida relating to feed composition in Latin America was completed and has been moved to the International Feedstuffs Institute at USU. To date, four organizational meetings have been held by INFIC, and geographical areas of responsibility have been assigned. USU was given the Near East (in cooperation with FAO), North America (in cooperation with Canada), and Oceania/Southeast Asia (in cooperation with Canberra). It will work cooperatively with Latin America to establish a center(s) there.

FUTURE PLANS: Work will continue toward making the Latin American center(s) an autonomous entity within INFIC, capable of performing all of the functions required to collect

and process feed data into a useful publication for calculating animal diets. Data will be collected and processed on a continuing basis. Laboratories will be encouraged to analyze feeds for more essential nutrient and biological data. Standardization of procedures and methodology will be stressed. The first international symposium, "Feed Composition, Animal Nutrient Requirements and Computerization of Diets," is scheduled for mid-summer 1976 at USU. It will be sponsored by INFIC, IFI, and the National Academy of Sciences Animal Nutrition Committee.

PROJECT TITLE: INDUSTRIAL EXTENSION OF SMALL-SCALE AGRICULTURAL EQUIPMENT DEVELOPED AT IRRI

CONTRACTOR: International Rice Research Institute
P.O. Box 583, Manila, Philippines

CONTRACT COORDINATOR: Dr. Nyle C. Brady, Director

PROJECT DURATION: Started April, 1975; Termination Date March, 1978

PURPOSE: This project is aimed at helping to solve the key problems of food crop production, including high-protein crops, by introducing small-scale, locally-produced, lower-cost, and socioeconomically acceptable farm equipment into Thailand and Pakistan and, later, into other countries. This will not only enable the operator of a small farm to shift from human and animal power (inadequate for continuous or double-crop farming) to partial or total mechanization, but will also put him in a more competitive position relative to costs and incentives. The second purpose of this project is to establish manufacturing capabilities to produce locally adapted and acceptable machines and spare parts and to provide maintenance services in each of these countries.

DESCRIPTION OF ACTIVITY: Since its inception, the IRRI program for developing machinery for rice production has developed, tested, and evaluated 36 different machines. It has finalized designs on 18 of them and several are now being commercially produced in the Philippines. Sales records are already impressive. IRRI's success has not been duplicated in neighboring rice-producing countries, largely because of the lack of trained personnel to establish contacts, the distances involved, and the costs.

Engineering capabilities provided under this project will: a) conduct economic and market evaluation studies to determine which machines offer the greatest potential for production and profitable mechanization; 2) carry out comprehensive tests to determine machine performance characteristics under local conditions; 3) provide continuous technical and in-country engineering assistance to manufacturers; 4) provide continuous business and management guidance to manufacturers to insure continued viable and profitable operations; 5) perform adaptive design and development work on the machines as required; and 6) promote this equipment through demonstration activities involving both farmers and manufacturers.

ACCOMPLISHMENTS AND UTILIZATION: The following assumptions are the basis for expected accomplishments and utilization regarding these machines: a) that

in each selected country there is a potentially effective organization, adequate production capacity and skill levels, and available materials to meet the goals; b) that rice production is sufficiently advanced in each country to warrant mechanization; c) that there are farmers who recognize the advantages of mechanization and have the desire and the necessary investment capital; d) that there are no government restrictions on the import of necessary materials for the manufacture of equipment and spare parts; and e) that the machines will find a ready market in competition with imported machines, which would probably be higher-priced.

FUTURE PLANS: The project plans to develop in each country an organization that can provide long-term support, and to establish within the first year one local company for the manufacture of these machines. Within the first year, it is anticipated that 10 machines of each of the three different types will be sold. Thereafter, the target will be to double the number of companies each succeeding year. It is anticipated that a total of 300 machines will have been produced and sold in each country by the end of the project.

PROJECT TITLE: AGRICULTURAL CREDIT FOR SMALL FARMERS: DEVELOPMENT OF A CREDIT INFORMATION SYSTEM

CONTRACTOR: Ohio State University
Columbus, Ohio 43210

CONTRACT COORDINATOR: Dr. Dale W. Adams
Department of Agricultural Economics

PROJECT DURATION: Started 10/31/74; Termination Date 3/31/76

PURPOSE: The goal of this project is to improve the effectiveness of small farmer credit programs by developing a better understanding on the part of LDC rural development planners regarding the credit needs of small farmers, and to help identify the institutional requirements and price policies needed.

DESCRIPTION OF ACTIVITY: The 1973 AID-sponsored Spring Review stimulated a great deal of concern with small farm credit issues. A number of USAID Missions and host countries indicated an interest in obtaining short-term technical assistance on this subject. Policymakers, credit technicians, and researchers concerned with farmer credit are professionally isolated and have little knowledge of innovative policy changes, credit research results, or outside information, and have little opportunity to interchange ideas. This project will establish contact with appropriate individuals, prepare and disseminate informational material, and set up three regional workshops for credit researchers and practitioners in the developing countries.

ACCOMPLISHMENTS AND UTILIZATION: A newsletter, consultation, and three workshops will be used to disseminate technical and other information to people and organizations responsible for developing viable credit facilities. An annotated bibliography on new agricultural credit publications and a directory of participants in the information network will be published. The contractor will assist AID in obtaining consultant assistance on small farmer credit issues.

FUTURE PLANS: On completion of the major part of the contract, the contractor will evaluate the usefulness of the newsletters and workshops. This will be done by contacting a sample of the newsletter recipients and workshop participants to determine whether farm credit should be institutionalized without AID assistance or if it can be institutionalized and to what extent continuing aid will be required.

PROJECT TITLE: TECHNICAL ASSISTANCE IN FOOD GRAIN DRYING, STORAGE, HANDLING, TRANSPORTATION, AND MARKETING

CONTRACTOR: Kansas State University
Manhattan, Kansas 66502

CONTRACT COORDINATORS: Dr. William J. Hoover
John R. Pederson

PROJECT DURATION: Started 6/30/67; Termination Date 6/30/76

PURPOSE: Estimates of LDC food grain losses from the field to the consumer are as high as 50 percent of total production; in some cases, this exceeds food deficits. This project's goal is to reduce losses of grains and grain quality during drying, handling, storage, marketing, and processing.

DESCRIPTION OF ACTIVITY: The contract covers the following activities: 1) help diagnose and solve food grain drying, storage, conditioning, handling, transportation, marketing, and processing problems in cooperating countries; 2) conduct training courses, seminars, and conferences on these subjects for AID and LDC personnel; 3) respond to technical inquiries; and 4) conduct trials with lateral technology transfer to adapt storage techniques to needs and to benefit small farmers, farms, and villages.

ACCOMPLISHMENTS AND UTILIZATION: KSU has assisted in drying, storage, handling, and marketing activities in Ghana, Dominican Republic, Honduras, Guyana, Jordan, Korea, Morocco, Guatemala, El Salvador, Panama, Ecuador, Bolivia, Brazil, Colombia, Indonesia, and West Africa. Major projects include helping implement grain drying, storage, and marketing programs in Honduras, West Pakistan, and West Africa (Entente Fund Program), as well as designing grain handling facilities and evaluating construction practices in Indonesia, Honduras, Senegal, Guatemala, and Nepal. The contractor has trained 165 participants from 22 countries in short courses and workshops at the University and overseas. In addition, KSU has conducted seminars for 150 operations and management personnel.

FUTURE PLANS: KSU will continue responding to LDC requests for help in grain drying, handling, storage, and marketing. There will be added emphasis on the socioeconomic aspects of on-farm grain storage and processing, and on an agribusiness component.

AGRICULTURAL INFORMATION AND RELATED SERVICES

U.S. Department of Agriculture

AID has a Resources Support Services Agreement (RSSA) with USDA to provide many kinds of agricultural information to the LDCs. U.S. inquiries also are handled, as appropriate. Specifically, the USDA answers technical inquiries received from the USAID Missions (direct-hire, contract, and PASA personnel), and from LDC governmental offices, institutions, and individuals. These inquiries may be for a specific USDA or land-grant university publication, for an AID-sponsored publication, and/or for information that requires in-depth searching. Technical manuscripts are developed and published on subjects covering, or related to, AID-sponsored research and technical assistance in key problem areas. The RSSA staff screens new publications issued by USDA and land-grant universities and provides USAID's notification copies of reports considered pertinent. Briefings and de-briefings are conducted with USAID, PASA, and contract personnel and with international visitors. An AID/USDA Reference Center has been established to serve the above-mentioned individuals and others. The Center contains recent significant agricultural development literature and reports developed under AID contracts and PASAs.

ASSISTANCE AVAILABLE THROUGH TA/AGR OFFICES

TA/AGR has more than 20 competent agricultural specialists available to provide technical assistance to LDCs upon request from USAID Missions and Regional Bureaus. These specialists have extensive experience in LDCs and professional competence in such areas as soil management, fertilizers, water conservation and management, crop production, livestock production, agriculture sector analysis, agricultural policies, and planning, marketing, and agribusiness. The staff maintains liaison with the international agricultural research institutes, universities conducting research or projects overseas, and United Nations agencies sponsoring agricultural programs in LDCs.

Travel costs for staff members responding to Mission technical assistance requests are arranged by mutual agreement between TA/AGR and the respective Regional Bureaus.

ASSISTANCE BY SPECIAL CONSULTANTS

TA/AGR also maintains a roster of technical consultants, all highly qualified in particular aspects of LDC agricultural operations. USAID Missions can tap this expertise through respective AID Regional Bureaus. Costs are funded by mutual agreement among the AID Missions, the Regional Bureaus, and TA/AGR.

ASSISTANCE FROM UNIVERSITIES WITH 211(d) EXPERIENCE

Universities with agricultural competence developed through 211(d) grants (see next section) may also be utilized to meet field requests for technical assistance. This assistance is arranged by the Office of Agriculture to the extent that "Basic Ordering Agreements," funded by the Technical Assistance Bureau, have been established. Individual "Task Orders" may be issued by USAID Missions requesting the assistance of specialists for particular field assignments.

211(d) GRANTS TO U.S. UNIVERSITIES AND COLLEGES

Section 211(d) of the Foreign Assistance Act of 1966 authorized grants to U.S. educational and research institutions for the purpose of building competence and expertise in selected areas related to international grants currently in effect.

RUMINANT LIVESTOCK CONSORTIUM--This organization has four member universities who are collaborating in studies of the complex and interrelated problems of livestock nutrition, breeding, disease control, marketing, and credit availability.

Texas A&M University
Livestock breeding and disease control.

University of Florida
Nutrition, forage production, and use.

Purdue University
Systems analysis of the livestock subsector.

Tuskegee University
Design and execution of ruminant livestock development plans.

UNIVERSITY CONSORTIUM ON SOILS OF THE TROPICS--The Consortium is made up of five member universities who are collaborating in a systems approach to solve the tropical soils problems. Each institution concentrates on one aspect, or relates its work to a specific ecological environment. Current areas of concentration include:

Cornell University
Soil resource inventory.

North Carolina
Soil fertility, relating plant nutrition to the physical and chemical properties of the tropical soils.

University of Hawaii
Microbiology and minerology of the soils of the tropics.

Prairie View A&M College
Delivery systems for soil technology.

University of Puerto Rico
Conservation, classification, and geography of tropical soils.

INTERNATIONAL SOYBEAN PROGRAM (INTSOY)--Two grants were initiated to strengthen the existing competencies and develop linkages with appropriate international centers and agencies in a mutual attack on the problems of soybean production for food use in tropical and subtropical areas. The work is designed to alleviate protein deficiencies among the urban and rural poor.

University of Puerto Rico
Disease insect control and cultural practices.

University of Illinois
Improvement of soybeans for the tropics and subtropics.

CONSORTIUM FOR INTERNATIONAL DEVELOPMENT (CID) (FORMERLY CUSUSWASH)--This is a group of universities specializing in soil and water problems of the LDCs. The joint program emphasizes water management both for irrigated and dry lands. Studies involve optimum water use, drainage, irrigation structures, irrigation practices, hydrologic systems analysis, and moisture utilization by crops, as well as related special economic and institutional factors governing technological introduction and use.

University of Arizona
Watershed management.

Colorado State University
Water delivery and removal systems.

Utah State University
On-farm water management.

University of California/Riverside
Dryland moisture utilization and related farming problems--summer rainfall.

Oregon State University
Dryland moisture utilization and related farming problems--winter rainfall.

AQUACULTURE AND MARINE RESOURCES--Two universities are addressing the important problems of increasing food supplies in less developed countries, especially the much-needed high-quality proteins, from either fresh water or the seas.

Auburn University (International Center for Aquaculture)
Aquaculture, with major emphasis on inland fisheries systems.

University of Rhode Island (International Center for Marine Resources Development)
Coastal zone resources economics, sociology, food technology, and coastal zone fisheries.

AGRICULTURAL ECONOMICS--Six universities provide services and training in areas of differing but inter-related aspects of agricultural economic development.

Cornell University
International agricultural trade, market structure and development, sector analysis.

Iowa State University
Sector analysis and planning, interrelationships between agriculture, and overall economic development.

Michigan State University
Sector analysis-simulation, employment generation, trade and diversification, marketing.

University of Minnesota
Technological change and development, labor markets, commodity markets, and trade.

Southern University
Unemployment and underemployment, and human resources development.

Virginia State College
Rural development and small farm businesses.