A.I.D. EVALUATION SUMMARY PART I

(BEFORE FILLING OUT THIS FORM, READ THE ATTACHED INSTRUCTIONS) PD-ABA-952

IDENTIFICATION DATA

A. REPORTING A.I.D. UNIT: S&T/AGR (Mission or AID/W Office)

(ES#)

B. WAS EVALUATION SCHEDULED IN CURRENT FY ANNUAL EVALUATION PLAN? yes ☐ slipped ☒ ad hoc ☐

Eval. Plan Submission Date: FY ___ Q ___

C. EVALUATION TIMING interim ☒ final ☒ ex post ☐ other ☐

D. ACTIVITY OR ACTIVITIES EVALUATED (List the following information for project(s) or program(s) evaluated; if not applicable, list title and date of the evaluation report)

Project #	Project/Program Title (or title & date of evaluation report)	First PROAG or equivalent (FY)	Most recent PACD (mo/yr)	Planned LOP Cost ('000)	Amount Obligated to Date ('000)
931-0610	Biotechnology - Limiting Factors in Biological Nitrogen Fixation	4/5/76	7/15/83	7,000	6,070

ACTIONS

E. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

Action(s) Required	Name of officer responsible for Action	Date Action to be Completed
1. To terminate funding in FY 88 after the last grants have been made, and not to renew the PASA, in spite of strong recommendation by evaluation team to continue and expand the project.	Bathrick Frederick Smith	5/1/90
2. AID staff to monitor projects continuing after the PASA with USDA has terminated.	Gill Malcolm	6/91

(Attach extra sheet if necessary)

APPROVALS

F. DATE OF MISSION OR AID/W OFFICE REVIEW OF EVALUATION: mo___ day___ yr___

G. APPROVALS OF EVALUATION SUMMARY AND ACTION DECISIONS:

	Project/Program Officer	Representative of Borrower/Grantee	Evaluation Officer	Mission or AID/W Office Director
Signature				
Typed Name	L. Frederick		E. Carter	D. Bathrick
Date:	19 Apr 89			5/April/90

H. EVALUATION ABSTRACT (do not exceed the space provided)

This project supports collaborative research between U.S. and LDC scientists on overcoming problems limiting the use of biological nitrogen fixation (BNF). Training of U.S. scientists in international agriculture and of LDC scientists in appropriate research techniques was another objective. The project was implemented through a PASA with USDA-CSRS, to use USDA expertise in agricultural science, their knowledge of U.S. scientists, and their efficient methods of funding grants. During the 13 years of the project (April 1976 to May 1989), AID supplied $6,070,000 and USDA-CSRS awarded $5,236,000 to a total of 85 separate grants. Fifty-four (54) U.S. scientists in 30 universities and one commercial company participated with more than 60 scientists in 36 countries (AFR-8, ANE-12, LAC-16); more than 53 students were awarded graduate degrees with at least 22 from developing countries; and research findings were reported in more than 108 scientific articles in publications permanently housed in libraries world-wide. This evaluation combines the team evaluation (November 17-19, 1987) and the final evaluation by the project officer of the project 931-0610, Biotechnology/Biological Nitrogen Fixation Limiting Factors. The PASA was initiated in April, 1976 and is scheduled to terminate May 31, 1989.

The evaluation team found the project to be on schedule, well managed and resourceful in handling budget cuts and increased overhead costs. Specific findings and conclusions included: (A.) Very strongly recommended continuation of this highly successful and cost effective project with funding to support at least 5 new grants each year. Also expansion of project to include technology transfer and use, and focus on common objectives were recommended. (B.) Identified some key technical achievements and noted that the impact is difficult to assess until these results have been applied in the field. Achievements included: Inadequate phosphorus, other nutrient elements, and rhizobia could be overcome by appropriate inputs; unfavorable environmental factors were managed by selection tolerant legumes and rhizobia; an outstanding rhizobia strain usually increased yield by 25 to 50% for Robut-related peanut lines in India and Cameroon (these yield increases could amount to $8,000,000 per year); beans bred to increase BNF capacity without nitrogen fertilizer produced the same yields as old lines with 40 kg nitrogen fertilizer per hectare; rhizobia strains isolated and tested in this project are being used in commercial inoculants in Cameroon, India, Philippines, Thailand, Zambia, and other LDCs as well as in the U.S.; and LDC scientists continue research on biological nitrogen fixation after the collaborative grant has terminated.

ABSTRACT

I. EVALUATION COSTS

1. Evaluation Team

Name	Affiliation	Contract Number OR TDY Person Days	Contract Cost OR TDY Cost (US$)	Source of Funds
Dr.Mark Stowers	Eastman Kodak Co.	5	523	Program
Dr.Abdul Wahab	AFR/TR/ARD	3	483	OE
Dr.Barbara Webster	Univ.of California Davis	4	1401	Program
Dr.Delane Welsch	Univ.of Minnesota	4	818	Program

2. Mission/Office Professional Staff Person-Days (estimate) 20

3. Borrower/Grantee Professional Staff Person-Days (estimate) 40

COSTS

A.I.D. EVALUATION SUMMARY PART II

J. SUMMARY OF EVALUATION FINDINGS, CONCLUSIONS AND RECOMMENDATIONS (Try not to exceed the 3 pages provided)
Address the following items:

- Purpose of activity(ies) evaluated
- Purpose of evaluation and Methodology used
- Findings and conclusions (relate to questions)
- Principal recommendations
- Lessons learned

Mission or Office: S&T/AGR

Date this summary prepared: 19 April 1989

Title and Date of Full Evaluation Report: Special Grants for Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries 1/20/88 rev. 2/15/88, rev. 2/2/89.

Project Purpose:

Purpose was to support collaborative research between U.S. and LDC scientists to find new and better ways to overcome problems that prevent optimum use of biological nitrogen fixation (BNF) in farming systems of LDCs. Results increase knowledge of the value of BNF systems and of special impediments in developing country situations. Training of U.S. scientists in international agriculture and of LDC scientists in appropriate research techniques was another objective.

The project was implemented through a PASA with USDA-CSRS, to use USDA expertise in agricultural science, their knowledge of U.S. scientists, and their efficient methods of funding grants. Because the research was of mutual interest, for an overall overhead of about 12% USDA-CSRS helped select research topics, sent out requests for proposals, screened preproposals, obtained full proposals, selected grantees based on peer mail reviews and a selection committee, made grants, approved work agreements with LDC scientists, managed the research grants and provided annual reports.

Over the 13 years of the project (April 1976 to May 1989), AID supplied $6,070,000 and USDA-CSRS awarded $5,236,000 for a total of 85 separate grants.

Evaluation Purpose and Methodology used:

This evaluation combines the team evaluation (November 17-19, 1987) and the final evaluation by the project officer of the project 931-0610, Biotechnology/Biological Nitrogen Fixation Limiting Factors. The project was conducted by USDA-CSRS through a PASA BST-0610-P-AG-2170-00 and the earlier PASA AG/TAB 610-9-76. The PASA was initiated in April, 1976 and is scheduled to terminate May 31, 1989. The team met for two days, at North Carolina State University with ten of the principal investigators (3 from LDCs) and visited USDA and AID in Washington, D.C. during one day.

SUMMARY

Findings and Conclusions:

The evaluation team found the project to be on schedule, well managed and administratively resourceful in handling budget cuts and increased overhead costs. Findings and conclusions included:

A. Organizational Achievements

1. Awarded 85 research grants to 54 outstanding U.S. scientists in 31 research institutions (one private company).

2. Provided funds and scientific collaboration through the U.S. institutions for more than 60 scientists in 36 developing countries (8 in AFR, 12 in ANE, 16 in LAC).

3. Project linked with four international centers (CIAT, ICRISAT, IITA, IFDC).

4. More than 53 students received graduate degrees through this program with at least 22 from developing countries.

5. Research findings reported in more than 108 scientific articles in publications permanently housed in libraries world-wide.

6. Developed a highly effective working relationship between AID and USDA.

7. Special note by team: This project has been the most effective program seen by any member of the review team in the ratio of achievements to total monies spent.

B. Technical Achievements

Although the team identified some key technical achievements, they noted that the impact is difficult to assess until these results have been applied in the field.

1. Inadequate phosphorus and other nutrient elements could be overcome by adequate fertilization without nitrogen.

2. Inadequate rhizobia could be overcome by selected strains properly inoculated.

3. Acid soils were managed by collection, isolation and selection of acid-tolerant legumes and rhizobia. Excess salt and other environmental factors were managed in similar ways. Introduction of an acid-tolerant rhizobium strain to the savannah region of Brazil resulted in the threefold increase in bean yield from 750 kg/ha with beans inoculated with local rhizobia to 2200 kg/ha using the introduced acid-tolerant inoculum. Since the total annual bean production in Brazil is 26 million MT, such new rhizobia are of immense potential importance.

4. An outstanding rhizobia strain for peanut was isolated that usually increased yield by 25 to 50% for Robut-related peanut lines in India and Cameroon. In North Cameroon, peanuts are the primary cultivated legume, covering 120,000 ha. Cultivar 28-206 accounts for 90% of this acreage, and this cultivar has given 28% yield increases in the field when inoculated with NC92, a rhizobium introduced through this program. This translates into an average yield response of 182 kg/ha, or a total of 20,000 MT/season. At a world price average of $400/MT, this one project

returns $8,000,000/year (or 1.3 times the total budget of this program). It should be noted that all of these peanuts are locally consumed as food. A Cameroonian company is now producing the appropriate inoculum. This rhizobium isolate came from Latin American, was tested in the field at ICRISAT and was then introduced into Africa via another limiting factors project.

5. Beans were bred to increase BNF capacity with the new lines with no nitrogen fertilizer producing the same yields as the old lines with 40 kg nitrogen fertilizer per hectare. Use of the new lines increases the yield of high-protein food available at a very low cost.

6. Wood represents a major energy source in LDCs. In subsahellian Africa, for example, it is estimated that 75% of total energy used domestically comes from wood, and for the rural family an average of 300 man days/year are required to gather sufficient wood. Among the fast growing trees with both wood and forage potential are leguminous trees such as Leucaena and Acacia. Selection of salt-tolerant, temperature-tolerant, or acid-tolerant rhizobia have been found to give increased yields of 2.0 metric tons/ha (over trees with local rhizobia) in Acacia. In a totally different tree study, using breeding and selection techniques, shade-tolerant peanut varieties were selected in the Philippines and Malaysia for intercropping with rubber trees. Rubber trees are primarily grown by smallholders (1ha is the average plantation size), and the trees begin to mature at 12 years of age. When intercropped with shade-tolerant peanuts, enough nitrogen is made available to the tree to supply the nitrogen needs for the first 6 years of growth. In addition, the farmer obtains crops of feed and food. There are 3,600,000 ha of rubber trees in Malaysia alone. Nitrogen fertilizer consumed for these is 39,000 MT/year. BNF using the current techniques would save approximately 30% of this requirement for a savings to the smallholder of $6,000,000/year. To this must be added the income from the intercropped peanuts (a calculated potential of $4,000,000/year). In the Philippines, in addition, the San Miguel brewery has shown an interest in developing a peanut "snackfood" product to help provide a cash income for the smallholder.

7. As a result of experimental results and rhizobial strain selection with other legumes, as well, inoculant production has also been started by private or government companies in Egypt, Venezuela, Brazil, Thailand, India, the Philippines among others. Even here in the U.S. a commerical inoculant manufacturer, is using Rhizobium strains, obtained from a limiting factors project, in their commercial peanut inoculum. Therefore, practical impacts have resulted in developing countries as well as the USA from this program.

8. In Latin America, beans (Phaseolus) are the staple mass protein crop. Yields and efficiency of nitrogen fixation have traditionally been low. Bean cultivars were selected and introduced into farming systems able to fix nitrogen and yield well under low pH conditions. Such selected beans were used as a recurrent parent crossed with high nitrogen-fixing genotypes. Several inbred backcross lines resulted that had better yield and better nodulation and nitrogen fixation than the traditional cultivars. This established the principle that nitrogen fixation can be enhanced by genetically manipulating the cultivars.6. Rhizobia strains isolated and tested in this project are being used in commercial inoculants in Cameroon, India, Philippines, Thailand, Zambia, and other LDCs as well as in the U.S.

Principal Recommendations

A. Very strongly recommended continuation of this highly successful and cost effective project with funding to support at least 5 new grants each year.

B. Expand the current scope of work within the Limiting Factors Project to include research designed and focused to allow the small farmer to effectively use the "breakthrough technology" developed during the past 12 years of the project. Examples of such research are development of rhizobia delivery systems for use in the LDCs or development of specific cultivars for breeding stock to be used to transfer desirable traits, i.e., increased nitrogen fixation to cultivars of regional interest. Additonal funding would be required to support this activity (at a minimum, an amount equal to that required for at least five proposals.)

C. Generate a compilation of available information obtained through this program and that obtained through other research on the environmentally impacted factors which limit nitrogen fixation in developing countries, and methods to assess the impact of symbiotic nitrogen fixation in the field. This information could serve to facilitate the transfer of successful technology produced in this program to the LDC. A modest amount of funding would be required to produce the document/manual.

D. The networking and meetings for scientific interchange were commended, but the team suggested that the project develop an action plan to facilitate communications between investigators. An integration of research efforts could provide an opportunity to become even more cost effective and also provide a greater opportunity to "brainstorm" to discover new solutions to very difficult problems. A modest amount of funding could provide a significant return.

The recommendations listed above are suggestions that may allow an already successful program to become more successful. The recommendations should not be viewed as a change of focus but as an extension of effort towards addressing the next limiting factors in the successful implementation of nitrogen fixation in developing countries. The review team recommends the adoption of all recommendations with sufficient funding to continue the Limiting Factors Project for five additional years (approximate funding required should equal $5,000,000).

Lesson Learned:

The biological nitrogen Limiting Factors project was based on the following convictions about development:

National development is dependent on agricultural development.

Agricultural development is achieved by increasing economic agricultural productivity, and scientifically improved technology.

Biological nitrogen fixation (BNF) is a system that can provide the essential element, nitrogen, in a cost-effective manner by using mainly resources already on the farm.

Seriously limiting factors have to be understood and overcome before BNF can be used in an optimum way in farming systems.

SUMMARY (continued)

BNF can be increased dramatically when the technology used is based on improvements developed through scientific research.

BNF Limiting Factors project is designed to mobilize U.S. research expertise to help solve problems (factors that limit the use of BNF), in developing countries.

Partnership research projects on mutually interesting problems were set collaboratively between developing country and U.S. scientists, with the idea that all countries involved will benefit.

BNF Limiting Factors project acts as a venture investment group to support those proposals with the greatest scientific merit and contribution to solving problems and increasing research capability of the scientists involved.

BNF Limiting Factors project distributes funds to the U.S. and developing country partners to complement the resources available at the respective research institutions.

U.S. and their collaborating partner scientists continue to work in their own institutions, but travel periodically to plan and work together, share results and publications, gain "hands-on" research experience, and, in some cases, academic training.

Publications, new technology or other intellectual property arising from the research are also shared.

Both partners help to bring useful results to those who can get them to farmers and other end users. Both partners interact to ensure that the projects succeed.

The outcome of all individual research projects depends on three major factors: the ability of proposers to develop a significant hypothesis (idea) and to adopt an appropriate approach to testing it; the competence, creativity, enthusiasm and dedication of the researchers; and the encouragement and support they have received in conducting their studies.

Projects that were well designed and fit together with existing research and facilities in both countries have proved extremely cost-effective and productive. The collaborating scientists often bring complementary skills to bear on selected problems.

Some of the most successful project have produced results with technical application to many countries (such as a special strain of rhizobia that increases yield of certain peanut cultivars by 25 to 50 percent, and breeding nitrogen fixation capacity into common beans (Phaseolus vulgaris). Hence, the results obtained from working in one country are useful in several others, giving a multiplier effect on the original investment. Other projects have produced valuable results that increase the knowledge base of both countries, and may lead to improved technology in the future. These results are preserved and available in more than 108 publications in permanently housed collections of scientific journals available in major libraries world-wide.

Possibly the greatest long-term benefits of this collaborative research has been the strengthening of the research capability of young research scientists returning to their own country. An important corollary is the strengthening of the U.S. research scientist in international activities, and the opportunity to help the developing-country scientist develop an effective research program.

The U.S. has much to gain from assisting the development of low-income countries. With some commodities, there may be competition, but adjustments can be made. But the developing countries are the fastest growing importers of U.S. farm products. Moreover, the experience gained from working with other countries is likely to benefit the U.S., for example, by introductions of plant and animal germplasm that resists pests, by learning how to control diseases before they migrate to the U.S., by sharing basic knowledge discovered jointly by the researchers, by reducing the cost of imported products, etc.

The concept of collaborative research is not new. In AID/S&T/AGR, collaborative research based on competitively chosen grants was an innovative approach to agricultural development initiated by the BNF Limiting Factors project. Judging by the achievements and enthusiasm for this project by the scientists in developing countries and the U.S., this concept of "Working together to help each other" needs to be used more widely in agriculture research.

XD-ABA-952-A

Report of the Review Team

Special Grants for Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries.

(PASA BST-0610-P-AG-2170-00)
PROJECT 931-0610

January 20, 1988

Revised February 15, 1988

Review Team: Dr. Mark D. Stowers, Chairman
Dr. Abdul Wahab
Dr. Barbara Webster
Dr. Delane Welsch

BIOLOGICAL NITROGEN FIXATION BIOTECHNOLOGY
LIMITING FACTORS RESEARCH
REPORT OF REVIEW TEAM

Executive Summary The Limiting Factors Program " aims to use U.S. expertise to conduct research in equal partner collaboration with developing country scientists on factors limiting the use of BNF in the developing country." The program has funded 82 grants to 53 scientists in 30 universities. Currently there are 22 active programs (all with research partners overseas) with 30 scientists in 19 countries. The program has supported 47 graduate students of which 17 were from LDCs.

The Limiting Factors Program has made significant contributions to the identification, understanding and elimination of factors that limit BNF in an extremely cost-effective manner. The following points summarize the review team's recommendations to make an already successful program to become more successful:

1. The program should be continued as recommended. Funding should be continued to allow support for a minimum of five new proposals per year.

2. Continue to develop new knowledge and new ideas related to BNF. Continue to conduct exploratory, potentially high-return, research as done for the past 11 years.

3. Continue to involve the organizational and methodological skills of U.S. personnel.

4. Continue to support on-going projects which show high promise of benefits to developing countries and to U.S. agriculture.

5. Continue to build upon those results which have potential for technology transfer.

6. Encourage in-country (host country) trained personnel, including those trained on the project and others who have skills and knowledge, to contribute to the transfer of BNF technology.

7. Involve in the program women and ethnic minorities to a greater extent.

BIOLOGICAL NITROGEN FIXATION BIOTECHNOLOGY
LIMITING FACTORS RESEARCH
REPORT OF REVIEW TEAM

Introduction: Biotechnology is becoming an increasingly important tool in providing the food supply for an expanding world population. The use of superior plant genotypes and biological nitrogen fixation (BNF) is one example. BNF provides particular benefits to leguminous plants by supplying nitrogen through a symbiotic association with root-nodule bacteria, called *Rhizobium*. The significance of BNF is its potential to increase legume yields with relatively low input. It is also a biotechnology which the small farmer is able to use with little technical training. The importance of BNF to the developing world is based on its ability to alleviate requirements for chemical nitrogen fertilizer and reduce energy costs. Equally important is the ability to produce high protein food crops, forages and wood with little or no nitrogen fertilizer.

The application of BNF to the small farm in developing countries offers significant opportunity for (1) increasing agricultural productivity in a relatively short time, and (2) the establishment of a working system with the end-user for the translation of further developments in agricultural biotechnology.

The Limiting Factors Program provides for research to optimize BNF by the selection of efficient bacteria matched with proper plant hosts. The application of this research is in developing countries through partnerships between principal investigators in the U.S. and developing countries. The success of the program can be measured by the technical achievements in overcoming factors limiting the use of BNF in developing countries and in organizational achievements in establishment of successful linkages between the U.S. and the developing countries.

Evaluation Methodology The review team was requested to assess the progress of the project, project design, operation of the project, the impact of the results and provide recommendations for the future directions. The review team consisted of Dr. Mark Stowers, Eastman Kodak Company, Chairman, Dr. Abdul Wahab. AID/AFR/TR/ARD/PA, Dr. Barbara Webster, University of California-Davis and Dr. Delane Welsch, University of Minnesota. Others present at the review: Dr. LLoyd Frederick, S&T/AGR, Project Officer, Dr. Gerald Elkan, USDA/CSRS and North Carolina State University, Program Director, and Dr. Charles M Smith, USDA/CSRS, Program Manager..

The review team was furnished the following documents for review prior to or during the review (November 16-19, 1987):

1). PASA between AID AND USDA (FY 1987 - 1988).
2). Project Evaluation Summary and Report of the Review Team Evaluation (June 30, 1981).

3) Project Authorization and Request for Allotment of Funds.
4) Proceedings: Coordinating Workshop for BNF Limiting Factors Program. Maui, Hawaii, August 1985.
5) Action Memorandum for Agency Director for Food and Agriculture, Bureau for Science and Technology.
6) Project Report for External Review/1987 Annual Report (November 1, 1987).
7) Scope of Work for External Review Team.

In addition to written documents, the review team heard presentations by several principal investigators and participated in one-on-one discussions with selected key principal investigators from the U.S. and LDCs during November 17-18, 1987, in Raleigh, North Carolina. The Chairman of the review team also reviewed a tape recording of a "brain-storming" session among several PIs discussing future directions of the project. The review team also traveled to Washington, D.C. to meet with Mr. David Bathrick, Director, Office of Agriculture, Dr. Clare Harris, Associate Director, USDA/CSRS, Dr. Charles Rumburg, Deputy Administrator, USDA/CSRS, Mr. Terry Pakovsky, Chief, Grants Administration and Mr. Dennis Brennan, Deputy Assistant Administrator, Science and Technology Bureau, AID.

External Factors: For the past eleven years the focus of the Special Grants Program for Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries (Limiting Factors Program) has been "to fund teams of U.S. and developing country scientists to collaboratively conduct research on the major factors limiting the full utilization of biological nitrogen fixation (BNF) technology by small farmers in developing countries". The approach has been to fund collaborative ventures where U.S. scientists are equal partners with collaborators in their own country. In the few cases where political situations have made it impossible to conduct collaborative activities, arrangements have been made to work with scientists in alternative countries.

Purpose: The Limiting Factors Program "aims to use U.S. expertise to conduct research in equal partner collaboration with developing country scientists on factors limiting the use of BNF in the developing country".

Achievements: Since its inception, the Limiting Factors Program has awarded 82 grants for 3 year duration (average) to 53 U.S. scientists in 30 universities at $67,000 (average). Approximately 50% of the funding is designated for items that support the activities of the overseas collaborator. Currently 22 projects are active.

When the Limiting Factors Project was established 11 years ago, there was no requirement for formal overseas collaboration. Of the current 22 active programs, all have active collaboration with scientists overseas [30 scientists in 19 countries (Barbados,

Brazil, Cameroon, Ecuador, Egypt, Honduras, Kenya, Malaysia, Mexico, Nepal, Pakistan, Panama, Peru, Philippines, Santa Domingo, Swaziland, Tunisia, Turkey, and Venezuela)]. There have been cooperative relationships with the international centers: ICRISAT, Hyderabad, India; IITA, Ibadan, Nigeria; CIAT, Cali, Colombia; and the International Fertilizer Development Center, Muscle Shoals, Alabama.

The Limiting Factors Program has supported 47 graduate students of which 17 were from LDCs. At least two individuals who received degrees through funding by the Limiting Factors Project have been awarded grants through the same program upon returning to their home country. This illustrates the success of the Limiting Factors Program in providing educational opportunities to individuals in LDCs who can make a larger contribution to their home country through obtaining research funding and making a contribution to solving critical agricultural problems.

Inputs: The project manager is Dr. Gerald Elkan, North Carolina State University, who replaced Dr. Robert Miller in 1981. All other personnel related to the project have remained as stated in the previous project evaluation of June 30, 1981. The project is administered by the USDA under PASA BST-0610-0-AG-2170-00 under the direction of Dr. Charles M. Smith. The AID project officer and technical backstop is Dr. Lloyd R. Frederick.

The total monies allocated to the project over the past eleven years are $5,570,000 out of $7,000,000 authorized. From the $5,570,000 transferred to USDA, $5,206,000 were awarded to participating scientists. For less than 14% of the funds, USDA/CSRS issued the requests for proposals to more than 300 addresses, organized and carried out the peer reviews both by mail and by conference, made the grants and transferred the funds, monitored the work agreements between the U.S. and LDC institutions, received the progress reports, and provided an annual report to AID.

The average number of new proposals funded between 1976 and 1981 was 8 per year at an average of $48,169 for a 3-year period. The average number of new proposals funded from 1981 to 1986 was 6 per year at $85,156 for a 3-year period. The total monies awarded annually from the project over the past three years has decreased significantly from $675,200 (including $334,700 in special monies for biotechnology research) in FY 1985 to $163,500 in FY 1987. For the combined FY 1986/1987 (no new funding was made in FY 1986), 36 preproposals were received, and 6 were funded (16.7%). The decrease in project funding has limited the number of projects funded and the scope of the program as a whole. This situation exists in spite of (1) the increasing number of good scientists in the area of BNF, both in the U.S. and in developing countries and (2) the increased knowledge base about other biological systems which limit BNF (both factors can be attributed in part to the success of this program).

Nonetheless, an optimum program is one in which from 30 to 40% of the proposals that are submitted are funded and chances for significant breakthroughs are maximized.

Outputs: The results of the research have provided significant progress toward understanding factors limiting BNF in developing countries. In some cases the research successes in this program represent breakthroughs not evident before, particularly with regard to reproducible inoculation responses with Rhizobium and development of superior nitrogen-fixing plant genotypes. In order to capitalize on the successes of the project and maintain its impressive record of successful research, continuation of the project with minor restructuring and refocusing is needed.

The Limiting Factors Program has been the most effective program seen by any member of the review team in the ratio of achievements to total monies spent by AID.

Beneficiaries: Up to the present time the major beneficiaries of the Limiting Factors Program have been the principal investigators of institutions in the U.S. and LDCs where research is conducted to establish and recommend solutions to factors that limit BNF in developing countries. There is considerable evidence to support the success of the project in awarding grants to institutions both here in the U.S. and in LDCs ($5,206,000). The general scientific community has benefited greatly by the publication of more than 88 research articles, including the booklet, "Proceedings: Coordinating Workshop BNF Limiting Factors Program, Maui, Hawaii, August, 1985" (91p), and the book, "Biological Nitrogen Fixation Technology for Tropical Agriculture",CIAT (726p).

Various LDCs have also benefited from this program. The success in reproducible inoculation response in peanuts in Cameroon will impact both food and revenue production. The identification of elite lines of bean with superior nitrogen fixation potential will allow a greater opportunity for increased yields in Honduras and other areas in Latin America. Other successes in strain selection for effective rhizobia, mycorrhizae, and in incorporating legumes into farming systems profitably have also impacted local agriculture.

The logical next step is to seek ways to deliver the BNF technology to LDCs at small farmer level. To do so, activities need to be targeted to on-farm field trials, implementation methodology for rhizobia inoculation, and delivery of desirable plant germplasm. The Limiting Factors Program has done an excellent job of doing high quality research and the integration of LDC collaborators into the mainstream of BNF research. The opportunity to build upon the success of the program and the network established by the program is clearly there.

14

Recommendations:

The following recommendations are made to allow an already successful program to become more successful. The suggestions are not a change in focus, but an extension of effort addressing the limiting factors in the successful implementation of nitrogen fixation in developing countries. The review team recommends the adoption of all recommendations with sufficient funding to continue the Limiting Factors Program for five additional years (approximate funding required should equal $5,000,000).

1). The Program should be continued to support exploratory, potentially high return, research as has been done for the past 11 years. This effort has been highly successful and cost effective. Funding should be continued to allow support for a minimum of five new proposals per year.

The review team suggests that the program continue its support of exploratory research in the understanding of limiting factors of BNF. The program has a very successful " track record " with this approach. Ideally, successes from this program component could be further developed and transferred to the small farmer in an integrated fashion.

2). The Program should be expanded with additional funding to focus on the transfer of its successful technology to small farmer applications.

The project has produced results that could have a significant impact on the small farmer in developing countries. It is now time to attempt to transfer these technologies (Rhizobium strains legume genotypes) to the end-user. The review team recommends that the existing project be expanded to establish the necessary technology for implementation of the successful results of previously funded research. Embodied in this recommendation is the need for (1) delivery systems for Rhizobium strains, (2) inoculant development, i.e., Rhizobium fermentation research, inoculant stablization, carriers, etc., and (3) research on development of legume genotypes with superior traits, such as enhanced BNF for particular geographical regions. The review team recognizes the contribution of collaborators in developing countries in the successful transfer of technology. Given the immense success of the Limiting Factors Program in establishing key linkages between scientists in developing countries and in producing quality research, it is recommended that this program be the vehicle for the technology transfer. Additional funding would be required to support this activity (at a minimum, an amount equal to that required in recommendation 1), i.e., support for at least five proposals).

3). The Program should be expanded with additional funding to focus on factors that are limiting the transfer of BNF technology to farms.

The review team suggests that the program be expanded to define specific factors that are limiting the transfer of BNF technology to farmers. The most significant limitation to the transfer of biotechnology from the laboratory to the field is the impact of the environment on the system. The review team recommends the compilation of available information identifying environmentally impacted limiting factors in developing countries and to formulate an approach for the assessment of success of BNF under conditions seen in various regions among developing countries such as tropical lowlands, temperate highlands, etc. Additional information will be gained from the transfer of technology recommended above. However, it is important that emphasis should be directed to research to insure the success of technology applied to new situations. A modest amount of funding would be required to produce the document/manual.

4) The Program should develop an action plan to coordinate research activities based on a common objectives, i.e., similar research approaches, such as, common plant species or geographical regions. The review team recommends that all funded work be integrated among projects that share common objectives either through common geographical regional issues or through similar research approaches or common crop species. In the past, formal workshops such as the one held in Maui, Hawaii in August, 1985, served this purpose. Perhaps local regional workshops representing not only the principal investigators but also key local officials--scientists, extension personnel, government staff and A.I.D. local mission individuals could be developed to promote local understanding of the significance of successful programs.

5) General administrative and organizational recommendations by the review team:

A. The current relationship between the USDA and AID should be continued.

B. The review team recommends that the peer review process be continued.

C. The Program should endeavor to solicit proposals from all segments of the research community through continual revision of ts mailing list to reflect all known interested parties. With regard to the adequacy of calls for proposals, a survey of research proposals funded indicates that funding went mainly to land-grant universities suggesting that the call may not have reached all segments of the research community. The review team has been made aware that the call for proposals goes to over 300 addresses, reaching a critical mass in the research field.

D. The administrators should periodically convene the principal investigators to discuss their research, to maximize the information transfer, encourage coordination of resources and germplasm, and attempt to standardize research methodology.

E. A greater involvement of the private sector is encouraged both in the U.S. and in the developing countries. The Limiting Factors Program has created an opportunity for the private sector to provide the product to the end user. It is important that the private sector become a part of the program early in its development to facilitate technology transfer.

F. A greater involvement of the local AID mission is recommended. A tremendous positive advantage can gained by an alliance with the local mission. An example of where the local mission can help is in the on-farm trials demonstrating the efficacy of the biotechnology of BNF.

G. An increased involvement of women and minorities is recommended in both the call for proposals and review of proposed research.

Unplanned Effects It is inconceivable that the founders of Limiting Factors could have envisioned the magnitude of the success of the project in the quality of research, the technical advances and the tremendous international network of collaborators with such a small amount of financial support.

Lessons Learned To summarize the lessons learned from Limiting Factors Programs, impacts can be made that positively affect agriculture through BNF in LDCs and an international network of scientists can be established with relatively small research funding. A lesson to be learned is how does one successfully transfer the successful technology generated through the program to the small farmer and how does one mobilize the excellent existing network of scientists to effect the transfer.

February 15, 1989

Dr. Lloyd R. Frederick
Office of Agriculture
Bureau for Science and Technology
Agency for International Development
Washington, D.C. 20523

Dear Lloyd:

I have received the copy of the report of the review team, and have no additional comments or suggestions. I am glad to see the report completed; however sad to hear that the program is scheduled to die.

The Limiting Factors Program has been an extremely successful program, as indicated in the report of the review team, in grants awarded, graduate students educated and scientific and technical achievements in the field. As a review team it was difficult to translate the exploratory research successes presented by the principal investigators to quantitative impacts on agriculture in developing countries. In my mind, it is like quantifying the impact of automobile, airplane or telephone in 1900 on the 1990s. In 1900 there were indications that each of these would have an impact; and there were individuals who saw the future opportunities to revolutionize the world, but no one could quantitate the impact.

It is a shame that there is lack of foresight at AID for the potential of this program given the tremendous infrastructure and technical basis already accomplished.

Thank you for the opportunity to serve on the review team. It was pleasure to work with you and the review team. I wish you success in your endeavors and hope to see you in the near future.

Very best regards,

Mark

Mark D. Stowers, Ph.D.
Technology Manager
Bio-Products Division

EASTMAN KODAK COMPANY 95 Allens Creek Rd. Rochester, New York 14650-0820 U.S.A. *Telephone* (716) 588-6100

18

ACTION MEMORANDUM FOR THE AGENCY DIRECTOR FOR FOOD AND AGRICULTURE, BUREAU FOR SCIENCE AND TECHNOLOGY

FROM: S&T/AGR, Mr. David D. Bathrick, Director

SUBJECT: Scope of Work for Team Evaluation of the Project, N-Fixation/Biotechnology Limiting Factors, (931-0610), with USDA Cooperative States Research Service (PASA BST-0610-P-AG-2170-00).

Background:

Your approval is required to proceed with an in-depth evaluation of the subject project. The last review of the project was conducted in June, 1981. This review will evaluate the performance of the project over the past six years and provide guidance to AID regarding additional authorization. This review was planned so the review team could visit several grantees at a coordination workshop to be held November, 1987.

Recommendation: In order to carry out this team review, your approval is required both for the Scope of Work and travel costs of the team.

APPROVED: _____

DISAPPROVED: _____

DATE: _____

Attachment: Scope of Work

Clearances:

S&T/AGR/RNR, L. Frederick _____ date 30 Oct 87
S&T/AGR/RNR, T. Gill _____ date 10-30-87
S&T/AGR, E. Roche _____ date _____
S&T/PO, V. Anderson _____ date _____

Info:

S&T/AGR, J. Cohen
S&T/FNR, J. Sullivan

DRAFTED BY:LFrederick:ryh:10/29/87:Wang#5111g

19

SCOPE OF WORK

In-Depth Team Review

Project Title: Studies of Factors limiting N-Fixation (Biotechnology) for LDC Crop Production (Biotechnology, Limiting Factors)

1. Project #: 931-0610
2. PASA #: BST-0610-P-AG-2170-00
3. AID Project Manager: Dr. Lloyd Frederick

Contractor: USDA - Cooperative States Research Service Contract Management

1. USDA Program Manager: Dr. Charles Smith, USDA-CSRS, Room 119, JS Morrill, Washington, DC 20251, Ph (202) 447-2039
2. Other Program Staff: Dr. Gerald Elkan, Department of Microbiology, North Carolina State University, Raleigh, NC 276595, Ph (919) 737-3945

Purpose of the Evaluation:

This project aims to use U.S. expertise to conduct research in "equal partner" collaboration with developing country scientists on factors limiting the use of biological nitrogen fixation (BNF) in the developing country. The evaluation will assess the caliber of U.S. scientist involved, the collaboration, types and progress of research activities funded to date, the impact of the project on LDC agricultural science and technology, and direction and scope of future activities. The project is now in its 11th year, and is approved through September, 1989.

Dates and Places of Evaluation:

1.	Raleigh, NC, November 16-18, 1987	Sub-project site and attend special meeting of P.I.s.
2.	Washington, DC, November 19, 1987	Visit USDA and AID Administration.
3.	Draft report due December 20, 1987	
4.	Final report due January 15, 1988	

Composition of Team:

The team has people of wide and varied experience, including international dimensions. The following persons have agreed to serve:

- Dr. Barbara Webster, Assoc. Dean of Agriculture, University of CA. Davis, CA 95616 (714) 752-2075

  Crop Scientist, research and university administration, international experience, CRSP researcher, BOSTID (NRC-NAS) member.

- Dr. Donald Plucknett, CGIAR Secretariat, World Bank, 1818 H St. N.W., Washington, D.C. 20433 (202) 334-8033

  Agronomist, farming systems, International Agr. Res. Centers research, international development

- Dr. Delane Welsch. Prof. of Agricultural Economics, Asst. Director International Programs, University of Minnesota, St. Paul, MN 55108 (612) 624-3221

  Agriculture economist, BNF analysis, international experience, farm record analysis.

- Dr. Abdul Wahab, Agriculturalist, AID/AFR/TR/ARD/PA, 2941 NS, Washington, D.C. 20523 (202) 647-8717

  Agronomist, tropical research, seed technology

- Dr. Mark Stowers, Director of Agriculture Technology, Eastman Kodak Co, 1700 Lexington Ave., Bldg. 610, Rochester, N.Y. 14650 (716) 722-6531

  Microbiologist, molecular genetics, international business

Other Participants:

- Dr. Lloyd Frederick, AID/S&T/AGR/RNR, Room 420 SA-18, Washington, D.C. 20523 (703) 235-1275

- Dr. Charles Smith, USDA-CSRS,

- Dr. Gerald Elkan, Prof. of Microbiology, N. Carolina State University, Raleigh, N.C.

Cost Analysis for Evaluation:

Name	Travel	Per Diem	Salary/ Consultant fee	Source of funds
Dr. Barbara Webster	600	382	None	S&T/AGR[1]
Dr. Donald Plucknett	172	158	None	S&T/AGR[1]
Dr. Delane Welch	523	382	None	S&T/AGR[1]
Dr. Mark Stowers	360	382	None	S&T/AGR[1]
Dr. Abdul Wahab	172	158	None	S&T/AGR[2]
Dr. Lloyd Frederick	172	158	None	S&T/AGR[2]

Total cost to S&T/AGR
Operating expense: $660
Program funds: $2959

1 - purchase order program funds project 936-4109
2 - operating expense funds

22

Project Background:

This project was initiated in FY 76 with the goal to improve food production in developing countries and reduce inputs for fertilizer nitrogen through greater exploitation of biological nitrogen fixation (BNF) by legumes. To achieve this goal, the project was to increase LDC research capability by support of outstanding U.S. scientists in collaboration with developing country scientists to conduct research to overcome factors that limit the use of BNF in these countries. Major activities of the project have included:

1. since inception, 82 grants have been awarded to 53 U.S. scientists in 30 research institutions,

2. the average funding per project was $67,000 for three-year studies with approximately 50% of the funding used for overseas collaboration,

3. currently 30 scientists in 19 LDC countries are active collaborators in the 22 active projects,

4. coordinating workshops are held about every third year, and

5. about 43 graduate students have earned advanced degrees; about half of these were from developing countries.

Research accomplishments are:

1. reported in more than 88 scientific publications, numerous oral and poster presentations, and workshop proceedings, including the book, Biological Nitrogen Fixation Technology for Tropical Agricultures, published by CIAT;

2. results of studies on 10 food legumes, several forage legumes, and three tree legumes; highlighted by:

   (A) breeding methods that increased the nitrogen fixation capability of common beans,

   (B) discovery and characterization of a rhizobium strain that increased yields of certain peanut cultivars in soils already containing compatible rhizobia,

   (C) acid tolerant rhizobia for leucaena and other legumes,

   (D) oil-based, lyophilized rhizobia as an improved inoculant,

   (E) yield increases due to rhizobia inoculation on different soils with different legumes, including some tree legumes, beneficial effects of mycorrhiza on nodulation and BNF,

   (G) root knot nematode reduced plant growth, but had no specific effect on BNF,

(H) found some rhizobial strains were more stable genetically and developed a screening technique to identify the more stable strains,

(I) improved small farmer storage and hand methods for application of rhizobia inoculant,

(J) measurement of actual amount of BNF in mixed cropping systems using 15_N, and

(K) new Medicago falcata and associated rhizobia germ plasm for breeding work was collected.

Problems and Issues to be Addressed by the Team:

While not excluded from this external evaluation exercise, the quality and quantity of the research performed under this program, as evidenced by the number of scientific papers published in refereed journals, is apparently quite high. Therefore, the principal concern of AID senior management, given the severe competition for limited funds both within the field of BNF and in other areas of agricultural research, is with questions of relevance, impact and cost-effectiveness vis-a-vis alternative programming approaches. Special issue statements are being provided to guide the evaluation team to questions of importance and timeliness to AID, and whose analysis and recommendation will help in subsequent decision-making.

Progress:

1. Is the project proceeding satisfactorily?

2. Are LDC collaborating scientists benefitting and supportive of the project?

3. Is the work sufficiently completed that the project is no longer needed?

4. ISSUE: NEED FOR VALIDATION/CLARIFICATION OF PROGRAM PURPOSE
The purpose, as given in the Research Project Statement, is to conduct research which will (i) identify and examine those factors that limit optimum BNF in tropical and sub-tropical agriculture, (ii) developing ways to overcome these limiting factors, and, (iii) devise new and improved ways to provide BNF technology to LDC small farmers.

The limiting factors of BNF were categorized as soil; plant; and rhizobial inoculant, strain selection and inoculation response. As a way to provide an effective and economical means to obtaining research by qualified workers on these factors, the USDA-CSRS is mandated to issue research grants for projects which address existing knowledge gaps on factors limiting BNF in developing countries.

The team is requested to review the progress and result achieved under each of the three elements in this purpose statement and, in combination with other issues which follow, provide its advice on whether (a) the purpose is too broad or narrow and (b) whether a small grant program is the most cost-effective method of such a purpose.

Project Design:

1. Is the scope of the project too broad? too narrow?

2. Are objectives being achieved for:
   a. training of national scientists in research?
   b. overcoming some limiting factors in BNF through research?
   c. linkages and networking?
   d. technical assistance?

3. How adequate are the calls for proposals, the selection techniques, the awarding of grants, and the follow-up on grant activities?

4. How adequate is the reporting system?

5. Are the available resources adequate? Is this research project cost effective?

6. ISSUE: APPROACH AND FOCUS

   The project statement calls for a Technical Specialist Group from USDA and AID to be convened and consulted to define the factors/problem areas that limit biological nitrogen fixation in tropical cropping systems that can be ameliorated by research. A USDA/AID Selection Committee awards grants on the basis of objectives, scientific merit, pertinence to development, design, methodology, feasibility etc. Increasing reliance is being laid on "Limiting Factors Program Coordination Workshops" for focus and coordination. The last one was held in Hawaii in 1985. At this session, suggestions were made, inter alia, to emphasize better nitrogen-fixing, higher yielding cultivars, include more genotypes and rhizobial strains, appropriate emphasis on biotechnology, and research findings implemented in farmers fields through extension oriented activities. The questions [illegible]

a) the "programming" approach taken seems largely passive, i.e., guidelines are issued, and could sometimes be self-serving, e.g. developing a consensus amongst participating parties. How are research priorities developed, monitored and changed and can the process be improved? Is it reasonable to expect a relatively small and short-term grant program to operate in a "programmatic" fashion?

b) concern has been expressed that the grants are scattered, lacking focus, are too small and of too short duration to bring any meaningful results. After 11 years, what do the facts and figures indicate regarding this concern? Given the project purpose, is it more justifiable to encourage open-endedness and innovativeness or, conversely, to encourage research in pre-selected priority areas closely coordinated with other AID-sponsored activity in BNF?

c) Is the PASA mechanism with USDA/CSRS the most effective one for achieving programmatic results? What are the advantages and disadvantages of alternative approaches, e.g., assigning the function and funds to AID's NifTAL project (a Cooperative Agreement between AID and the University of Hawaii)?

d) How can or should the IARC's be involved effectively in this program, particularly in utilization of results, developing technology packages and extension?

e) Should system-based research (e.g., IBSNAT) methodology, be used for developing a complete package of practices and an expert system for outreach?

Project Operations Management:

1. Is there good cooperation between USDA and AID?

2. Is the collaborative arrangement between the grantee U.S. institution and the co-investigator institution adequate and appropriate?

3. How does the LDC scientist and institution contribute to the project?

4. How does the U.S. scientist and institution contribute to the project:

Personnel:

1. Is the staffing adequate and appropriate?

Impact of Unplanned Events:

1. How have changes in AID personnel, in USDA personnel affected project? Other?

Impact of Results:

1. Are the results currently being achieved both applicable and useful to developing countries? Where? What effects can be measured?

2. Is there any indication that the technology improvement developed by this project have been, or will be, used by farmers in the developing world?

3. Can the impact of this project on research capability of developing country scientists and institutions be measured?

4. Has this project had a positive/negative impact on U.S. agriculture?

5. ISSUE: RELEVANCE AND IMPACT

The grants, particularly those involving cooperative field studies with developing countries, are intended to result in benefits which include:

(1) increased knowledge concerning the response of major legumes in LDC's to inoculation; (2) development of research program and trained personnel in BNF within developing countries which should help in-country BNF long after these grants have ended; (3) the chance to demonstrate the benefits as well as the techniques for legume inoculation to small landholders within on LDC.

(a) what are its actual or potential benefits?

(b) what evidence do we have that this grant program has assisted developing countries in becoming aware of the potential of BNF and have begun programs and institution-building to apply the research results achieved to date? In short, is anything changing on the farm which can reasonably be attributed to this program?

ecommendations:

1. What are team recommendations regarding the project objectives, goals, relative value?

2. Does the project contribute to sustainable agriculture, low-resource agriculture, low-input agriculture, biotechnology, and rural income?

3. Should this project be extended?

4. ISSUE: OVERALL ASSESSMENT

Based on the documentation supplied and discussion of the above issues with evaluation participants, provide an overall assessment at the following levels:

(i) research products, i.e., quality, quantity and cost-effectiveness;

(ii) relevance of research results to agricultural problems in tropical and sub-tropical areas in the developing world; and

(iii) actual/potential impact of program in developing countries and on-farm

Executive Summary:

Should not be more than one page, single spaced.

List of Documents to be reviewed by the Team:

1. Current PASA and amendments
2. Project Paper
3. 1986 Annual Report
4. Proceedings: Coordinating Workshop BNF limiting Factors Program

Proposed Schedule of Events:

1.	Approval of Scope of Work	10/20/87
2.	Distribution of Scope of Work and Documents	11/12/87
3.	In depth team evaluation	11/16-20/87
4.	Team leader submits final report to S&T/AGR	1/31/87

Dr Frederick — from Chuck Smith

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of providing such services has been

NS FOR EXISTING AND CERTAIN NEW
SEARCH PROGRAMS

National Agricultural Research,
t of 1977 (7 U.S.C. 3311) is amended

)00,000 for the fiscal year ending
section (a) and inserting in lieu
fiscal year ending September 30,
l year ending September 30, 1983,
r ending September 30, 1984, and
ar ending September 30, 1985,";
)00,000 for the fiscal year ending
section (b) and inserting in lieu
fiscal year ending September 30,
l year ending September 30, 1983,
r ending September 30, 1984, and
ending September 30, 1985,"; and
eof a new subsection as follows:
provision of law effective beginning
5 per centum of the total funds
y fiscal year for the conduct of the
ided for under the Act of March 2,
tch Act (7 U.S.C. 361a et seq.); the
ram provided for under the Act of
n as the McIntire-Stennis Act (16
and competitive grants programs
(c) of the Act of August 4, 1965 (7
earch program provided for under
the native latex research program
Commercialization and Economic
C. 178 et seq.); and the research
s for which funds are appropriated
heading or a successor heading,
at State agricultural experiment
n of the Act of March 2, 1887.".

IONS FOR EXTENSION PROGRAMS

National Agricultural Research,
t of 1977 (7 U.S.C. 3312) is amended
for the fiscal year ending Septem-
thereof "$350,000,000 for the fiscal
$360,000,000 for the fiscal year
)00,000 for the fiscal year ending
0,000 for the fiscal year ending

S PROVISIONS

cultural Research, Extension, and
.S.C. 3101 et seq.) is amended by
ew sections:

"PROGRAM EVALUATION STUDIES

"SEC. 1471. (a) The Secretary shall regularly conduct program evaluations to meet the purposes of this title and the responsibilities assigned to the Secretary and the Department of Agriculture in this title. Such evaluations shall be designed to provide information that may be used to improve the administration and effectiveness of agricultural research, extension, and teaching programs in achieving their stated objectives. 7 USC 3317.

"(b) The Secretary is authorized to encourage and foster the regular evaluation of agricultural research, extension, and teaching programs within the State agricultural experiment stations, cooperative extension services, and colleges and universities, through the development and support of cooperative evaluation programs and program evaluation centers and institutes.

"GENERAL AUTHORITY TO ENTER INTO CONTRACTS, GRANTS, AND COOPERATIVE AGREEMENTS

"SEC. 1472. (a) The purpose of this section is to confer upon the Secretary general authority to enter into contracts, grants, and cooperative agreements to further the research, extension, or teaching programs in the food and agricultural sciences of the Department of Agriculture. This authority supplements all other laws relating to the Department of Agriculture and is not to be construed as limiting or repealing any existing authorities. 7 USC 3318.

"(b) The Secretary may enter into contracts, grants, or cooperative agreements, for periods not to exceed five years, with State agricultural experiment stations, State cooperative extension services, all colleges and universities, other research or education institutions and organizations, Federal and private agencies and organizations, individuals, and any other contractor or recipient, either foreign or domestic, to further research, extension, or teaching programs in the food and agricultural sciences of the Department of Agriculture.

"(c) The Secretary may vest title to expendable and nonexpendable equipment and supplies and other tangible personal property in the contractor or recipient when the contractor or recipient purchases such equipment, supplies, and property with contract, grant, or cooperative agreement funds and the Secretary deems such vesting of title a furtherance of the agricultural research, extension, or teaching objectives of the Department of Agriculture.

"(d) Unless otherwise provided in this title, the Secretary may enter into contracts, grants, or cooperative agreements, as authorized by this section, without regard to any requirements for competition, the provisions of section 3709 of the Revised Statutes (41 U.S.C. 5), and the provisions of section 3648 of the Revised Statutes (31 U.S.C. 529).

"RESTRICTION ON TREATMENT OF INDIRECT COSTS AND TUITION REMISSION

"SEC. 1473. Funds made available by the Secretary under established Federal-State partnership arrangements to State cooperative institutions under the Acts referred to in section 1404(16) of this title and funds made available under subsection (c)(2) and subsection (d) of section 2 of the Act of August 4, 1965 (7 U.S.C. 450i) shall not be subject to reduction for indirect costs or for tuition remission. No indirect costs or tuition remission shall be charged against funds in 7 USC 3319.

Ante, p. 1297.

Ante, p. 1304.

19