PD-AAZ-065
60234

IMPROVED SEED PRODUCTION AND UTILIZATION (Seed Program/Industry Development, 1958-1987)

IMPACT EVALUATION REPORT

Prepared for

Science and Technology Bureau
Agency for International Development

By

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(202) 638-2002

November 1987

PD-AAZ-095

IMPACT EVALUATION OF SEED PROGRAM AND INDUSTRY DEVELOPMENT AND IMPROVED SEED PRODUCTION AND UTILIZATION PROJECTS

Worldwide Projects located at Mississippi State University

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November 18, 1987

The views and interpretations expressed in this report are those of the authors and should not be attributed to the Agency for International Development.

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PROJECT DATA SHEET

Title: Seed Program and Industry Development, March 18, 1958 to July 15, 1986 – Project Number 931-0203

Improved Seed Production and Utilization, July 16, 1986 to present – Project Number 936-4143

Contracts:

Contract Number	Type	Total Period
AID/W-607	Annual Contract with Amendments	3/18/58-3/31/71
AID/cds-2976	Annual Contract with Amendments	4/1/71-3/31/73
AID/CM/TA-C-73-74	Annual Contract with Amendments	4/1/73-6/28/75
AID/TA-C-1219	Four Year Contract	6/30/75-3/31/79
AID/DSAN-CA-0148	Cooperative Agreement	4/30/79-7/14/86
AID/DAN-4143-A-00-6047-00	Cooperative Agreement	7/15/86 to Present

Purpose: To improve capabilities in LDCs for the efficient production, conditioning. distribution and utilization of seeds of improved food and feed crop varieties.

GLOSSARY

CIAT	–	Centro Internacional de Agricultura Tropical/International Center for Tropical Agriculture, Colombia
FAO	–	Food and Agriculture Organization of the United Nations
FAS	–	Foreign Agriculture Service, U.S. Department of Agriculture
GOB	–	Government of Brazil
ICA	–	Instituto Colombiano Agropecuario/Colombian Agricultural Institute
ICA	–	International Cooperation Administration (Forerunner of Agency for International Development)
IDB	–	Inter-American Development Bank
PID	–	Project Identification Document
PRP	–	Project Review Paper
ROCAP	–	Regional Office for Central American Programs (AID)
RTG	–	Royal Thai Government
UNDP	–	United Nations Development Program
USDA	–	U.S. Department of Agriculture

SUMMARY

A. Setting

Mississippi State University (MSU) entered into a contractual arrangement with the International Cooperation Administration, AID's predecessor agency, in 1958 to provide assistance on a worldwide basis in seed production, processing, storage and distribution to less developed countries.

B. Description of Activity

A contractual relationship between the two entities has been maintained for almost 30 years. Over that period of time there have been only two major changes. 1) Beginning in 1984 the method of financing was changed from full funding under the central contract to one in which field missions were required to fund activities in their countries under a "buy in" system. 2) In 1986 the contractual arrangement was changed to place major emphasis on research and research networking rather than technical assistance, service, training and technology transfer.

Over the 29 plus years of the contractual arrangement MSU has provided assistance and services under the centrally funded contract to 57 countries. In addition, MSU has provided significant amounts of assistance to less developed countries which were financed by AID Missions or by other donors.

The seed project was initiated to assist in developing seed systems in developing countries which would take improved varieties developed by breeders, multiply the seed and, while maintaining quality, deliver it to farmers. As most recently stated, the goal of the project is to increase the quality and quantity of food and feed production in LDCs. The purpose is to increase LDCs capability for efficient production, conditioning, distribution and utilization of new and improved seed.

The seed project is implemented by the MSU Seed Technology Laboratory (STL). Over the 29 plus years of the contractual arrangement almost all work was performed by tenured and permanent staff of the STL assisted by tenured professionals from MSU departments such as Agronomy and Agricultural Engineering. The project is fully integrated into on-going activities of the STL. MSU has established an excellent track record in responding to requests for assistance from AID Missions.

C. Impact: Findings and Analysis

In the four countries and one international research center visited by the team, it was found that the impact of assistance provided by MSU has been clearly beneficial. The impact of training by MSU has been particularly impressive but this should not diminish the substantial

achievements achieved through technical assistance, services and technology transfer. In all four countries a functioning seed industry has been established, though the future viability of the seed industry in Niger is much less clear than in Honduras, Brazil and Thailand. In each of these last three countries, an effective, profitable and growing private seed industry has been established.

A review of documentation on the worldwide program indicates that activities under the MSU worldwide contract have led to the growth of a seed industry in many countries. Establishment of a viable industry appears to have been more readily achieved when there was also bilateral assistance in seed technology.

Training has strongly influenced the initiation of seed programs in developing countries. In countries such as Brazil and Thailand and at CIAT, training on a regional and country basis is now conducted by people trained by MSU.

While research was not a major focus of the seed project, the necessity for MSU to seek solutions to technological problems led to research which has made a substantial contribution to drying and storing seed in the humid tropics.

MSU has been institutionally committed to fostering private enterprise involvement in the seed industry in the U.S. and overseas. A characteristic of seed programs where MSU was involved is the development of a private seed industry when profitable opportunities come into being.

In the countries visited, technology transferred by MSU was suited to the volume of work and kind of seed being processed.

In comparison to services provided by similar institutions, MSU's cost of providing services has been low and greater amounts of total funding have been allocated to providing technical assistance.

Technical assistance provided by MSU is of very high quality. This is recognized throughout the world by private enterprise, other research organizations, less developed countries and the donor community.

Activities under the seed project are fully integrated with all activities of the STL. Personnel, facilities and equipment of the center are used interchangeably for domestic and international activities as well as for those funded by AID and other donors.

The "buy in" system for USAID financing MSU activities overseas under the seed project has led to some delays and inefficiencies. A study should be performed on the current financing arrangement with MSU.

D. Lessons Learned and Policy Implications

1. Seed programs need to consider the role of private enterprise and public service. Both will be needed to assure a well-rounded program.

2. Trained staff is essential to project success.

3. An on-going agricultural research program dedicated to providing improved crop varieties is necessary for project success.

4. Continuity and integration into on-going programs significantly improves the quality of services provided to AID by outside organizations and so does the use of permanent tenured staff.

5. Wide support by government is helpful to the establishment of a viable seed program.

6. International centers can be excellent locations for regional training.

7. Missions must properly sequence proposed assistance efforts to assure conditions favorable to project success.

8. Follow-on activities after project completion can be important to successful institutionalization of programs.

9. Systems for financing contract services should facilitate, not constrain, AID or contractor actions.

I. SETTING

A. Development of the Project

The Mississippi State University Seed Technology Laboratory (STL) was established in 1950 as the Regional Seed Research Laboratory when refurbishing of a building, funded by the state legislature at $75,000 in 1948, was completed. The initiative to establish a seed laboratory came from the seed industry through the efforts of the Mississippi and the Southern Seedmen's Associations. These seedmen recognized that profitable crop production required high quality, pure seed, harvested, stored, and marketed in ways to assure maximum viability. They also knew that there existed no institution which would take new varieties produced by plant breeders and make the seed available to farmers in useable form. They saw the need for establishment of an organization which could train people to fill the gap between plant breeder and farmer. In April, 1952 the STL initiated an annual Seedmen's Short Course to provide instruction on all aspects of seed production, handling, distribution and marketing for the domestic seed industry.

In 1955 Joe Walker, an ICA Agriculture Officer, attended the Seedmen's Short Course and out of that experience, the STL initiated the Ten Weeks Short Course for international students. The first group of international students, financed by ICA and FAS, attended the Ten Weeks Short Course in 1956. This was followed in 1958 by the initiation of a worldwide contract between ICA and STL. Under the terms of this contract, AID/W 607, which, with amendments, remained in force for 13 years, MSU agreed to provide development, training and technical services in the area of seed improvement to less developed countries. The STL was charged by the University with carrying out its responsibilities under the contract in cooperation with the Departments of Agronomy, Horticulture, and Engineering, the School of Forestry, the Agricultural Extension Service and the Agricultural Experiment Station.

As the STL moved into the international area it continued, and continues today, strong ties with the domestic seed industry. The Mississippi Seedmen's Association, the Southern Seedmen's Association and the American Seed Trade Association cooperate with STL in a variety of seed improvement programs. STL maintains close ties with the seed industry throughout the United States, including the large multinationals distributing seed throughout the world. The seed industry calls on STL for technical advice, product testing and training. While, as indicated below, STL's academic achievements have indeed been impressive, the laboratory has, at the same time, maintained a practical, hands-on approach which still makes it possible to provide technical assistance to the seed industry both domestically and internationally.

B. Scope of Services

From March, 1958 to July, 1987, the project called for MSU to provide the following services:

1. Assistance in planning seed production and supply programs and projects.

2. Analyses and recommendations to resolve technical and operational problems in seed production and handling, including quality control.

3. Technical and economic feasibility studies of seed facilities and services.

4. Designs and technical specifications for physical facilities and equipment and assistance in installation and operation of equipment, storage, and production units.

5. Adaptation of technical design, operational criteria and management requisites to the arid or humid tropics and sub-tropics.

6. Planning and executing training programs ranging from on-the-job training to graduate degree programs in seed technology. The training programs will be U.S., third country, regional and in-country.

7. Information and advisory services in seed program and industry development and operation to AID, host country nationals, other AID contractors and other research centers.

With the initiation of project 936-4143 in July, 1986 the following adaptive research tasks were added to the services to be provided by MSU.

- Farmer seed selection and storage practices.
- Quality control for seed multiplication and production.
- Seed drying and storage in the tropics.
- Quality control for different scales of production, crops and climates.
- Identify seed characteristics of longevity and viability for incorporation by breeders into improved crop varieties.
- Policy reforms and methods to promote private sector seed production and supply.
- Role of extension, credit, price and markets in increasing production and use of improved seeds.

II. DESCRIPTION OF ACTIVITY

A. Introduction

Before describing the scope and objectives of the MSU contracts and cooperative agreements to provide technical assistance and services for seed program development in less developed countries (LDC), some brief comments on the structure and composition of the evaluation process appear appropriate. There are two matters that will be discussed.

1. While over the 29 years in which there has been a contractual agreement between MSU and AID, MSU has provided assistance and services to some 57 countries, the evaluation was limited to visits to four countries and the international research center, CIAT. During the visit to CIAT some information was also obtained about seed industry development in Colombia in relation to MSU activities there. Of the four countries visited (excluding Colombia) two of them, Brazil and Thailand, also received bilateral assistance from MSU under AID on other bilateral contracts for at least 10 years. Niger, the third country, did not receive bilateral assistance from MSU, but technical assistance under contracts with other organizations was provided for seed industry development for five years. In the fourth country, Honduras, bilateral assistance to the seed industry was carried out at the Zamorano agriculture school in Honduras. Thus, in three of the countries visited, in addition to assistance provided by MSU under the worldwide contract, bilateral assistance in seed industry development was provided while the fourth was host to a regional seed program. The existence of these seed programs in addition to assistance provided by MSU in seed industry development through the worldwide contracts or cooperative agreements was a complicating factor in assessing the impact of the worldwide project. It is necessary both to distinguish the impact of the worldwide project activities from that of the bilateral project and to assess the role of assistance provided under the worldwide arrangements in bringing about bilateral or regional projects. A review of the literature indicates that it was not uncommon for there to be bilateral assistance for seed industry development in addition to MSU assistance under the worldwide contract. However, this was not true in a number of cases.

2. The second notable characteristic of the four countries visited was that in each instance the impact of MSU involvement was favorable. This was less true in Niger than in, say, Brazil; but given the constraints in Niger, the seed centers are perhaps operating at a minimally acceptable manner. However, the literature indicates that, while MSU assistance in seed industry development often led to successful seed operations, this was by no means true in all cases. This, indeed, is inherent in development situations. The evaluation team could have visited more countries had additional funds been available for the consultancy and travel.

3. Because of the two characteristics cited above of the countries visited, the evaluation team concluded that one could only generalize from experience in the four countries to the worldwide program by exercising great caution. The impact of MSU assistance and service will

be evaluated separately for each of the four countries and CIAT. Then, using material contained in MSU project reports, evaluations and provided through personal interviews, an attempt will be made to assess the impact of MSU activities on a worldwide basis. However, these assessments will be less comprehensive and determinate than would have been possible from detailed study of a broader group of countries.

B. Objectives and Purposes

The Improved Seed Production and Utilization project, originally entitled Seed Processing and Testing, referred to in this report as the seed project, was initiated for the purpose of assisting in the building of seed industries in developing countries which would take seed of improved varieties produced by plant breeders, multiply it, while maintaining quality, and deliver it to farmers.

While there was some expansion of the scope of work over time, the fundamental services to be provided by MSU remained consistent over the 28 year period from 1958 to 1986. The scope of work called for MSU to:

1. Organize seed improvement programs, including the certification and analysis of production, processing and storage needs.

2. Survey and provide advice on planning, design and construction of physical facilities.

3. Train public and private sector seed people.

4. Prepare informational, instructional and reference publications.

With the signing of the 1986 cooperative agreement the emphasis changed from technical assistance and services, development of essential technology and information and training to seed technology research and development. While research was undertaken by M.S. and Ph.D. candidates studying under the worldwide program, and MSU on their own and in cooperation with private industry, undertook research and testing to solve specific technological problems, research was not a major component of the seed project. It was, rather, a by-product of other endeavors. Because research has been a major component of the seed project only since July, 1986, it is not possible to evaluate the impact of research efforts at this time.

The goal of the seed project as stated in the most recent project paper is to increase the quality and quantity of food and feed crop production in LDCs. The purpose is to improve the capabilities in the LDCs for efficient production, conditioning, distribution and utilization of seeds of new and improved food and feed crop varieties. If such concepts as goal and purpose had been part of AID's predecessor agency project system, the current goal and purpose would have been applicable to the seed project when it was initiated in 1958. It is the implementation emphasis on research that distinguishes the present project from the original.

C. Implementation

The seed project is for the most part implemented by members of the STL with some assistance as needed by members of other departments such as Agronomy and Agricultural Engineering. Reliance on outside consultants is held to an absolute minimum. For example, during the seven year period 1979-1986, consultants were used for only 6 of the 157 individual tasks carried out by MSU.

The seed project is fully integrated into the ongoing activities of the STL. During the July, 1985 to June, 1986 period the eight professional staff members spent 38% of their time working on the seed project. In addition, the Director of International Programs for Agriculture and Forestry spent 8% of his time on the project. Of these nine people, five of them had been working on the seed project since 1960 or before. When not working on the seed project, professional staff carry out the normal teaching and research responsibilities of university faculty members. Professional staff are paid from the seed project only for the days they actually work on it.

Historically, the STL has established an admirable track record with respect to USAID Mission requests for assistance. The 1983 evaluation of the seed project attributes this ability to respona to the fact that all staff members have broad training and experience and can share teaching, research and service activities and so can substitute freely for each other in the absence of a staff member on an overseas assignment. The 1970 evaluation stated that "MSU has been responsive to all technical assistance and training requests and has provided timely and useful reports, materials and advice as well as providing supporting services to this activity from relevant universities." The judgement of these two evaluations has been supported in interviews with the present and a former project manager, USAID agriculture officers and host country agriculture officials. Implementation performance of a high quality promptly undertaken is also indicated by the wide utilization of the STL by private industry and a wide spectrum of international donor agencies such as the World Bank, IDB, FAO, UNDP, and the Swedish, Dutch, German assistance programs.

III. IMPACT: FINDINGS AND ANALYSIS

A. Introduction

The evaluation of impact will consist of two major sections. The first will be individual sections on each of the four countries and one international research center visited by the evaluation team. These individual sections will consist of a complete evaluation of each including a section on lessons learned and policy implications. This will be followed by a more general analysis of the worldwide program based on the five individual assessments, interviews and a review of project documentation.

B. Country Studies

1. Brazil

a. Setting

Up until the early 1960's, Brazil had no seed production program. Seeds brought into the market were also sold as grain for consumption. There were no trained resources in seed production and there were no regulations to control the quality of seed sold in the market.

Under the MSU contract, MSU provided two instructors and training materials for the first Latin American Seed Testing and Processing Course held in Chile in early 1959. One Brazilian attended this course and became very enthusiastic about promoting a seed improvement program for Brazil. Subsequent to this course, Drs. Bunch and Andrews visited Brazil to advise on seed processing, drying and storage facilities.

Brazil has four distinct regions; each representing different problems, different needs, different population structure, and different stages of development. These regions can be defined as:

- The Amazon Basin: Few people, limited known technology, rapid decomposition of soil organic matter, severe leaching due to slash and burn agriculture.

- The Northeast: Limited market structure, feudal land tenure in the Mata, limited mechanization, small farming units of subsistence agriculture, limited leadership, limited technology and resources.

- South-Central States: Fairly sophisticated agricultural community with developing infrastructure to support research and applied results; resources available for development if priorities established; marketing system adequate.

- South: Well developed agriculture, mechanized large units together with small farms, and

b. Description of Activity

In 1963, MSU designed seed processing facilities for the government at its inspection stations in the state of Rio Grande do Sul. A foundation seed processing plant was designed for the University in Vicosa. A commercial size seed processing plant complete with unloading facilities, artificial dryer, a modern conveying system and up-to-date equipment was designed for the Ministry of Agriculture in Pelotas. The Team observed this plant and found that the original equipment at the processing facility and laboratory are still in operation.

In the early 1960's, the government decided it needed seed laws and regulations to protect the farmers and to insure that they were buying high quality, improved seeds. Assistance was provided by MSU in promulgating the seed laws.

At the onset of the Brazilian seed program, improved varieties of some field crops, such as corn, were available for multiplication and distribution to farmers. The availability of improved varieties provided the sound basis of the Brazilian program.

There were four Brazilians working in seed production, some of these had been trained at short courses given by MSU staff. By 1960 there were at most 10 seed producers in the country. The Ministry of Agriculture invited MSU to come to Brazil to discuss the development of a seed program in 1959.

All of the MSU assistance noted above was carried out under the MSU worldwide project. This led to the preparation of a USAID bilaterally funded project for the Seed Program/Industry which was implemented by MSU. This contract was signed in 1964.

The purpose of this project was to develop a corps of trained Brazilian seed technologists and seed certification (production) specialists, and promote enactment and enforcement of effective legislation and organizational procedures which make a significant contribution and stimulate private enterprise to consider developing a sound commercial certified seed industry in Brazil.

The scope of work considered necessary to accomplish the project purpose encompassed:

- Promoting national seed legislation.
- Establishing a seed multiplication and distribution system.
- Developing a private seed industry.
- Training Brazilian personnel.
- Establishing seed testing laboratories, seed processing plants and seed storage facilities.
- Planning and conducting seed research.
- Promoting the production of seed and plant material for improved crops.

c. Impact: Findings and Analysis

The MSU worldwide project provided the stimulus and catalyst for the development of a sound seed program. This project introduced the Brazilians to the need for a full-scale seed program for the country.

It was the bilaterally funded project which implemented the scope of work that really started the expansion of a seed industry in Brazil. Project personnel worked nationally with the GOB and with any and all groups interested in developing the basic infrastructure of the country required to provide the farmers an adequate supply of improved seed as needed.

The development of human resources was an important part of the project. Appropriate technical personnel were selected and financed for degree orientated training at MSU. Short courses of various types and on-the-job training were planned and implemented in Brazil in cooperation with local organizations, and seminars were held for the purpose of exchanging information and discussing local policies regarding seed.

The project provided pilot installations for drying, storage, processing and testing seeds. These installations were also useful in training programs.

Groups were organized to develop regulations for seed moving in commerce, others for discussion and suggested action in other areas.

The project (contract) personnel in Brazil were strongly supported, both administratively and technically, by personnel associated with the MSU worldwide project.

In the early 1960's there were 200,000 ha. cultivated for seed production and this has increased to 3.5 million ha. in 1986. At most there were 10 seed producers in 1960 and now there are over 700 producers. Over 70 Brazilian students have been trained at MSU, 85% are still working in agriculture and of these, 90% are working in seed production.

The impact of the MSU worldwide project has been to provide the initial stimulus and continuous support to the Brazilian seed program. MSU was instrumental in initially training many of the officials and faculty members in seed production. For example, the faculty at the University in Pelotas has trained 132 people to the M.S. level in seed production. Of this number, 102 were Brazilians and 30 foreigners.

The initial phase of the MSU project centered upon promoting national and state legislation and training of personnel to install and operate seed testing, processing and seed storage facilities. The multiplication and distribution, along with seed research, were catered for in the later phase. Advancement of project development of a private sector seed industry was most evident in the South where ecological, sociological and economic conditions were highly favorable for developing private sector initiative. This is in contrast to the Amazon Basin where seed multiplication and distribution remain in the public sector.

d. Lessons Learned

The Brazilian seed program has been very successful for both the public and private sectors. The reasons for this success are:

- Improved crop varieties were available for multiplication and distribution.
- A nucleus of trained staff who were enthusiastic and had an incentive for developing a program.
- An awareness of the importance of developing a sound seed program as exemplified by the legislation enacted.
- Achievements in the areas of participant training and the establishment of a system of seed testing, processing and storage facilities.

Essential for private sector participation was that during all stages of implementation responsible entities retained confidence in the seed quality control system; that all rules and regulations were uniformly and impartially applied; that access and or right of review by an impartial tribunal was structured into the system as a matter of right to assure local grievances being heard and impartially resolved.

There has been a multiplier effect resulting from technical assistance furnished in the area of design, installation and operation of seed processing equipment. Brazilian seed growers are purchasing their equipment from numerous local manufacturers. This equipment is being fabricated or copied from American source prototypes.

2. Honduras

a. Setting

The development of a seed program was initiated in Honduras in the summer of 1965 when USAID/Honduras requested the services of MSU. Prior to the visit by MSU staff to Honduras little work had been done to establish a seed production, storage and distribution system in the country. Some small seed farms had been established as a result of cooperation with USDA. These farms did produce selected, but not improved, seed for sale. The Rockefeller Foundation had started collecting and testing seed varieties and financed the establishment of a firm, STICA, which was providing extension services to farmers and supplying them with seed of improved varieties. Some improved variety seed was imported by private firms from the U.S. and distributed to farmers by retailers. There were only two partially trained seed specialists in Honduras working on seeds. Improved varieties were available from indigenous or nearby sources for reproduction, processing and distribution. Seeds initially to be handled by the seed service were maize, sorghum, rice and beans.

b. Description of Activity

Assistance to development of the seed industry in Honduras was provided exclusively through the centrally funded worldwide contract except for seed staff who received training under the ROCAP regional contract with MSU for assistance to the Escuela Agricola Panamericana located at Zamorano, Honduras. During the time at which the two seed plants were being planned, designed and initially operated -- 1965 to 1970 – MSU professional seed staff made nine trips to Honduras for a total of 91 days. Some time was spent at MSU preparing for trips and writing reports, probably a total of around 180 days. In addition, MSU devoted seven months of work to preparing detailed plans and specifications for the Honduras seed facilities and equipment during 1965 and 1966.

The major focus of the seed program in Honduras was the construction of two facilities to meet Honduras's seed production goals for 1970. Facilities for temperature and humidity controlled storage and uncontrolled storage, drying and temporary storage, seed processing, conveying and grading were constructed. Despite the shortage of trained personnel, the first Honduran to complete degree training did so in 1969 almost a year and a half after the first seed plant started operation. Two Hondurans did attend the MSU seed short course in 1968, two attended the short course at Zamorano in 1968 and five more attended in 1969. Starting in 1972 training began to receive more attention and eight students received B.S. degrees and five students received M.S. degrees between 1972 and 1985. Following completion of the plant and the initial two and a half years operation, only infrequent visits were made by MSU staff to Honduras to provide follow-up advice and guidance. During 1974, 58 professional person days were spent in Honduras by MSU staff appraising seed production and marketing, preparing recommendations and proposing necessary action. In 1975 three visits were made to Honduras. The first visit, lasting two days, included a review of operational problems at one seed processing plant. The second visit of 11 days was for the purpose of assisting in the drafting of a seed law. The third visit of 12 days was to review operations at the two seed plants and make recommendations to increase operational effectiveness. The final trip to Honduras recorded was made in 1978 by two seed professionals to review maintenance requirements at the two seed plants. The two persons spent a total of 24 days in Honduras.

In 1983 the seed industry in Honduras entered a new phase with the issuance of a decree by the Minister of Natural Resources. This decree defined a strategy of support by the public sector of a private seed industry. This was followed in 1986 by the formation of Seedmen's Association and the creation of a Seed Advisory Commission. There are nine private seed companies in Honduras. Presently only two of them have their own seed plants but three are planning construction of plants. Companies not having seed plants contract with the Escuela Agricola Panamericana or the Ministry of Natural Resources for seed processing. Private seed companies distribute 75% of the maize seed and 80% of the rice seed sold.

c. Impact: Findings and Analysis

A reasonably successful seed industry has been developed in Honduras which is supplying farmers with improved varieties of important crops. These include maize, beans, sorghum, soybeans, rice and vegetables. Officials in the Ministry of Agriculture and the Seed Division of the Ministry stated on a number of occasions that MSU played a critical and essential role in support of the growth of a viable seed industry. This view was supported by faculty and staff at the private Escuela Agricola Panamericana which also received assistance from MSU and provides training in seeds to Hondurans and others in Central America. Observations by the study team and interviews with faculty of the STL led the team to concur in the assessment of the role of MSU in Honduras. The team was particularly impressed by the repeated statements by Honduran seedsmen about the importance of maintaining a continuing relationship with MSU.

The seed industry in Honduras has evolved over time into a diversified enterprise with important participation of both the public and private sectors. The private sector produces and distributes most of the improved maize and rice varieties. These are the two crops which have sufficient demand to be profitable to private enterprise. The public sector provides support to the private sector by processing seeds for private firms which do not have processing plants. Private companies also import and sell hybrid sorghum and vegetable seeds which are not, at present, technologically or economically feasible to produce in Honduras. Note that while rice seed production is not a profitable undertaking for private enterprise in most developing countries, it is in Honduras because most of the rice is produced on a few large scale farms rather than by a large number of small producers. Rice for consumption is also produced by large farm operators who do not save their seed but rely on seed producers for new seed each growing season.

Beans, soybeans, open-pollinated sorghum and some rice and maize are produced, processed and distributed by the public sector. The public sector provides improved seed varieties that cannot be profitably produced and distributed by the private sector but are important for the continuing growth in agriculture production. The public sector also undertakes testing of seed varieties to assure the maintenance of quality.

Honduras, today, has an integrated seed industry. The private sector is becoming increasingly involved in all aspects of the seed industry and it appears likely that the private sector will continue to expand. Government policy certainly favors expansion of the private sector, though implementation of the policy may, at times, run into institutional bottlenecks. Thus, the development of the seed industry in Honduras appears to be following a path that is common in countries where a seed industry is developed. The lead is taken by government, private industry then enters the market and takes over where profits can be realized. The public sector continues to service crops and farms that private industry cannot and to assure that quality and viability remain.

While the Honduras seed industry is now proving to be a successful undertaking this was not always the case. During the initial years, progress was slow if not almost non-existent. For example, a MSU review of the Honduras seed program in 1974 showed that one of the two plants built with the help of MSU was being utilized at only 5% of capacity. While there were a number of factors which could be cited as contributing to this low utilization, it appears likely that the major cause was a shortage of adequately trained people. As noted earlier, the first Honduran did not complete degree training until a year and a half after the first plant was completed and the remainder of the training before 1972 was short course training or some on-the-job training by MSU. With the increase in degree training which began in 1972, the operation of the seed plants began to improve and over the past decade performance has shown considerable improvement. This improvement has also been accompanied by the movement of trained seed technologists into more senior positions within the Ministry of Natural Resources and an institutional strengthening of the role of the seed service with the Ministry. Some 90% of the persons trained in seeds have remained in agriculture and 80% in seeds. Not all of these continue to work in the public sector but they are contributing to the growth of the private seed industry.

d. Lessons Learned and Policy Implication

1. Adequate training is essential to the successful growth of the seed industry. Sufficient numbers of seed people need to be trained so that there will be trained seed technologists available to move into senior positions in the Ministry and to work in private enterprise.

2. There is a role for both private and public enterprise in the seed industry. Private enterprise will, if not actively discouraged, move into the areas where a profit can be made. They will not, however, work in areas or varieties which are unprofitable and here the public sector has an important role.

3. Short term consultancies can be quite effective in providing advice, guidance, plans, specifications and supervision for the construction of facilities and installation of equipment. However, follow-on assistance, particularly training, is critical to successful development of a seed industry.

3. CIAT

a. Setting

Regional training through the international center CIAT is the most significant impact of MSU in Colombia. The setting in the region at the time the training began is correctly described in a report developed in 1978 by the seed unit from a survey of the constraints on the development of agriculture in the region. These constraints were identified in that report as follows:

- The greatest deficiency uncovered in most country studies was a lack of clear and consistent policies for seed program development. Country situation profiles

prepared for this analysis show that 15 out of the 22 Latin America and Caribbean countries studied do not have available a clearly defined set of seed policies.

- The next most limiting factor uncovered was an inadequate number of properly trained and experienced seed professionals. People with some training have not had the opportunity to further upgrade their training and to relate to other professionals with similar interests and problems.

- Seed quality control programs were found to be very weak in the majority of the countries. Although most of the countries have some kind of legislation on paper, implementation of quality control activities was found to be poor. These conditions have often resulted in seed of questionable quality being supplied to farmers and a loss of confidence in the materials available from both the private and public sectors.

- Limited breeder and basic seed supplies for further multiplication by local seed enterprises were found to be an additional major limiting factor. In many instances improved cultivars have been released by national programs with no accompanying basic seed available for subsequent multiplication.

- Seed drying, conditioning, and storage was also found to be inadequate in most of the countries in the region.

- Marketing systems, particularly for farmers with small holdings, were found to be weak and limited.

Although some help had been provided by MSU to two government supported agencies, these constraints largely describe the needs of agriculture in Colombia when justification for a seed unit at CIAT were being developed.

b. Description of Activity

Although the major impact of MSU in Colombia was through an extensive program of training of personnel in the region served by CIAT, there were various activities performed by MSU prior to the establishment of the CIAT program which contributed to the seed infrastructure in the country.

The organized seed industry in the country began with the establishment in the mid 1950's of CAJA AGRARIA by support from the Rockefeller Foundation. The purpose of CAJA AGRARIA was to increase the production of certain crops including corn, papaya and beans. Until 1967 only slight progress was made in developing a seed industry because there were no trained personnel, no organization for the delivery of seed and no rules or regulations to assure seed quality. At that time MSU began giving modest assistance to CAJA AGRARIA and

ICA (Instituto Colombiano Agropecuario) by selecting seed production areas, design of seed processing facilities, in the development of rules of certification and in the training of personnel by one-on-one delivery and the first short course held in October, 1969.

Although these efforts to assist Colombia continued, MSU's goal of regional training only began to be put into place in 1975. As a result of MSU's encouragement and promise of assistance CIAT received funding from the Rockefeller Foundation to support the development of a proposal to be presented to interested donors for the creation of a seed unit. The proposal emphasized the need to provide seed training capabilities and technological support for national programs by producing foundation seed and to do research in seed physiology and technology. Also, at that time "management reported that support was being sought from UNDP, AID and Title XII (for collaboration with MSU)."

In late 1978 a five-year project was signed in Washington, D.C. with the Swiss Development Cooperation and the project was initiated in January, 1979. The objectives of the agreement were:

- Train personnel in government and private institutions, primarily from Latin America and Caribbean countries, in various aspects of seed industry and seed program development.

- Extend technical collaboration to countries in the region interested in seed program development, with the aim of expanding the production of high quality seed of improved cultivars at all levels, from the breeder to the commercial stage, with main emphasis on, but not restricted to, the commodities with which CIAT works.

- Conduct specific research in seed technology highly relevant to CIAT commodity interest and relevant to problems of the impact areas.

- Provide CIAT with a single unit to cooperate with commodity programs in multiplying, processing, storing and distributing advanced experimental material, or breeder and basic seed, to collaborating countries for their further multiplication.

At that time (1979) all the elements were in place to begin the building of a seed unit complete with staff and source of trainers. Training began which has had remarkable impact.

c. Impact: Findings and Analysis

MSU was training Colombian students at MSU as early as the mid 1960's. For example, C. Gomez of the seed certification program received the M.S. degree in Seed Technology in 1969. Upon returning, these students added impetus to a struggling seed industry. MSU held the first seed course under the auspices of ICA in October 1969. The first rules and regulations for

seed certification were developed in 1970. During this period MSU was working with CAJA AGRARIA and ICA to improve seed production and dissemination.

MSU's participation in a training program that has had far reaching impact and in the development of a seed unit at CIAT began with a visit in August, 1975 by Dr. H. Dean Bunch to CIAT. The purpose of the visit was to explore possible areas in training, research or service where MSU seed technology might contribute to the program at CIAT. This assistance by MSU continued through the development of detailed plans for a seed unit and the preparation of requesting documents.

The development of the seed unit facility made it possible to teach a range of courses to train all personnel needed for the visualized new seed industry. Training courses were offered to increase the number and competence of personnel to accelerate national seed program development. A combination of intensive seed production and technology courses with a duration of 8 weeks, advanced 4-week short courses, in-service training, and in-country training courses were used for this purpose. In the first five years there were 283 participants in short courses at CIAT, 267 participants in in-country courses and 319 in workshops for a total of 869. Participants in these courses were from 30 countries. By 1987 more than 600 had received training in courses at CIAT, more than 700 in workshops and 900 in courses in countries in the region for a total of 3,200 (Figure 1).

Training is now in Phase II in which general courses are no longer given at CIAT. Instead CIAT will assist people they have trained who will be giving the general courses in their country. CIAT will be giving specialized courses in areas which have been identified as problem areas or bottlenecks to seed production wherever they occur. In summary, training has gone from complete participation by MSU staff at CIAT, to CIAT staff training at CIAT, to CIAT assisting people they have trained to present courses in their countries. The seed unit impact has been so visible that the seed unit has now become a part of the CIAT core budget.

d. Lessons Learned

1. International centers can make excellent training sites for regional training.

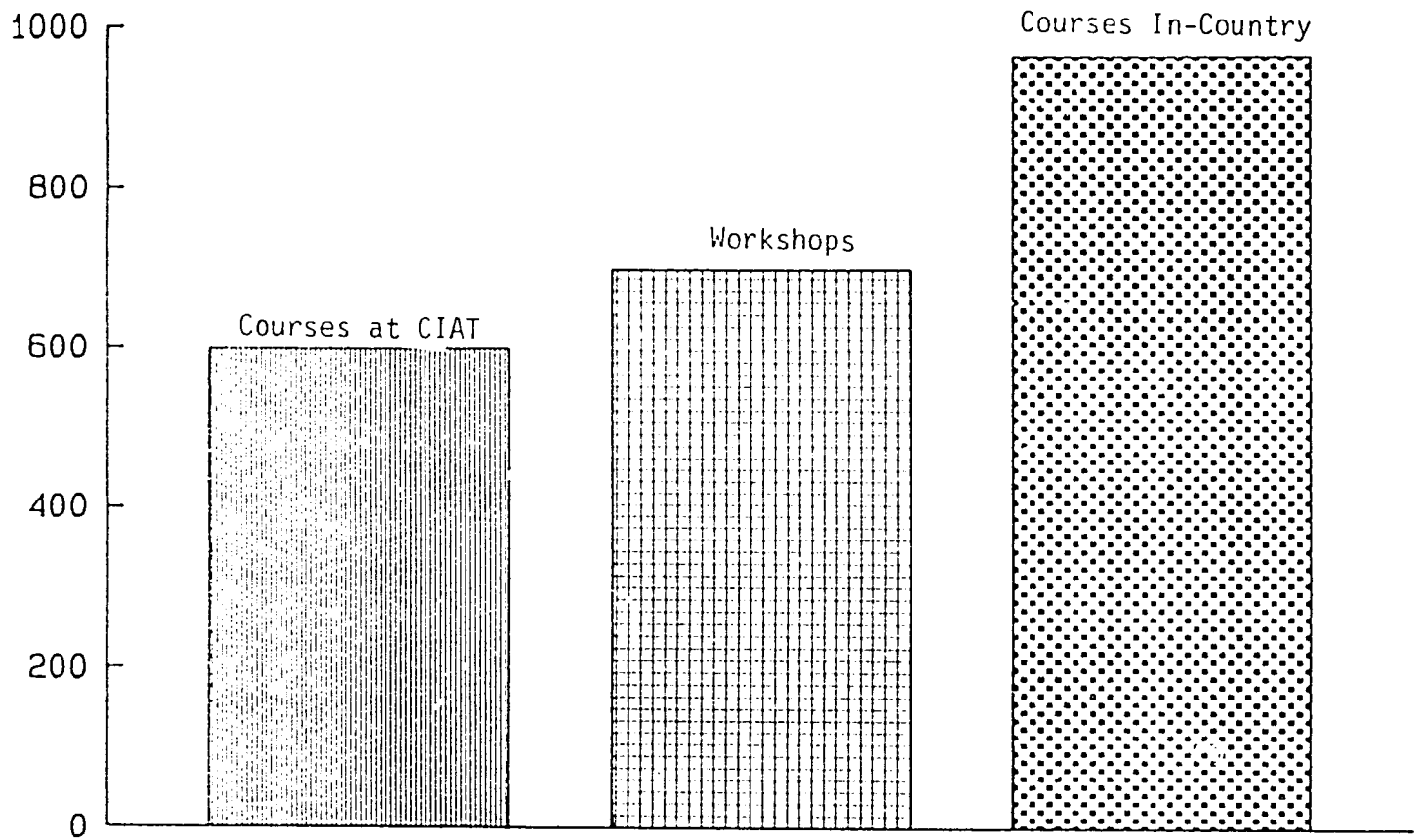
2. Improved varieties such as were available from ICA and CIAT together with training in seed science and technology and government support are the elements necessary for a successful seed enterprise and productive agriculture.

3. The AID principle of teaching how to fish rather than providing fish was demonstrated when MSU's students became trainers of trainers.

4. The seed unit's seed handling facilities and technical assistance from the seed unit staff should be used by CIAT breeders and variety development programs.

FIGURE 1

PARTICIPANTS IN DIFFERENT ACTIVITIES



Training activities performed by the Seed Unit in the region, 1979-1987.

4. Niger

a. Setting

In early 1977, USAID requested assistance from MSU to study the need for establishment of a climatized seed storage facility for peanut seed.

The study determined that there was a need for climatized storage for breeder's and basic seed materials for a maximum period of 18 months. These seed materials should be maintained to insure against major loss of early generation seed stocks should a natural disaster occur and deplete current production. It was recommended that climatized storage should be constructed and kept operational. To keep this storage facility operational, competent managers should be trained, seedlots be limited to manageable quantities and the seed placed in storage should be of good initial quality. A seed storage facility with dry-cool climatic conditions with a capacity of no more than 150 tons of peanuts was recommended for installation.

MSU recommended that the Government of Niger request foreign aid assistance to train personnel charged with managerial responsibilities at the seed storage facility.

b. Description of Activity

The rationalization and recommendations made by MSU were incorporated into the USAID funded National Cereals Program (NCP) which was started in 1975. The design of this project was influenced by the drought related disasters in the Sahelian region in the early to mid 1970's.

The NCP was designed as a comprehensive research-production-economic improvement program to increase the productivity and economic status of the traditional farmers and provide reasonable safeguards against a re-occurrence of the disastrous consequences of another prolonged drought. Assistance for the development of a seed multiplication and production program was a prominent part of the NCP.

The objectives of the seed multiplication component of the NCP were to:

- Develop an organization and facilities to increase the quality of good seed of superior varieties in a manner assuring farmers receiving the seed that it will have the performance characteristics equivalent to the variety as released by the research worker.

- Train a corps of Nigerien technicians and farmer-seed producers in techniques required for production, processing, distribution, maintenance of high quality and marketing of seeds, to assure attainment of a level of technology and educational skills capable of providing a self-sustaining Nigerien seed program.

- Produce seeds by utilizing a package of production practices proven to be technically superior by the research service and within the economic capacity of the average Nigerien farmer, to demonstrate the advantages and improved yields available to the producer.

In order to accomplish the objectives of the seed multiplication of the NCP as stated above, project inputs were provided to obtain expert technical assistance for a four-year period, organize and develop a foundation seed center, develop and establish facilities for five seed multiplication centers strategically located in Niger, train personnel and finance some of the local costs.

c. Impact: Findings and Analysis

The five seed multiplication centers and the foundation seed center were sited, facilities constructed and provided with basic seed processing equipment.

Limited progress was made during the period in developing a corps of trained seed specialists in Niger. Two students earned B.S. degrees in agronomy-seed technology from MSU, three technicians were given four week study tours with elements of the seed program in Morocco and Tunisia, and three workers were sent to a seed technology short course in Cameroon conducted by MSU. There was also considerable in-country training. Prior to the NCP, one Nigerien had been trained to the M.S. level.

In Niger, the seed program/industry has a secondary but limited role as a supplier of seeds to replenish seed stocks lost as a result of localized natural disasters such as devastating disease and insect infestations and drought. As the program developed, the quantities of seeds needed for the localities subject to disaster became rather predictable and they are more or less built into the seed demand estimates. The security seed stock concept is peculiar to the Sahelian region and must be considered as a form of insurance in the national interest to soften and shorten the impact of devastating droughts.

d. Lessons Learned

The basis for the development of the seed program in Niger was largely to establish an activity which could cater to the demands for seed during adverse environmental conditions, such as droughts. However, at the initiation of the NCP and its seed production component, there were no significantly improved varieties released and ready for multiplication to the farmers. Ten years after the NCP was started, the Team saw little evidence of improved varieties available for multiplication and distribution.

Poor cooperation and coordination among the elements of the seed program and associated agencies limits the potential for developing a sound seed program.

Lack of a clear policy definition relating to the roles and responsibilities of the agencies involved in variety development and seed production can be a severe limiting factor. A seed production program is unlikely to be successful unless there is an effectively operating research program to provide improved varieties for multiplication.

The absence of a sufficient supply of trained personnel is a critical constraint to successful development of a seed industry.

5. Thailand
   a. Setting

AID assistance to the Thailand seed program began in much the same pattern that occurred in many other countries – key agricultural administrators were invited to attend a short course on seeds held in a nearby country -- in this case – Taiwan in 1959. From this contact, Thai participants returned to Thailand and some filled key administrative positions. Because of their training and positions the need for an improved seed program to spark agricultural production quickly became known to the Thai Government and other agencies, including donor agencies and foundations.

Prior to 1972 the Ministry of Agriculture and Cooperatives produced and distributed limited quantities of "foundation" class seed to "key" farmers through a joint program with the Department of Agricultural Extension (DOAE). This program did not significantly change the seed program or increase agriculture production.

In 1972 a decision was made, perhaps by or influenced by MSU graduates, to establish a program that would increase the supply of high quality seed and encourage more active participation of the private sector in supplying seed of Thailand's basic crops: rice, maize, soybeans, kenaf, mungbeans, cotton and peanuts. Part of the plan resulting from this decision brought in two consultants from MSU; their analysis of Thailand's seed situation provided a useful description of the "setting" at that time.

Seventy percent of the population is engaged in agricultural production. Therefore, a seed program that would improve the lot of the farmer would help the country. Toward this end, the consultants identified the following constraints:

- The activities and/or goals of the various agencies engaged in seed production and supply in Thailand were not closely coordinated. The result was sporadic, duplicating and often opposing activities. A national seed plan was needed to establish firm, consistent policies for the seed program/industry development, to define the responsibilities of the various agencies and direct their efforts, to set realistic goals and to ensure necessary cooperation and coordination among agencies.

- Trained manpower and technical facilities were inadequate.

- The private sector was not involved in the overall improvement effort.

The consultants made 23 recommendations to alleviate these constraints. The objective was to develop a strong on-going program to produce and supply improved seed so farmers would have access to seed of higher yielding varieties which would increase production and income.

b. Description of Activity

The conclusion that a concerted seed program was needed could have been based on the observation that, after at least two decades of a rice cultivar improvement program, the new varieties were still not being used by farmers. This, coupled with the facts that agricultural administrators were knowledgeable of the advantages that high quality seed could impart to higher yields and the availability of new cultivars, made the decision to go for a seed project easy.

At the beginning, the Thai government recognized the need for outside assistance and requested MSU under the worldwide contract to review seed production and supply in Thailand and make recommendations for a plan of improvement. The first set of recommendations (1973) addressed the needs for a seed facility which could receive, clean, upgrade, process and test seed produced by contract growers. This facility would also be used for training purposes. Plans for such a seed center were developed by MSU. The center was constructed at Phitsanulok and is now known as seed center No. 1.

In 1974 USAID/Thailand requested assistance in the preparation of PID and PRP for a seed industry development loan project. MSU prepared the plans and documents. In 1975 MSU was again requested to assist in the preparation of a Project Paper for the Thailand Seed Development Project. This project was approved. Model facilities for the loan project were designed and specifications were developed in late 1975.

In 1977 a ten year USAID supported program started in which MSU provided technical assistance in all phases of the development of the infrastructure for a new program in seeds. During the two phases of this program six seed centers were built in the communities in which the seeds to be processed were produced. All units were used to produce foundation seed, develop extension programs, train extension agents, work with seed producers and implement seed quality control procedures for the seed unit. These units have served as role models for private industry.

Part of the success experienced in getting the seed centers together can be given to the dedicated services of two MSU faculty who were present in Thailand for the ten years of the project, and during this time MSU's campus staff served as backstopping resource persons. MSU, also, assisted private seed companies who were following the leads opened by the RTG/USAID/MSU programs.

MSU has been instrumental to the Thai seed program by providing degree training. More than 25 Thai students have received degrees in seed technology from MSU. The flow of students in seed technology has induced hundreds of Thai students in other disciplines to attend MSU.

c. Impact: Findings and Analysis

The greatest impact of MSU in Thailand has come from training. The technical knowledge of the trained Thais has added more than just having it available to the developing seed industry, it has assisted the decision-making process because the people in decision-making positions could better appreciate the advantages of a seed program.

Fortunately, several events culminated in 1975 that contributed to the success of the seed program and Thai agriculture. A cadre of trained people were available in the country, a seed facility and a seed program were in place and an improved variety of corn – Suwan 1 – was just released. Other varieties were available, especially rice varieties which were initially selected in 1950.

The seed centers designed by MSU have served as a model for the private sector and have influenced other governments and institutions to fund an additional 15 seed centers patterned after the MSU plan. Private seed firms, as well, visit the centers and receive design and operational information.

Most of the seed produced in the centers is used in goverment incentive programs. Some of these programs expedite the delivery and use of improved varieties to farmers on an exchange basis. The production and sale of seed of some crops will never be profitable, therefore, the government must perform the role of supplier. The seed centers make this possible.

d. Lessons Learned

Successful seed programs are the key to improved agricultural production. A seed program has a greater opportunity for success if improved varieties are available to be multiplied and disseminated.

Thailand should serve as a model for what is needed to have a successful seed program in LDCs. Thailand had in place a core of trained people, they had a supportive government, and a source of improved varieties. Fortunately, continuous technical services were provided throughout the entire developmental phases of the seed program by the same dedicated personnel who lived in the country. And finally, but very importantly, a backstopping technical service was available from MSU.

The Thailand seed program has provided impetus to the private sector to move into the business of supplying seed to farmers. In fact, contract growers for seed centers are hounded by

private industry for the seed they produce for the center. Where seed of the crop can be profitable, such as hybrid corn, private industry is already on site and is receiving cooperation and some technical assistance from the public seed program and from MSU. The government seed program will continue to provide seed to implement government programs including the motivation and delivery of the extension program.

The evaluation team saw a need for technical assistance to be provided in the area of vegetable seed production, handling and processing. There is a need also for training in seed pathology in large seeded legume crops including soybeans. This training or assistance should be sufficiently thorough to give direction to research into the local problems and solutions of oil seed production. Likewise the team saw a need to emphasize the importance of the timely delivery of breeders and foundation seed of the improved varieties to the seed centers. Also, a need was seen to improve the cooperation and networking of university personnel and seed center personnel, especially in the areas of student training and research.

C. Worldwide Program

The specific types of activities undertaken by MSU under the worldwide program have been the following:

- Preparation of project papers for project seed components.
- Evaluation and recommendation for future actions.
- Design and specification for seed facilities.
- Regional, in-country, in-service and on-the-job training.
- Degree and special training at MSU.
- Information services.
- Analysis and resolution of technical problems.

1. Training

Within the context of the worldwide seed project, major emphasis has been given to training as a critical element in the development of an effectively operating seed production and distribution system.

Over the life of the contract MSU has provided short courses at MSU and overseas, non-degree academic training and degree training. During 1958 to 1987, MSU has undertaken the following training activities.

Sixty-two in-country and regional short courses, workshops and seminars for 1,923 participants have been conducted. Of these MSU had major responsibility for 31 courses and participated in 26 others for which another entity had major responsibility, usually an international research center such as CIAT.

Four hundred eighty-one participants from 75 countries have participated in the MSU/USDA sponsored seed improvement course lasting nine to ten weeks. Five countries have sent more than 20 students to the short course while seven have sent more than 10 but less than 20.

Non-degree training of 1 to 2 semesters has been provided to 70 participants from 20 countries. Academic training leading to the granting of degrees has been provided to 281 students from 51 countries. The major emphasis has been on graduate degrees. Only 13% of the degree students were B.S. candidates while 70% earned the M.S. and 17% the Ph.D.

MSU has information about 193 degree students who completed their degrees between 1959 and 1984. Of these graduates, 67% are working in the seed industry, 55% in the public sector and 12% in the private sector. There are 27% of the students who are working in agriculture but not in the seed industry. Often these are people who have been promoted to senior positions where their responsibility is broader than seeds though they may still have significant influence on seed programs within their countries. The team observed examples of this in Brazil, Thailand, Honduras and Niger. Of the remaining 6%, the current occupations of 5% were unknown and they have presumably left agriculture and the seed industry, while 1% were deceased. Thus the data show that out of 193 academic students receiving degrees at MSU 96% have remained in agriculture and that over two-thirds of those in agriculture are working on seed programs. While it is not possible to quantify the impact which these degree students have had and are having on the seed industry in the same 43 countries they represent, it is obvious on the face of it that their influence must be considerable. Certainly this was true in the four countries where in-depth studies were undertaken by the evaluation team.

The evidence indicates that non-degree and short course trainees have also largely remained in the seed industry. Nearly all of those attending these courses are employed in the public and private seed industry and they returned to their jobs.

One interesting aspect of attendance at regional workshops or seminars is the influence such attendance has had on the initiation of seed programs. As was noted in the beginning of this report, the AID interest in entering into a contract with MSU was the result of participation in a MSU seed short course. Original interest by both Thailand and Brazil in developing a seed industry was generated by participation in regional seminars conducted by MSU. In many instances seed programs have been instituted in developing countries as a result of efforts of returned participants from MSU. Finally, training in seed technology in the third world is now being carried out by former participants at MSU for in-country or regional training courses. Brazil and Thailand are initiating regional training courses in seed technology. In both Thailand and Niger, as well as Brazil, returned participants are and have been training staff, and at CIAT the staff has assumed responsibility for the conduct of training courses. In conclusion, there is little doubt that MSU training in seed technology has had and will continue to have a strong influence on the growth of the seed industry in many less developed countries.

2. Research

As noted in the previous section, research and research networking had not been a major component of the MSU contractual arrangement until the signing of the 1986 cooperative agreement. It is, of course, too early to evaluate the impact of these new elements. However, research was not ignored by MSU during the first 28 years of the relationship with AID. Research was undertaken by MSU alone and in cooperation with private enterprise. The research was applied research to resolve problems encountered in the State of Mississippi and in developing country seed operations. The major technological problem encountered, and the one on which most research was focused, was the maintenance of quality and viability of seed during storage in the humid tropics. The technological problems were how to reduce seed moisture to acceptable levels of dryness and how to maintain low moisture levels between crop seasons. This problem had not been addressed and new ground had to be broken in seeking solutions. Significant progress was made in developing drying and packaging systems. Today it is possible to successfully maintain seed quality and viability between growing seasons in the humid tropics for most seeds. The exception is oil seeds where problems still persist. That successful seed storage can be done in the humid tropics is almost solely due to the experimental work carried out by MSU with the cooperation of U.S. private enterprise. It should be noted that achievements in increasing the storability of seeds in humid climates have not only benefited developing countries. The effectiveness of seed storage in the humid southeastern United States has been substantially increased as a result of research undertaken by MSU on seed preservation in hot, humid climates.

Inasmuch as MSU is embarking upon a new component under the present contractual arrangement, MSU and AID should give strong consideration to engage in collaborative seed research activities in those countries where the present programs are considered to be on-going success programs. An example would be an activity with Thailand in pathology on large seeded legume crops.

3. Private Enterprise

There has always been a very close relationship between the seed program at MSU and private enterprise. The closeness of this relationship is illustrated by a visit to the seed laboratory at MSU. The laboratory contains all of the latest equipment used in seed processing. Virtually all of this equipment has been made available to MSU without charge by the manufacturers of seed processing equipment. It is ample evidence of the high regard in which the industry holds MSU and the value they put on the relationship.

The MSU seed laboratory was started as the result of efforts by private seedmen in Mississippi. The purpose was to train operators of seed plants which would provide, process, store and deliver improved seed developed by breeders to farmers. With the establishment of the seed laboratory, the seedmen's short course was established to provide training for the small "mom and pop" type seed enterprises in Mississippi and the rest of the southeast. As the course demonstrated its usefulness and MSU pioneered new technological advances the clientele for the course

expanded throughout the United States to include people from large-scale private enterprise, other educational institutions and government officials. It is no exaggeration to state that MSU became the center of excellence for seed technology in the United States and, eventually the world.

When AID arranged for MSU to become involved in developing countries, MSU integrated overseas operation into the going concern in seed technology that had already been established. This included a strong emphasis on the establishment of a private enterprise seed industry and the involvement of the U.S. private seed industry in less developed countries. This was done by influencing the development of seed laws and regulations which provided opportunities to private enterprise, providing advice and guidance to U.S. firms wishing to invest in developing countries and by cooperative work with U.S. private seed companies on technological problems. MSU was institutionally committed from the beginning to private enterprise development in the U.S. and it has continued to be in its overseas activities.

4. Technology Transfer

Technology transfer activities of MSU are closely intertwined with technical assistance activities. For example, in providing technical assistance for the design and specification of seed storage facilities in humid countries, technology is also being transferred.

The appropriateness of technology actually transferred to developing countries was observed in four countries visited by the evaluation team. In each country the plant, equipment and methods of operation recommended by MSU were effective in cleaning, testing, conditioning, storing and producing seed. Additionally, the machinery was being operated and maintained in reasonable condition by local staff. The processing system was suited to both the volume of work and the kind of seed to be processed. The appropriateness of the technology transfer is also attested to by the adoption by private seed companies in Brazil, Honduras and Thailand of the technology recommended by MSU and by the copying by Brazil machinery manufacturers of machinery for seed processing imported in accordance with MSU recommendations.

5. Project Costs

The estimated total cost of the worldwide seed project for the 29½ years from March 1958 to September 1987 is $4,668,000. The largest element in the budget is for salaries and fringe benefits, $2,396,900 while expenditures for equipment, largely for research training, and outside consultants were, respectively, only $49,400 and $45,400. Overhead costs were $993,300, other direct costs $136,000 and travel and per diem $541,000. These are some features of the MSU budget that are worth noting.

During the first 15 years the AID contract did not pay MSU for either fringe benefits or overhead (indirect costs). The costs of these items during the 15-year period have been calculated to be $434,000. Adding overhead costs and fringe benefits, conservatively estimated, brings the

total cost of the contract over 15 years to $1,553,500, of which MSU financed 27.9%. Expenditures on equipment have been minimal and were mostly for start-up costs during the first five years of the project. No equipment has been purchased with AID funds since 1973 and no AID funds have ever been used for buildings or large equipment. Few graduate students have been funded from central contract arrangements. During the first 12 years of the project 12 MSU students were funded. At present 1 graduate student is being funded. Costs for these 13 students are not available. Other students have been funded from other sources, including AID bilateral funding.

In comparison to some other educational institutions providing agricultural services to less developed countries which are financed by AID central contracts MSU costs are low. A recent study comparing the MSU contract with two other contracts found the following:

- Daily cost for providing services for technical assistance, training and dissemination of information by MSU were 18% of institution x and 34% of institution y.

- MSU administrative costs were only 2% of its budget while administrative costs were 11% of budget for institution x and 46% of budget for institution y.

- In-country technical assistance was 47% of the MSU budget while it was only 29% and 16% respectively for institutions x and y.

When compared to the other institutions providing similar services MSU shows low daily costs of services, a high proportion of budget costs going for technical assistance and a small part of the budget allocated to administrative costs.

Because of the nature of the project it is not possible to do a cost benefit analysis. However, some indication of what the magnitude of net benefits may be is indicated by the following. Total costs of the seed project to AID have been about $4,668,000. In Brazil the Associacean Estaduais dos Producton de Semestes, the association of private seed producers, has computed the benefits to farmers from producing grain with improved seed. They calculate that 35 million tons of grain worth Cr.210 billion or almost 4 billion dollars was produced in Brazil in the 1987 crop year from improved seed. Of this production they attribute 20% to the use of improved seeds. Thus 7 million tons, worth Cr.42 billion or $792 million, of grain production can be attributed to improved seeds. Both public and private participants in the seed industry attribute much of the success of the seed program in Brazil to assistance provided by MSU. Taking into account that much of the assistance to Brazil provided by MSU was through a bilateral program, it would appear conservatively reasonable to attribute ½ of 1% of increased grain output from improved seeds to the MSU worldwide program. This would mean an income stream of $3,960,000 per annum, 84% of total AID financing for the worldwide program.

6. Technical Assistance

MSU has provided the following kinds of technical assistance to the seed industry in developing countries.

- Planning, organization and implementation of seed production and supply activities in LDCs.

- Identification, analysis and recommendation for technical and operational problems.

- Designs and specifications for seed facilities and equipment and assistance in installing, checking and managing plant.

- Technical and economic studies to establish design criteria.

Over the period 1958 to 1987 MSU provided technical assistance to 64 countries by 264 teams. Of this technical assistance 211 teams for 49 countries were financed under contractual arrangements with AID while 35 teams for 15 countries were financed separately by other donors. On the average one and a half technical specialists were involved in each trip and each trip averaged over 17 days. Over the 29 year period 369 trips were made by technical specialists who spent a total of 4,798 days providing technical assistance.

A review of programs in four countries and at one international center, study of available project documents and interviews with AID and host-country officials and representatives of private enterprise have led the team to conclude that the standard of technical assistance provided by MSU was extremely high. Technical assistance has in over 98% of the cases been provided from the MSU tenured and permanent staff of professionals. The technical competence of this staff is widely recognized throughout the world by developing countries and donor organizations alike.

Three events in two countries visited illustrate the quality of technical assistance provided by MSU. In Brazil MSU followed up initial assistance provided under the worldwide contract by furnishing ten years of on-site bilateral assistance financed by AID. On completion of the bilateral assistance, Brazil applied for and was allocated an Inter-American Development Bank loan to finance additional facility installations and training. MSU was selected by Brazil to provide technical assistance for design and installation of buildings and equipment as well as to undertake necessary training activities. In Thailand the seed facilities installed with technical assistance provided by MSU proved so successful that both the EEC and the Japanese provided additional funding to Thailand for the construction of 14 seed centers. Also in Thailand, the team was informed on a visit to one of the larger private seed companies that they relied heavily on technical assistance provided by MSU.

7. Relation of Centrally Funded Project to Other Activities

The way in which the centrally funded seed project relates to other overseas activities by the STL is a function of how that organization operates. The laboratory operates as a unit performing teaching, research and extension or information services. These services are provided both domestically and internationally and are funded from various sources. The primary source of funds is the State of Mississippi but funding is also provided by private industry, by USDA, AID for the centrally funded project and bilateral USAID activities and other international and bilateral donors, and by other governments. Personnel, facilities and equipment of the center financed wholly or in part from various sources are used interchangeably for domestic and international activities. For accounting purposes it is possible to allocate expenditures to various funding sources but operationally such a division is not made. All activities undertaken by the laboratory are interrelated and mutually supportive. A means of improving maize drying in the humid tropics by modifying the heating systems developed under contractual arrangements with FAO will be utilized domestically and internationally on activities funded from various sources.

An illustration of this kind of interrelationship is the graduate degree program funded from AID and other donor sources. Few of these students are funded under the centrally funded project. As noted earlier, 12 were funded during the first 12 years of the centrally funded project and one is currently being funded. All of the other international students have been funded from other sources -- usually by AID bilateral programs or by other donor agencies. Yet, operationally, they contribute to the centrally funded project and are considered to be a part of that activity. They do research which addresses problems which fall within the boundaries of centrally funded projects. Their research results are used by and disseminated by the laboratory under the worldwide project. They are also used domestically and, as appropriate, internationally for activities funded from other sources.

The same sort of relationship described above for participant training at the graduate level exists for the other activities carried out by the laboratory. The major strength of the MSU STL is that it has been able to combine funding from various sources to carry out a uniform program domestically and internationally. In one sense this makes it somewhat difficult to evaluate one component of the laboratory's activities because of problems in separating out integrated functions. However, such integration clearly strengthens all components of the total MSU program in seed technology.

8. AID Funding

For the first 26 years of the project MSU activities under the central project were financed from central funding resources. The one exception was that, for a period of time, travel and per diem expenses were funded by the requesting USAID Mission. In 1984 this system was changed with central funding supporting activities at MSU and international research centers and USAID Mission funds financing work with bilateral programs. This system is called the "buy in" process. The system is theoretically sound based on the premise of user costs. However, the evaluation

team believes that there may be some disadvantages to this system which merit consideration. It appears to adversely affect operations both within AID and at MSU.

On the AID side it appears to unnecessarily complicate the process of Missions requesting assistance from MSU. Under the "buy in" system the USAID Mission must go through a contracting process to obtain MSU services. This is in AID a time-consuming process and can slow down what historically has been a fast-response process. Additionally, if unplanned for needs for MSU services materialize, the USAID Mission must find financial resources to fund the MSU services and this may well be a difficult and time-consuming process. On the MSU side it appears likely that the ability of MSU to do forward planning and to allocate resources to meet AID's needs for services may be impaired.

During the period of this evaluation the team did not have sufficient time nor the mandate to make a thorough enough study of the current system to clearly establish its merits or demerits. However, the team does believe that it would be beneficial for AID to undertake a study of the current system for financing MSU seed activities in cooperation with MSU.

IV. LESSONS LEARNED AND POLICY IMPLICATIONS

A. Country seed programs need to consider the role of private enterprise and public service. Private enterprise will effectively and efficiently provide improved seeds to farmers when it can make a profit. There will be some instances where profits cannot be made and public services will be needed. Public involvement is also necessary, at least during the early years, to assure that quality standards are maintained.

B. A properly trained core of technological staff is an essential element for successful implementation of a seed program. If trained staff is not available in an LDC, then training the core staff should be the first order of business.

C. For a seed program to be successful improved seed varieties must be available for reproduction and distribution. Distribution of seed varieties which are no better than those which farmers can save makes no contribution to the growth of agriculture production. Neither does it offer any incentive to farmers.

D. Continuity and integration into ongoing programs significantly improves the quality of services provided under contract to AID by outside organizations. The almost exclusive use of tenured staff over extended periods of time by MSU was a major element in their high level of performance.

E. The prospects for success of seed programs in an LDC are greatly increased when there is wide support by government. Full backing for the seed program at senior levels within the Ministry of Agriculture is essential and endorsement of the seed program by supporting elements, such as planning and finance, is helpful.

F. International centers can be excellent locations for regional training. To be so it is essential that they have appropriate technological teaching staff, proper specialized teaching facilities, language capability and proximity to prospective training. A similarity of environment at the center to that of the trainees' host country is also important.

G. It is essential for Missions to properly sequence proposed assistance efforts to assure that conditions favorable to project success exist. The Niger seed program is an example of a seed project where the absence of proper sequence has limited project accomplishments.

H. When project activities have been completed and terminated it is often important to successful institutionalization of the program in the host country to have a mechanism for providing follow-on consultations.

I. Systems for financing contract services need to be ones which facilitate, rather than constrain, prompt and effective action by AID and the contractor.

ANNEX A

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ANNEX B

PERSONS CONTACTED

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ANNEX C

ACTIVITIES AND ACCOMPLISHMENTS – 1958 TO 1987

1. Short Term Technical Assistance

a. Latin America

– AID financed: 100 trips
15 countries
1.5 specialists per trip
16 overseas days per trip

– Other financing: 13 trips
5 countries

b. Africa

– AID financed: 64 trips
22 countries
1.5 specialists per trip
20 overseas days per trip

– Other financing: 3 trips
2 countries

c. Asia

– AID financed: 47 trips
12 countries
1.5 specialists per trip
25 overseas days per trip

– Other financing: 8 trips
3 countries

d. Europe

– Other financing: 11 trips
5 countries

f. Total Short Term Technical Assistance

– AID financing: 211 trips
49 countries

– Other financing: 35 trips
15 countries

2. Regional and In-Country Training

a. Latin America

– MSU Major Responsibility:

Short Courses	18
Number of Persons	549
Seminars	2
Number of Persons	92

– MSU Major Assistance to Others:

Short Courses	7
Number of Persons	164
Seminar	1
Number of Persons	43

– MSU Major Assistance to Others:

Seminar	1
Number of Persons	53

b. Asia

– MSU Major Responsibility:

Short Courses	6
Number of Persons	189
Workshops	2
Number of Persons	66

– MSU Major Assistance to Others:

Workshop	1
Number of Persons	59

c. Total Regional and In-Country Training

– MSU Major Responsibility

Short Courses	31	
Number of Persons		902
Seminars	3	
Number of Persons		135
Workshops	2	
Number of Persons		66
Total	34	1,103

– MSU Major Assistance to Others

Short Courses	18	
Number of Persons		504
Seminars	1	
Number of Persons		53
Workshops	7	
Number of Persons		263
Total	26	829

3. Training at Mississippi State University

a. Academic Training

– Latin America

Degrees Earned

B.S.	11	
M.S.	86	
Ph.D.	25	
Total	122	
Number of Countries		14

Non-degree

Number of students	2
Number of countries	2

b. Africa

Degrees Earned

B.S.	25	
M.S.	29	
Ph.D.	4	
Total	58	
Number of Countries		20

Non-degree

Number of Students	12
Number of Countries	5

c. Asia

Degrees Earned

B.S.	1	
M.S.	76	
Ph.D.	18	
Total	95	
Number of Countries		14

Non-degree

Number of Students	54
Number of Countries	11

d. Near East

Degrees Earned

B.S.	0	
M.S.	5	
Ph.D.	1	
Total	6	
Number of Countries		3

Non-degree

Number of Students	7
Number of Countries	2

e. Totals

B.S.	37	
M.S.	196	
Ph.D.	48	
Total	281	
Number of Countries		51

4. Seed Improvement Course

a. Latin America

Number of Students	74
Number of Countries	19

b. Africa

Number of Students	145
Number of Countries	28

c. Asia

Number of Students	233
Number of Countries	16

d. Near East

Number of Students	15
Number of Countries	8

e. Others

Number of Students	14
Number of Countries	4

f. Total

Number of Students	481
Number of Countries	75