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IMPROVEMENT
OF THE
INTERNATIONAL CAPABILITIES
OF
UNIVERSITIES
(THE 211(D) PROJECTS)

ANNUAL TECHNICAL REPORT NO. 4, PART I.
1971 - 1972

SUMMARY AND OVERVIEW

SUBMITTED BY

COUNCIL OF U. S. UNIVERSITIES FOR
RURAL DEVELOPMENT IN INDIA
NOVEMBER, 1972

UNIVERSITY OF ILLINOIS
UNIVERSITY OF MISSOURI
KANSAS STATE UNIVERSITY
UNIVERSITY OF TENNESSEE
THE OHIO STATE UNIVERSITY
THE PENNSYLVANIA STATE UNIVERSITY

COMPILED IN THE OFFICE
OF THE EXECUTIVE DIRECTOR
326 WATERS HALL
KANSAS STATE UNIVERSITY
MANHATTAN, KANSAS 66506
NOVEMBER, 1972

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211(d) PROFESSORS

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Kansas State University - David Lineback

University of Missouri - J. M. Poehlman

The Ohio State University - George S. Taylor

The Pennsylvania State University - Richard Cole

University of Tennessee - David Brown

Part I of the Annual Report contains an overview and summary of the six individual reports which were published as Part II. The Executive Director of CUSURDI prepared Part I with financial assistance provided from each of the Universities through Kansas Agricultural Experiment Station Project 5-315.

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ANNUAL TECHNICAL REPORT, PART I

1971-72

IMPROVEMENT OF THE INTERNATIONAL CAPACITY OF CUSURDI UNIVERSITIES
(The 211(d) Projects)

submitted by

THE COUNCIL OF UNITED STATES UNIVERSITIES

FOR RURAL DEVELOPMENT IN INDIA

This is Part I of the fourth annual consolidated report on the Section 211(d) Grants to the six universities that are members of the Council (CUSURDI). Council members are: University of Illinois, Kansas State University, University of Missouri, The Ohio State University, The Pennsylvania State University, and University of Tennessee.

INTRODUCTION

Involvement of CUSURDI Universities with Agricultural Development in India began in 1952. By 1955, five universities had contracts with AID to assist at Indian agricultural colleges and research stations. The sixth university entered the program in 1966. Subsequently, four of the universities undertook new responsibilities in India in connection with the Agricultural Production Project.

As the universities became more deeply involved in agricultural development work abroad, the need became evident to strengthen their capacity to render effective technical assistance. But it was exceedingly difficult to obtain state and private financing to finance the "international dimension" in the Universities. Fortunately, Congress in 1966 had added Section 211(d) to the Foreign Assistance Act providing that the Agency for International Development could support "research and educational institutions in the United States for the purpose of strengthening their capacity to develop and to carry out programs concerned with economic and social development of less developed countries."

In discussing this legislation, the Congress suggested certain philosophical guidelines for the new programs. These programs were to center on a joint university-federal government approach to strengthening the nation's research and education capability, in connection with technical assistance efforts determined to be in the national interest. The program was to give broad scope to the universities in planning and executing the activities needed to achieve the jointly-determined objectives.

Rationale for 211(d) Projects at
CUSURDI Universities

As soon as the 211(d) program was announced, the Council of U. S. Universities for Rural Development in India expressed a keen interest in involving its member universities in the program. In view of the heavy demands being made on university resources by their programs in India, CUSURDI and AID felt that the prime need was to use 211(d) funds to build strength around selected fields where there was interest, a potential for exceptional competence, and a need for application in India. In May, 1968, a 211(d) grant was made to each of the six institutions. These grants were to be managed separately by each institution, with coordination provided through CUSURDI.

The grants listed the following objectives:

1. To increase the capability of these institutions to render assistance to developing nations and generate increased public awareness of the significance of the international service dimension of university education and research.
2. To increase the pool of manpower with capabilities of rendering assistance to developing nations.
3. To assist in the development of international service faculties in the Council Universities and act as a catalyst in the expansion of interest in professional international service careers.
4. To encourage college students (undergraduate and graduate) to seek careers in foreign assistance work.
5. To more effectively use present U. S. field personnel in the development and training of candidates for professional service positions in developing countries.
6. To develop a corps of experts in the various phases of agricultural development that will be available as consultants in the evaluation and solution of problems in which there is a national interest.

The CUSURDI institutions and AID agreed upon specific technical fields of work to be undertaken by each institution as follows:

Illinois: Identification, causes, and control of agronomic crop diseases.

Kansas: Improved grain utilization.

Missouri: Breeding of agronomic crops.

Ohio: Soil-plant-water relationships.

Pennsylvania: Crop production and management.

Tennessee: Economic issues of agricultural development

Since the objective of CUSURDI is centered on development of Indian Agricultural Universities and Indian agriculture, the international focus of the 211(d) projects has been upon the problems of Indian agriculture, with emphasis upon applicability to other countries. In the past year, unsettled Indian-U. S. relationships have caused some of the field work to be shifted to other countries.

Annual technical reports for each of the six 211(d) projects for the year 1971-72 have been submitted to AID by the Universities, with a combined report from the Council as Improvement of the International Capabilities of Universities.

PROGRESS IN THE FOURTH YEAR

This section provides an analytical overview of progress reported in the separate university reports in the strengthening of the international dimension of the universities in teaching, research and service activities, in the on-campus undergirding of overseas contracts, and in the expansion of the university horizon in general. In addition to a summary of progress made in the technical field of the grant, an effort is made to convey an idea of the impact of the grant on the international posture of the University, and to give some indication of the scope of international involvement of each institution.

Evaluation Criteria

For the application of criteria of progress, the six objectives of the grants may be condensed into two:

1. Improving the ability of the participating institutions to render technical assistance by:
 - a. Interesting more students in international careers,
 - b. Enlisting the interest of more faculty in problems of international development,
 - c. Involving students and faculty in research on problems in developing countries,
 - d. Improving the training of students for international careers through more foreign experience for students and teachers and "internationalized" courses.

2. Generating public awareness of the need for increased university competence for work in developing countries and on problems of international significance.

The measurement of progress toward achievement of these goals is difficult. How much international involvement and capability are needed? How much progress has been made? These elements are hard to quantify, but it can be concluded that the institutions are making progress from bases that are much too low as measured by the demands placed on the institutions and the observable opportunities to improve effectiveness of international endeavors. It is also obvious that capacity has been below demand for services.

The productivity of the improvements that have come from the 211(d) program can be judged in terms of the quick absorption of the few students who have been trained in the program, the magnetic effect of the 211(d) grants in attracting other high quality staff and students to the participating departments, the growing demand on the 211(d) professors to consult and give seminars in the U. S. and abroad, the number of colleagues who are associated in the 211(d) activities, the new and enriched courses offered, and the publications that are following from 211(d) research.

Public support for an international element in university programs also is growing, to some extent in measurable ways, but largely in ways that are subtle and intangible, but none the less vital. For example, one Council member has observed that the universities recognize that an active international involvement is essential if the institution is to attract and hold top-notch staff.

Specific Accomplishments

This section gives some of the highlights of accomplishments as reported in the individual reports.

A Stronger International Aspect of Teaching

The carefully-designed training afforded to 211(d)-supported students provides an example of a superior kind of training for American graduate students interested in international careers. The first persons to graduate from the program have been readily absorbed in overseas assignments. Each institution also reports continued progress in broadening the geographic scope and courses and curricula open to all students.

Efforts to use 211(d) to improve teaching continues to place primary emphasis on the enrichment and broadening of course content, and the preparation or assembly of reference materials from overseas, and especially from developing countries. Sinclair, (Illinois), is assembling a set of color slides of plant diseases. Poehlman, (Missouri), has selected slides

and other materials from the less developing countries dealing with breeding of rice, wheat, sugar cane and pulses as related to food production. Arscott and Taylor (OSU), have been assembling a series of monoliths of tropical soils. Brown (Tenn.) is developing constructs and reference materials oriented to less-developed countries and dealing especially with planning and implementation of agricultural programs at the level of the local decision-maker.

Emphasis at all institutions is placed on better utilization of the growing supply of staff with international experience. Thus, Kansas State is using the 211(d) students who did thesis research in India in seminars. Missouri has drawn upon the Indian experience of 4 staff members to offer a new seminar "Philosophy of Extension" primarily for foreign students in agronomy. At Penn State, the 211(d) Professor has made a conscious effort to involve as many faculty as possible in the training of the 211(d) students. The 211(d) professor at Ohio State worked on a committee that developed a plan for the systematic utilization of visiting scholars throughout the University.

Each of the 211(d) professors writes of the high value in the eyes of faculty, students, and Indian collaborators, placed upon the overseas field experience made possible through 211(d). Students and their advisors are forced to tackle the special difficulties of doing research in a strange environment and with limited resources. Indian colleagues work as active partners in the research, and share in the responsibility of supervising American graduate students. With rare exceptions, the 211(d) students are developing strong orientation toward international careers.

The total number of graduate students supported in whole or in part by 211(d) funds is 22. Numerous other American and foreign students are advised by the 211(d) professors, and an even larger number are benefitted through enriched course offerings or by indirect contacts with the program.

The 211(d) grants have also helped to strengthen teaching by helping to bring outstanding foreign scholars to the campuses. To cite two examples, Kansas State benefitted by seminars and consultations with Dr. H. A. B. Parpia, Director of the Central Food Technology Institute, Mysore. Ohio State offered 5 seminars by noted soil scientist Hans Jenny, and three other international scholars were brought to the College of Agriculture with non-211(d) funds. In 1973, it is planned to bring Dr. A. P. Abral, of the Central Government Salinity Institute, Kamal, for a seminar.

Increased Competence for Research in Developing Countries

The 211(d) grants were not given to support research as an end in itself. But specific, practical research projects in foreign countries

have been a major means of getting faculty and students interested and involved in international development and of strengthening their capacity, and that of their institutions, to render technical assistance. In the process, University institution building programs in India have benefitted, and new knowledge has been produced of mutual value to India and the U.S. In explaining the contribution of research to meeting grant objectives, Poehlman (Mo.) says: ". . . competency is developed by active participation in a program where results can be assessed, mistakes recognized and corrected, and accomplishments recorded." (Part II, p. 62).

At Illinois, a pattern has evolved whereby Indian and American students work together on plant disease problems. The 211(d) students continue this association while they do their thesis research in India. Sinclair lists 4 benefits from the overseas field research: New experience for students and advisors, increased international value of results, low labor costs for field experiments, ability to study pathogens without bringing them to the United States.

For Penn State, Cole comments on the complementary benefits from field work on forage crops in India and Central America in strengthening an area of competence at his institution. Lineback (KSU) reports on the mutual benefits to Kansas State and CFTRI that are resulting from the research projects of the 211(d) students. Areas of mutual interest are being identified for future research, and technical information is being exchanged. For example, the project has identified some Indian wheats with unusual baking qualities that are of interest to Kansas State.

The organization of a cooperative International Mungbean Testing Laboratory has been one of the major results from the research activity at Missouri. Seeds have been distributed to 8 countries in 4 continents. Linkages developed with other institutions and with USDA through this program strengthen Missouri's capability to do international work with the pulses and other crops. Indirectly, Missouri's wheat breeding research in Orissa gave them the knowledge needed to develop a meaningful research program for a Libyan graduate student at Missouri.

At Ohio State, Taylor reports that field work done in the Punjab and in Mysore is resulting in the involvement of a number of Ohio State faculty in foreign agricultural development and thus strengthening the international capability.

Tennessee's research, according to Brown, is moving from analysis of selected agricultural economics problems in Mysore State to a focus on the means of improving the process of decision-making at field levels of rural development programs. International and inter-institutional linkages are being formed that will strengthen Tennessee's capability in this field.

Contribution of the Grants to
Backstopping of University
Programs in India

Numerous examples are given in the reports of the efforts made in the 211(d) program to support the University AUD programs. There are examples, too, of increased use by AID of the resources being developed through the program.

Tennessee has given special attention to improving the offerings in agricultural economics, planning and agricultural policy in relation to the needs of participants on the Knoxville campus. Similar efforts are reported for other universities. Several institutions commented on the value to Indian participants and to U. S. students also, of a close association with American students who were planning to do research in India or who had returned from a study tour. Illinois calls attention to the valuable contributions made to the AUD programs at Jabalpur and Patnagar by U. S. graduate students who did research, taught, and helped in laboratories. Their help was especially valuable because they worked in a field in which little technical assistance had been given.

Each of the institutions made the 211(d) research in India a part of the research program of the institution to which the students were attached. The results of the research were made available to the AUD teams and Indian counterparts.

Ohio State used small sums from its 211(d) grant to make possible special training in tropical soils for a staff member who was enroute to duty in India, and training in aquatic weed control for another staff member who had been in India and desired to further advance his skills for future overseas service.

Improved Capacity for Consulting

Most of the 211(d) Professors mention an increase in requests for consultation on the home campus, elsewhere in the U. S., and abroad as a result of their continued involvement in international agriculture. Among the examples cited, especially noteworthy ones include the invitation of the government of Romania for consulting assistance from Poehlman, (Missouri) and the consulting assignments of Brown, (Tennessee) with the Agricultural Development Council, with the AID Technical Assistance Bureau and with the Peace Corps.

All of the 211(d) Professors are heavily engaged in departmental and college international committees on their home campuses.

IMPACT OF GRANT SUPPORT ON
DEVELOPING INSTITUTIONAL CAPABILITY

The impact of the program on the international capability of the six institutions is reflected by figures showing growth in numbers of faculty with international experience and outlook; by qualitative indicators of the development of "internationalized" professors; by the output of students with global training and interests; and the rate of expansion in resources for international study such as libraries, teaching materials and laboratory equipment. These changes are not entirely a result of the 211(d) program, but it has had an important influence. Some of the more exciting figures given in the reports include: The estimate of Tennessee that of 50 graduate students in agricultural economics, 19 are oriented toward the economics of developing countries; the statement from Penn State that the proportion of Agronomy faculty interested in international assignments has grown from 10% in 1968 to 75% in 1972; and the substantial support from university funds to international teaching and research activities at all institutions.

Some of the most impressive evidence of results from the grants comes from reports of the international activities of the 211(d) Professors. Trip reports from these men clearly show that they are long past the stage of the "familiarization and contact tour." They are in frequent substantive communication with key foreign scientists in their fields and they are at home on campuses and in laboratories not only in India but in international centers elsewhere. The field trip of a 211(d) Professor is likely to include the giving and receiving of information and materials with colleagues in half a dozen institutions in two or three countries; participation in several seminars; counseling with American and foreign students, and direct participation with colleagues and graduate students in a research project. The itineraries for field trips of Sinclair, (Illinois) and Lineback, (Kansas State) and Taylor, (Ohio State) illustrate the solid content of these trips. (Part II, pp. 26-29, 43-45, and 78-79). It is not surprising that the 211(d) Professors are so well regarded on their home campuses by colleagues as internationally-recognized authorities and by students as stimulating advisors and teachers.

The universities are using substantial amounts of non-211(d) money to augment activities supported by the grants. Some readily identifiable items include: For Missouri, half of the salary of 211(d) Professor Poehlman, and support of an experiment station project; for Ohio State, the salary of a second professor on tropical soils; for Tennessee, an additional man-year of faculty time and support for five non-211(d) students with international career interests. For all six institutions, contributions are mentioned for faculty time, support of graduate students and visiting professors, secretarial help, research facilities, and other direct costs. Other important contributions include new or re-oriented courses supportive of grant objectives. The scope of contributions discussed in the individual reports varies, but the range of directly identifiable program contributions from the universities ranges from half to more than twice the expenditures from 211(d) funds.

UTILIZATION OF UNIVERSITY RESOURCES IN DEVELOPMENT

The extensive commitments of the CUSURDI institutions to foreign technical assistance give assurance that the benefits from the 211(d) grants will be effectively used. The following international agricultural development activities are reported:

Illinois: India - AID University project, Ford Foundation agricultural economics project, and Coordinated Soybean Project.

Sierra Leone - AID university project

Indonesia - MUCIA university project

Nepal - a survey of higher education

West Indies - Horticultural crops project

World Wide - Soybean Research (PIRIDS)

Kansas State: India - AID university & APP projects

Nigeria - AID agricultural education project

World Wide - AID grain processing and handling

Missouri: India - AID university & APP projects

Yugoslavia - Veterina: science exchange program

Ohio State: India - AID university project and Ford Foundation agricultural engineering project

Uganda - AID university project

India & Tunisia - Peace Corps training

India & Brazil - Graduate Study abroad

India - Farmer exchanges

Penn State: India - AID university & APP projects

Argentina - AID project

Spain - AID project

Uruguay - Planning under way with AID

Tennessee: India - AID university and APP projects

World Wide - Cooperation with ADC Research & Training Network

Over the past 17 years, the CUSURDI universities have contributed about 460 man-years of technical resources to Indian agricultural education and research. For the eight agricultural universities with which they were working in 1972, the total was 392 man-years distributed as follows:

Illinois: 112

Ohio State: 105

Kansas State: 61

Tennessee: 60

Missouri: 35

Penn State: 19

To these university contributions should be added the approximately 900 Indian students given training, the inputs through the APP program and the technical assistance efforts made in other countries. In view of the large total effort made by the Universities, the modest financial contribution of 211(d) to improvement of capability for international work has been a much-needed investment.

FUTURE PLANS

The phase-out of AUD and APP projects in India has been accompanied by instructions from AID not to continue 211(d) activities in India. The Agency has indicated willingness for grant activities to be re-oriented to other developing countries.

Several of the CUSURDI universities feel that their contacts in India are so firmly established, so mutually beneficial and so strongly desired by Indian colleagues, that they should be continued where possible. Lineback, (Kansas State) says the close relationship between Kansas State and the Central Food Technology Research Institute is ". . . the most outstanding accomplishment of the grant-- and has significantly increased the competency of Kansas State University to render assistance to India and other developing nations. . . The relationships between these two institutions and between scientists who now know each other on a personal basis promise to be very useful for mutual cooperation in the future. . ." (Part II, p. 31) Incidentally, the third KSU 211(d) student was diverted from India on the basis of USAID instructions. He subsequently was granted a student visa by India.

Alternative sites are being chosen for those students that cannot be sent to India. Illinois has shifted one graduate student to IITA in Nigeria, and Kansas State and Missouri are placing students in Thailand.

In several institutions, supplementary funds have conserved 211(d) money or the program has not moved ahead as rapidly as projected. One-year extensions have been requested for Kansas State and Missouri. Tennessee may also ask to extend. At Penn State and Ohio State, two-year extensions are being requested.

THE 211(d) APPROACH FOR BILATERAL COOPERATION

The 211(d) program had to build its own contacts and relationships in India without the intermediary services of USAID. The individual professors and administrators, both in India and the United States, took readily to the new opportunities created for individual and institutional collaboration. After some uneasiness at USAID and GOI levels, highly effective working relationships developed, and have continued even through the vagaries of Indo-American policy in the past year. The presentations of Cole, (Penn State) and Lineback, (Kansas State) are particularly eloquent on this point. (Part II, p. 31 and pp. 104-105).

The idea of applying the 211(d) grant concept as a vehicle for simultaneously extending technical assistance for research and institutional development and building the U. S. competence to do a better job has been advanced by several of the 211(d) Professors. Here is a program that encourages the maximum cooperation and enthusiasm among U. S. and foreign scholars, effectively utilizes graduate students from both countries, enlists the support of department and college administrators, and avoids domination by central bureaucracies. Unlike most technical assistance programs, the concept is of collaborating scientists rather than of advisors and advisees. As expressed by Lineback (Part II, p. 42) "it is probable that the 211(d) concept will, in the long run, prove to be the most viable, least expensive vehicle to foster establishment of significant long-term relationships between institutions and scientists in developing nations and their counterparts in the U. S. and without the political implications of technical assistance teams."

THE 211(d) PROGRAM
CONSOLIDATED REPORTS OF THE CUSURDI UNIVERSITIES

1971-72

PART II. ANNUAL TECHNICAL REPORT NO. 4

This section contains the reports prepared by each of the six participating institutions. Work schedules of the 211(d) Professors made necessary the preparation of annual reports prior to receipt of the Revised Annual Report Guidelines, July 21, 1972. Where time has permitted revision, supplements are appended to the reports.

An analytical summary of these reports, prepared by the Executive Director, CUSURDI, is issued separately as Part I.

University of Illinois
University of Missouri
Kansas State University
University of Tennessee
The Ohio State University
The Pennsylvania State University

Compiled in the Office
of the Executive Director
326 Waters Hall
Kansas State University
Manhattan, Kansas 66506
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UNIVERSITY OF ILLINOIS

COLLEGE OF AGRICULTURE

DEPARTMENT OF PLANT PATHOLOGY

ANNUAL TECHNICAL REPORT OF 211(d) PROJECT

1971-72

ANNUAL REPORT ON THE 211(d) PROJECT
FOR THE UNIVERSITY OF ILLINOIS
(FISCAL 1972)

Title: A Grant to Develop Within the University of Illinois
Specialized Competency in the Study and Control of
Diseases of Agronomic Crops of Developing Nations.

Grantee: University of Illinois, Urbana, Illinois 61801

Director: Prof. James B. Sinclair, Department of Plant Pathology

A. Statistical Summary:

Period of the Grant: May 1968 through June 1973

Amount of the Grant: \$200,000

Expenditures for 1971-72: \$54,565

Accumulated Expenditures: \$159,715

Anticipated Next Year: \$40,285

B. Narrative Summary:

This is the fourth Technical Report concerning the development within the University of Illinois specialized competency in the identification, cause and control of diseases of agronomic plants of India and other countries and the establishment of international plant pathology as a legitimate and continuing function of the University and the College of Agriculture. This 211(d) Program is linked with the University of Illinois College of Agriculture's international program for the development of soybean as an oil and food crop in developing nations, as well as in the U.S. The 211(d) Program has increased the competency of the 211(d) Professor in international agriculture, particularly in international plant pathology. The graduate teaching and training program has increased the pool of manpower with international experience and understanding of the problems of developing nations. The research and teaching programs developed under this grant, have a strong international dimension which has had an influence on many people within and outside of the university community. The research has centered on diseases of soybean and other grain legumes.

C. Detailed Report

I. General Background and Purpose of the Grant: This is one of six separate grant proposals submitted to the Agency for International Development by the Council of United States Universities for Rural Development in India (CUSURDI) for funding to begin in 1968. The University of Illinois proposal was built around the need to employ a full-time, tenured faculty member who would conduct research, supervise graduate students and carry out other activities, all for the purpose of increasing the competency of the University in international plant pathology with emphasis on Indian agronomic crops, particularly soybeans.

A Coordinated Soybean Research Project (CSRP) was started in 1967 between the University of Illinois College of Agriculture and the two university (JNAU and GBPATU) in India, with whom the college was cooperating in an university-development program. Little information was available on soybean diseases and their effects on production in developing countries. There was a need for an experienced plant pathologist to develop a program in this area. The 211(d) Program provided some of the funds needed to begin this program.

II. Objectives of the Grant:

1. List of Grant Objectives:

- A. To increase the capabilities of the University of Illinois in the area of international agriculture, particularly in the area of plant protection and plant pathology, and to generate increased public awareness of the significance of the international dimension of university education and research.
- B. To increase the pool of manpower with understanding of problems of developing nations.
- C. To assist in the development of faculties and competencies in international agriculture, particularly plant pathology, at the University of Illinois and act as a catalyst in the expansion of interest and training for careers in international agriculture.
- D. To educate college students for careers in foreign agriculture.
- E. To more effectively use university personnel with foreign experience in the development and training of domestic and foreign students for professional positions in international agriculture.
- F. To develop a corps of experts in the various phases of agricultural development which may contribute to the evaluation and solution of problems in which there is national interest.

2. Review of the Objectives:

All the objectives of the grant have been met. The Program has increased the competence of the 211(d) Professor in international agriculture, particularly in plant pathology and soybean diseases. Through the contacts with the 211(d) Professor and the graduate students involved in the Program, many faculty at the University of Illinois and other domestic and overseas institutions; students; nonacademic and nonuniversity personnel; both within and outside

of the State of Illinois have become aware of the significance of the University of Illinois in international agriculture. This has been accomplished through formal classroom presentations and informal discussions both on and off the campus. Announcements concerning these activities are published in the local press, in professional newsletters and in overseas publications.

The research and teaching programs developed under this grant, have a strong international dimension which has had an influence on many people. The teaching of advanced courses and graduate student training programs directly or indirectly under the direction of the 211(d) Professor is not only educating college students in international agriculture, but is acting as a catalyst in the expansion of interest and training students in this area. Faculty members in plant pathology, horticulture, and economic entomology with international experience have been directly involved in formal course presentations, seminars, and discussions in the department of plant pathology.

If an area has received more emphasis than another, it has been in graduate student training and research. The graduate training program is increasing the pool of manpower with international experience and understanding of the problems of developing nations. There were seven students involved in this program this year. The program was so arranged that U.S. graduate students work with graduate students from India in the same laboratory and on complementary research problems. The U.S. students continue their association with some of these Indian students while studying and working in India. This has provided a basis for an institution to institution working relationship.

Soybean is an important crop in the U.S. and in India. Programs for the development of soybean as a commercial crop have been started in other countries including Thailand, Brazil and some African countries. The experience gained by the 211(d) Professor and the graduate students (both domestic and foreign) both here and abroad aid in the understanding and solving of soybean production problems due to diseases both in the U.S. and developing countries. Control measures beneficial to all countries concerned can be developed only after the various disease problems are known and understood.

III. Accomplishments: The 211(d) Program at the University of Illinois has continued to make substantial progress during the fourth year. This year was considered the peak of activity, with the upcoming fifth and last year, to be one of phasing down and completing projects begun earlier in the program. Four students were either going to or returning from their overseas assignments during this past year. The 211(d) Professor made two trips to India during this period.

The remarkable progress during the past four years justifies the efforts and support given by the University of Illinois, the College of Agriculture, AID, and CUSURDI to the entire program. The 211(d) Program is an outstanding success. The broad objectives of the grant are continually being met as the final year of the program begins. It should be emphasized that the success for the past four years was possible because of the efforts of many people. The accomplishments of this Program were possible because of: (1) substantial financial and logistical support from the University of Illinois, the College of Agriculture, and the Department of Plant Pathology; and (2) the total cooperation on the part of University of Illinois personnel at all levels, as well as at several institutions and other agencies in India and other countries.

A. Development of Teaching Competence. The formal course dealing with epidemiology of plant diseases was given in the Fall semester (see previous technical reports). The international experience of the 211(d) Professor, his collection of international scientific literature, as well as color slides of crop production and diseases from foreign countries were used to illustrate principles taught in the course. This gave the course an international dimension that would not otherwise be available to the students. Both foreign and domestic students were enrolled in the course, representing at least five disciplines. The department provided over \$836 for teaching aids and materials in support of this and other teaching activities. Because of budget cuts, this amount will not be available next year.

A large number of seminars and special talks were given at most of the overseas institutions visited, as well as in the U.S. Each time the AID-sponsorship of the program was acknowledged with emphasis on the Indian involvement.

A special seminar was presented to the department in September, 1971, and an invitational talk was given to a group in Hamilton, Mississippi on the program and some of the experiences resulting from traveling in India and other countries in August 1971. A special research report was given to the Seventh Annual Illinois Soybean Conference in January 1972, and a special lecture was given in April 1972 to a class of the University of Illinois in the department dealing with chemical control of plant diseases.

While overseas, the 211(d) Professor gave, besides the usual seminars: invitational lectures at: Kasetsart University in July 1971, the Society of Biological Chemists at GBPATU in August 1971, the Plant Protection Workshop at GBPATU in August 1971, the meeting of the Development Assistance Group of Thailand in March 1972, and the Agricultural Society of GBPATU in March 1972, and in addition the first two seminars of a scheduled series dealing with plant pathology at GBPATU in March 1972.

B. Development of Research Competence. A very active research and graduate training program has developed involving American and Indian students since the completion of the research laboratory in May 1969 (see Technical Report #1). There were seven graduate students (five Ph.D. and two M.Sc. candidates) participating in the program this past fiscal year, five American and two Indian.

The research program involves laboratory, greenhouse, growth chamber and field work (facilities and maintenance provided by the University). All members of the group work together and assist one another in their respective research efforts. The success of this relationship can be partially judged by the fact that over 20 research contributions and publications have come from the program in fiscal 1972. The areas of research include soybean diseases, and the movement of systemic fungicides in soybeans and grasses. Publications were printed in Indian and German journals, as well as U.S. journals. A list of the major publications is attached.

Soybean is being introduced as a possible oil and food crop in India through GBPATU (Pantnagar) and JNKVV (Jabalpur). The research on soybean diseases done at either of these Universities and in this laboratory is of mutual benefit to both countries.

Three students have completed their research studies on soybean and other crops in India; R. A. Sikora, W. A. Meyer, and B. L. Kirkpatrick. One student, J. F. Nicholson, is now working on soybean diseases at JNKVV, Jabalpur. R. W. Schneider is doing research on cowpea (another grain legume crop) diseases in Nigeria.

This has been a truly international research program. These men carried on research projects involving disease organisms found to be of economic importance in both countries. They have made comparisons in the behavior of these organisms, which would not have been possible under any other conditions. It is not advisable to import strains of plant pathogens from other countries for study in the U.S. because the imported strain may be more virulent than the indigenous ones. Therefore, these men have had the opportunity to note similarities and differences between these organisms, often using the same crop varieties and noting their response in both countries. This is of great interest to the Indian, African and U.S. scientists. There is an advantage for conducting extensive field studies in India and Africa as compared to the U.S., because of the low cost of hand labor. All research results are made available to plant pathologists in the three countries.

R. A. Sikora's program of research while in India (GBPATU) was concerned with control of nematodes and nematode diseases by biological means. W. A. Meyer's (JNKVV) work was concerned with studying a soil-borne soybean pathogen that causes the disease, charcoal rot of soybean. It is known to occur in soybean fields in Illinois and other states. B. L. Kirkpatrick (GBPATU) studied chemical control of soybean seedlings through seed treatment. J. F. Nicholson (JNKVV) is studying seed-borne pathogens in soybean. R. W. Schneider (IITA, Nigeria) is studying foliage blight organisms on cowpea and soybean. The results of his work will be of mutual interest and benefit to both countries.

Besides the graduate students listed above, the 211(d) Professor has acted as research adviser to a number of other graduate students, both U.S. and foreign, in plant pathology and other departments on the University of Illinois campus, as well as in India.

The seminars and invitational papers given at various institutions already cited often concern the research results from this laboratory. These talks provide up-to-date information to the overseas researchers and give the 211(d) Professor new insights and approaches to his own as well as the graduate students' research. The mutual benefits derived from this direct contact with plant scientists in the various countries visited cannot be overemphasized.

C. The Graduate Student Program. This year there were seven graduate students in the program, which has been so arranged that the U.S. students work with graduate students from India in the same laboratory and on related research problems. The U.S. students continue their association with the same Indian students when they go to India to continue their studies. This provides an obvious strong association and basis for cooperation between the Indians and the U.S. students while the latter are studying and working in India. It has provided a blueprint for future institution to institution cooperation cooperation.

Extremely favorable comments have been made concerning the activities of the graduate students while studying overseas. It seems that their efforts have been most effective and they have set high standards for other graduate students to follow. Several personal letters are on file to support these statements. All comments from the administration and faculties of the Indian universities involved have been very complimentary. This portion of the program has been an outstanding success.

Funding in support of graduate students has come from many sources. A brief statement for each student involved in the program concerning his activities and source of funding is given below in alphabetical order:

O. D. Dhingra -- An M.Sc. graduate from JNKVV in plant pathology, he joined the department in September 1971 to do graduate work toward the Ph.D. He worked with Mr. Meyer at JNKVV for over six months before coming to the University of Illinois and worked with Mr. Nicholson in this laboratory for about five months before the latter's departure to JNKVV for a year of study. He is supported by other than 211(d) funds.

P. D. Kharbanda -- Originally he came from PUAT. He completed his requirements for the Ph.D. in plant pathology in August 1971. He worked with all the American students before their departure to their overseas assignments. He was supported by other than 211(d) funds.

B. L. Kirkpatrick -- The only M.Sc. candidate in the 211(d) Program; he studied at GBPATU in August 1971 through January 1972. He is scheduled to receive his degree in August 1972. He was sponsored by 211(d) and other funds during his course of study.

W. A. Meyer -- He worked at JNKVV for one year beginning in January 1971. He was supported by departmental, fellowship, and 211(d) funds while studying at the University, before and after his study period in India, and by a special USAID/Delhi Local Currency Contract while in India. He worked with P. N. Thapliyal and P. D. Kharbanda before leaving for India, and with O. D. Dhingra both at JNKVV and the University of Illinois. He is expected to complete all the requirements of the Ph.D. by August 1972.

J. F. Nicholson -- He began his studies and research program at JNKVV in February 1972. His entire program in India is supported by 211(d) funds. He worked with the three Indian students in the program before his departure. Portions of his work while at the University were supported by other than 211(d) funds.

R. W. Schneider -- Mr. Schneider is now studying at the International Institute of Tropical Agriculture, Ibadan, Nigeria. Originally, it was planned for him to work at GBPATU Pantnagar, but with permission of AID/Washington, he was allowed to study at IITA beginning in March 1972. He is expected to remain there for one year supported by 211(d) and IITA funds.

R. W. Slusher -- His 3-year overseas experience in Taiwan makes it unnecessary for him to travel to India. He is scheduled to complete all the requirements for the M.Sc. in January 1973. He has been partially supported by 211(d) funds. His knowledge and experience added to the international quality of the program.

D. Development of competence for Consultation and Service. The 211(d) Program has provided the unique opportunity for UI to have a Professor with a strong interest in international agriculture to devote full time to the development of a program of teaching, research and graduate student training with international involvements as related to India and other countries.

In order to be knowledgeable in many aspects of international agriculture, and to carry out the format of the Program, it is necessary that the Professor make at least one trip to India and other cooperating countries each year. These trips not only allow the Professor to set up the essential esprit de corps so that the logistics of the program can be worked out, but it is mandatory that he accompany the students to India. None of these young men have had any international travel experience, let alone the experience of working in a developing nation. The Professor can be of invaluable assistance to these young people helping them to adjust to the new situations found in foreign countries. (For an illustration of the value of 211(d) travel see Appendix 1)

As a result of two trips to Thailand, the Professor successfully encouraged the sending of four Thai graduate students to UI to study soybean culture. One of these students will study soybean diseases in his laboratory. They will begin work in September 1972. One of the 211(d) graduate students is doing research at the International Institute of Tropical Agriculture, Ibadan, Nigeria. These accomplishments were realized because of the direct professional contacts developed during visits to these and other countries.

Professor Sinclair made two trips to India during fiscal 1972. The first was to accompany B. L. Kirkpatrick to Pantnagar and the second to accompany J. F. Nicholson and his family to Jabalpur. Further competence of the 211(d) Professor is reflected in his involvement in three international programs at the University of Illinois and the College of Agriculture. These are:

1. Continuing to serve on the Advisory Committee to the UI Tehran Research Unit in Iran. The universities, Illinois, Tehran have maintained an exemplary institutional to institutional relationship for a number of years.
2. Collaborator with the Program for International Research, Improvement, and Development of Soybeans (PIRIDS). As interdisciplinary effort involving most of the departments of the College of Agriculture, it will eventually operate in 12 countries and is part of the Soybean Coordinated Research Project in India.
3. Collaborator on a research project concerning Tropical Root Crops. The program is coordinated by the Department of Horticulture.

He was elected this year by the departmental faculty to serve on the Environmental Quality Council Task Group on Pesticides and Pest Control Systems.

Recognition of the international status and involvement of the 211(d) Professor was shown this past year by: (1) the invitation to participate in a discussion session on the training and education of graduate students from the Third World Nations at the Second International Congress of Plant Pathology, September 1973; and (2) the request to serve as vice chairman of the International Cooperation Committee of the American Phytopathological Society.

Competence in international agriculture was further developed in other areas by:

1. Beginning a world collection of 5 x 5 cm slides on soybean diseases. When the collection is completed, it will be duplicated and distributed at cost.
2. Continuing as a "Career Consultant" to the Peace Corps.
3. Continuing to serve on the American Phytopathological Society's International Cooperation Committee.
4. Arranging for the visiting professorship of Dr. F. Eskandari, University of Tehran, Iran in the department of plant pathology. He studied for five months beginning in September 1971. He met and consulted with several of the graduate students. The 211(d) students were given the opportunity to meet with him and his family on many occasions. This was the beginning of an institution-to-institution program in plant pathology.
5. Arranging for the visiting professorship of Dr. J. C. White, Louisiana Tech University, Ruston for three months beginning in June 1971. He gained a deep appreciation for the international program and insight into some of the agriculture problems of a developing nation, by meeting and working with students from India and America.
6. Continuing many of the activities initiated in previous years, such as: (a) participating in the Southern Regional Research Project (S-72) on soybean seed quality; (b) collaborating with Indian plant pathologists on planning research work, graduate student training, course offerings, etc.; (c) cooperating with other departments in the College of Agriculture and several programs; and (d) cooperating with the 211(d) Professors and other members of CUSURDI.
7. Providing resumes of the program and activities of the students and 211(d) Professor for the attention of professional newsletter and the local news media.

Expenditures from the 211(d) grant funds for the University of Illinois are presented in the accompanying table (Table 1). The expenditures for airline tickets are only estimates until receipt of official advice of charges from the Grant Office. No stipends for graduate students were used during the first year, \$2,188 was used during the second year, \$6,500 in the third year, and \$11,315 in the fourth year. Additional support for these and other students in the program came from a variety of sources other than 211(d) funds. Travel expenses shown are for U.S. travel (domestic), for the consultant visit of Dr. Moore (see Technical Report #1), and for estimated costs for international airfares for the 211(d) Professor and three students (and their families). There was no equipment purchased in 1970-71 or 1971-72 and only minimal expenditures for supplies and services.

The estimated budget for fiscal 1973 includes stipends for the remaining students (Schneider, Slusher and Nicholson) and the salary and fringe benefits for the 211(d) Professor. At least one additional trip to Nigeria for the 211(d) Professor is planned, in order to consult on the progress of Mr. Schneider and to advise on his thesis research problem. If money is available, it will be used to send the Professor to annual meetings of the American Phytopathological

Society. The remaining portion of travel money will be used to pay air-freight shipping costs for Messrs. Nicholson and Schneider and their return expenses. It will be used for financing meetings of the 211(d) Professors and other domestic travel. Only a minimal amount of money is earmarked for supplies and expense.

It will be noted that an additional \$10,000 will be required to fully carry out the proposed program.

Table 1. Expenditures and estimates in U.S. dollars from the 211(d) grant funds for the University of Illinois for the five-year period, May 1968 through June 1973.

Budget Item	Fiscal Year				Totals June 1972	Estimates 1972-73	Totals	Firm Budget	Balances + or -
	1968-69	1969-70	1970-71	1971-72					
<u>Salaries and Fringe Benefits</u>	17,627	22,533	23,867	25,288	89,315	26,423	115,738	130,000	+14,262
<u>Stipends</u>									
Schneider		2,042		3,365	5,407	4,800	10,207		
Kirkpatrick		146	3,542		3,688		3,688		
Slusher			2,958	3,637	6,595	3,700	10,295		
Nicholson				4,313	4,313	6,264	10,577		
Subtotal		2,188	6,500	11,315	20,003	14,764	34,767	31,000	- 3,767
<u>Travel</u>									
Airline tickets	1,400 ^{a/}	1,720 ^{a/}	1,311 ^{a/}	9,654 ^{a/}	14,085	4,500	18,585		
Other	1,269	1,047	1,189	7,638	11,143	1,350	12,493		
Subtotal	2,669	2,767	2,500	17,292	25,228	5,850	31,078	13,000	-18,078
<u>E & E</u>									
Equipment	3,803	16,220			20,023		20,023		
Supplies	3,336	961	179	670	5,146	1,831	6,977		
Publication costs						1,417	1,417		
Subtotal	7,139	17,181	179	670	25,169	3,248	28,417	26,000	- 2,417
GRAND TOTALS	27,435	44,669	33,046	54,565	159,715	50,285	210,000	200,000	-10,000^{b/}

^{a/} This travel figure includes the estimated cost of international air fares of Prof. Sinclair; B. L. Kirkpatrick; W. A. Meyer and family; and J. F. Nicholson and family. Upon receipt of an official advice of charges from the Grant office, this amount will be included as an exact amount. Breakdown of estimated travel expenses in \$US for fiscal 1972 follows:

Name and No. of tickets	Airfares (GTR's)	Other costs	Shipping costs	Domestic travel	Subtotal	Grand total
Sinclair 2	3,852	2,105		265	6,222	
Nicholson 3	4,008	1,057	473		5,538	
Schneider 2		2,310	625		2,935	
Kirkpatrick 1	1,794	530	273		2,597	
	9,654	6,002	1,371	265		17,292

^{b/} An additional \$10,000 will be needed to fully carry out the remainder of the program (see Section VI of this report). An additional \$3,000 is needed for supplies, expense and a trip to India to evaluate the impact of the 211(d) program on the Indian Institutions involved.

E. List of Publications For Fiscal 1972 Resulting From The
University of Illinois 211(d) Program

1. Gray, L. E., & J. B. Sinclair. 1971. Systemic uptake of ¹⁴C-labeled 2-(4'-thiazolyl)benzimidazole in soybean. *Phytopathology* 61:523-525.

Abstract: Direct evidence of the uptake and translocation of TBZ (2-(4'-thiazolyl)benzimidazole) was obtained using ¹⁴carbon-labeled TBZ and nonlabeled TBZ. Both compounds were absorbed by roots of soybean seedlings, and appeared to move unaltered into all aboveground tissues. The accumulation of ¹⁴C-TBZ increased in epicotyl and root tissues with increase in exposure time, while radioactivity in hypocotyl tissues was not affected by exposure time. TBZ was fungitoxic for Cephalosporium gregatum both in vitro and in vivo. TBZ, used as a soil drench in clay pots (25 ml of 200 µg/g in 750 g soil), restricted the development of internal browning in soybeans which were wound-inoculated with C. gregatum when plants were 8 weeks old. The fungus could not be reisolated from treated plants.

2. Nicholson, J. F., & J. B. Sinclair. 1971. Thielavia basicola and Pestalotia sp. internally seedborne in soybean. *Plant Dis. Reprtr.* 55:911-912.

Abstract: The internally-borne fungi of 17 seed lots of 'Lee 68' soybeans harvested in five states were determined in vitro. Fungi isolated represented the following genera: Alternaria, Aspergillus, Cercospora, Chaetomium, Fusarium, Penicillium, Pestalotia, Rhizopus, Sclerotinia, and Thielavia (basicola). Occurrence was influenced more by growing area than by different dates of planting, harvest dates, or whether seed was hand- or machine-harvested. Pestalotia and T. basicola have not been previously reported from the U.S. as being internally seedborne in soybeans. T. basicola was reisolated from soybean stems above the point of wound-inoculation.

3. Nicholson, J. F., W. A. Meyer, J. B. Sinclair, & J. D. Butler. 1971. Turf isolate of Sclerotinia homoeocarpa tolerant to Dyrene. *Phytopath. Z.* 72:169-172.

Abstract: Ten Sclerotinia homoeocarpa isolates were collected from Seaside bentgrass (Agrostis palustris) plots either nonsprayed or sprayed with Dyrene or Actidione-thiram for 6 consecutive years to control Sclerotinia dollarspot. Control with Dyrene was not obtained the sixth year. Isolates from control and Dyrene-sprayed plots were found to be tolerant to 1000 µg/g of Dyrene in vitro, pathogenic to A. palustris and presence of these infection centers caused by Dyrene-tolerant isolates in the sixth year, explains the lack of control of Sclerotinia dollarspot with Dyrene. The isolate from the Actidione-thiram-sprayed plot was not tolerant to Dyrene.

4. Meyer, W. A., J. F. Nicholson, & J. B. Sinclair. 1971. Translocation of benomyl in creeping bentgrass. *Phytopathology* 61:1198-1200.

Abstract: Root uptake and translocation of benomyl and its breakdown product, MBC, were studied in Toronto creeping bentgrass stolons having either one or two root systems. Bioassay and thin-layer chromatography showed the presence of fungistatic compounds throughout all tissues of stolons

with a single root system. This showed translocation of benomyl upward in the transpiration stream to the growing point. When benomyl at 100, 500, or 1,000 mg/liter was sprayed on leaves, upward translocation was found but no downward translocation. Using a double-cup technique, a second and separate root system was established five nodes from the first. When this system was exposed to either 25, 100, 500, or 1,000 mg/liter benomyl for 4 days, the fungistats were found to be translocated back into the crown to the first root system. This indicated "lateral" movement of the fungistats.

5. Thapliyal, P. N., & J. B. Sinclair. 1971. Translocation of benomyl, carboxin, and chloroneb in soybean seedlings. *Phytopathology* 61:1301-1302.

Abstract: Use of ^{14}C -labeled and nonlabeled fungicides as seed treatments of soybean showed that benomyl and chloroneb initially tended to localize in cotyledons, while carboxin did not. At 4 days after treatment, chloroneb was redistributed into the hypocotyl and cotyledons, whereas benomyl moved only into the epicotyl. Carboxin was distributed uniformly throughout the seedling, with higher concentrations in the epicotyl.

6. Nicholson, J. F., G. G. Gray, & J. B. Sinclair. 1971. Excised grass blades for fungicidal evaluation against Helminthosporium sorokinianum. *Plant Dis. Repr.* 55:959-960.

Abstract: A new in vitro method for evaluating fungicides for control of Helminthosporium sorokinianum on Kentucky bluegrass is described. Excised blades were surface sterilized, inoculated with a conidial suspension of H. sorokinianum, and sprayed with the respective fungicide. The blade was placed in a sterile test tube containing 1 cc of sterile water and incubated at 26 ± 1 C for 4 days. Effective control was obtained with Dyrene 50 WP and F-2966.

7. Nicholson, J. F., & J. B. Sinclair. 1971. Amsoy soybean seed germination inhibited by Pseudomonas glycinea. *Phytopathology* 61:1390-1393.

Abstract: Pseudomonas glycinea was shown to inhibit germination of soybean seed, and thus, affect seed quality. Two isolates were recovered from infected seed, and were distinguished in vitro in that one had a smooth surface and margin; the other, a rough surface and margin. Both isolates were identified as P. glycinea by their identical reaction to standard biochemical tests as compared with the reaction of a known culture of P. glycinea. The three isolates did not grow on Kado's selective medium D4 for pseudomonads. When suspensions of our two isolates were infiltrated by vacuum into sterilized Amsoy seed, germination was significantly inhibited (death of seed) to 45% by the rough-margined isolates, and was significantly delayed to 84% by the smooth-margined isolate, as compared to 90% germination of the control. The known culture of P. glycinea inhibited germination 68%. The bacterium was isolated from 17 seed lots of Lee 68 soybean collected from five states. Recovery in vitro of P. glycinea isolates ranged from 4 to 64% among the individual lots. The incidence of P. glycinea was correlated with the inhibition of germination both in naturally infested and artificially inoculated seed.

8. Sinclair, J. B. 1971. Potential of systemic fungicides on some tropical crops. *J. Nehru Krishi Vishwa Vidyalaya Res. J.* 5(1):1-8.

Abstract: A brief history on the development of systemic fungicides, the compounds now in use or being tested, and the potential use of systemic fungicides on some tropical crops is presented.

9. White, J. F., J. F. Nicholson, & J. B. Sinclair. 1972. Effect of soil temperature and Pseudomonas glycinea on emergence and growth of soybean seedlings. Phytopathology 62:296-297.

Abstract: An isolate of P. glycinea from soybean seed significantly reduced emergence of inoculated Amsoy seed at constant soil temperatures of 20, 25, 30 and 35 C, respectively, with the greatest reduction occurring at 35 C. Mean height of 6-day-old seedlings from inoculated seed were significantly less than from noninoculated seed only at 25 C. There were significant differences between the mean dry weight of seedlings from inoculated or noninoculated seed. Isolates similar to the one used for these studies may be an important factor in evaluating soybean seed quality.

10. Schneider, R. W., J. B. Sinclair, & L. E. Gray. 1972. Etiology of Cephalosporium gregatum in soybean. Phytopathology 62:345-349.

Abstract: C. gregatum was isolated from taproots of soybeans within 7 weeks after planting in field plots infested with the pathogen. The fungus was detected in the tops (ninth node) of plants at the early pod-filling stage within 1 day after artificial inoculation of hypocotyls, and within 2 days after a fungal suspension was added to the nutrient solution in which the plants were growing. Conidia are apparently the principal means of spread within the plant. In both greenhouse and field experiments, more stem browning developed in plants inoculated at 4-6 weeks, than in those inoculated 8-12 weeks after planting. Infected plants exposed to low temperatures (18-24 C) for 4 weeks had significantly less stem browning than those exposed for 10 and 12 weeks.

IV. Impact of Grant Supported Activities in Developing Institutional Capabilities: The University of Illinois 211(d) Program has been involved in many of the other programs of the University concerned with the development of Indian agriculture, as well as that of other countries (see Section V of this report). Among these programs are: The Coordinated Soybean Research Project (CSR); the various institutional development programs at JNKVV and GBPATU graduate student participant training programs of India and other countries; and the informal institution to institution programs.

1. Coordinated Soybean Research Project. Each of the students involved in the 211(d) Program has done research and studied soybean and soybean diseases at the two contract universities, JNKVV and GBPATU and worked with the Indian and American technicians in the program. The 211(d) Professor has given many formal and informal seminars, met with various research groups to exchange technical information, and discussed soybean diseases and their control during each visit to India. These discussions were held at many Indian universities and institutions other than the two contract universities.
2. Institutional Building Programs. The students involved in the University of Illinois 211(d) Program have taught formal courses (R. A. Sikora), assisted in the instructional laboratories (W. A. Meyer and J. F. Nicholson), have given seminars on their research to audiences in both the U.S. and India. There has not been a 2-year "adviser or technician" in plant pathology at either contract university and only two, 3-month "short-termers". Essentially the 211(d) Program in plant pathology was used to provide this expertise at the contract universities.
3. Contract Universities' Participants. Of 23 University of Illinois graduate students from India in plant pathology in the past 10 years, six have been USAID participants primarily from our two contract universities. The 211(d) Program was the only program that would have U.S. students, who were to study and work in India, work closely with these participants and other students from India. It has provided a basis for the development of an institution to institution relationship in plant pathology.
4. Institution to Institution Programs. The 211(d) Program has given the University of Illinois an opportunity to begin developing an institution to institution program in plant pathology in India as well as Sierra Leone, Iran, and Nigeria, that has set a format for the development of similar programs in other academic areas and countries. Graduate student exchange has set the stage for possible faculty exchange. However, in order to be successful, it is absolutely necessary that there be a 211(d) Program or some similar supported program in the U.S. to provide the funds for such an exchange.

V. Utilization of Institutional Resources in Development: The following is a summary of the international programs of the University of Illinois, College of Agriculture. Similar material was summarized for the "Directory of University Competencies and Resources in Specific Areas Supported by 211(d) Grants". A brochure entitled: "International Programs and Studies 1972-74" at the University of Illinois Urbana-Champaign, published in May 1972 provides a similar resume.

International activities of the College continued at relatively high level during 1971-72. Changes in international relationships and AID objectives had a considerable effect on contract operations in India and Sierra Leone.

A principal objective of the Office of International Agricultural Programs is to strengthen international involvement of departments, and improve integration of international activities with ongoing or planned teaching, research and public service programs. To this end, interdisciplinary, cooperative programs are being encouraged.

The instructional programs of the College of Agriculture have an international dimension that is rapidly broadening. The College fully recognizes the world food-population problem as one of the major issues facing mankind and hopes to assume a major role within the University community in studying its solution. The College of Agriculture is expanding its international agriculture program in order to educate American students for development activities abroad as well as to train foreign students who come to the College to study.

The College has had cooperative working agreements in India since 1952 and in Sierra Leone since 1963. At the present time there is a close relationship between the College and the Indian states of Madhya Pradesh and Uttar Pradesh and with Njala University College (NUC) in Sierra Leone, through contracts with the United States Agency for International Development (AID). In India, College of Agriculture staff members are assigned to Jawaharlal Nehru Agricultural University (JNAU) at Jabalpur and Govind Ballabh Pant University of Agriculture and Technology (GBPATU) (formerly Uttar Pradesh Agricultural University) at Pant Nagar and, as at Njala University College, they assist in the development of integrated programs for teaching, research, and extension. As a part of the Midwest Universities Consortium for International Activities, Inc. (MUCIA) AID contract activity in Indonesia, the College expects to participate in institution-building programs at two Indonesian universities. A study team from the College of Agriculture and the College of Education recently was requested by the Government of Nepal to conduct a survey of higher agricultural education in that country.

In India, in addition to the two university-building projects, the College has agricultural economics staff working with several Indian universities under Ford Foundation auspices for research and development of agricultural economics programs. A Coordinated Soybean Research Project (CSRP) has been conducted at JNAU, GBPATU and the Urbana-Champaign campus since 1967. This project is aimed at developing India's capabilities to produce, process, and utilize soybeans. Research programs and personnel at the two Indian institutions and at Urbana are closely integrated under the leadership of project coordinators at Urbana-Champaign and in India. This program has stimulated rapid expansion of soybean acreage in India and a keen interest in the possibilities of developing a soybean processing industry there.

The Program for International Research, Improvement, and Development of Soybeans (PIRIDS) was organized in 1969 and has generated widespread support, interest and enthusiasm, both on campus and in many cooperating countries and institutions.

Requests for information on soybean culture and improvement have been received from a large number of countries throughout the world. Active cooperation in field trials of varieties, cultural practices, and inoculation are underway in Colombia, Ecuador, Brazil, Sierra Leone, Nigeria, India, Thailand, and Indonesia. Simpler trial materials have been furnished to a number of additional countries. Varieties under test include improved types originating in the United States, Colombia, Brazil, Uganda, Australia, India, Thailand, and Indonesia.

Entomologists in the PIRIDS program are assembling a worldwide reference collection of literature and specimens of arthropods attacking or associated with soybeans. Two publications have been issued, giving extensive bibliographies of references on two major insect pests of the soybean. Information gathered in this work is being recorded and updated through use of computer facilities.

A special concentration in the multi-disciplinary PIRIDS program is on food uses of the soybean which require minimal processing. Studies are underway on a wide variety of possible food products, and several very interesting prototype products have been developed. Staff members in charge of this work are traveling extensively in Latin American and Asia, to demonstrate the basic process, to encourage its use in research on products meeting local taste preferences, and to bring back to their own laboratory useful information on possible uses and on traditional soybean or grain legume food products.

Other PIRIDS personnel also have traveled extensively during the past year. Included in such trips were service on FAO projects in West Pakistan and Thailand, as well as visits to all the major cooperating locations of field trials.

Also in 1969 a study of Agricultural Development Strategies was organized and funded. This study will concentrate on research to determine the best strategies for agricultural development, using an interdisciplinary and comparative approach to actual developmental problems.

International instructional and research programs are closely related to these overseas service projects in which the College participates. Supervision of graduate thesis research is possible in India (agronomy, agricultural economics, animal science, dairy science, and agricultural engineering), Sierra Leone (agronomy, animal science, and agricultural economics) and Indonesia (several departments at varying times).

Department of Agricultural Economics

With funds from a Ford Foundation grant, the Department of Agricultural Economics is participating in the development of agricultural economics in India. The objectives of the grant are to help further strengthen the work in agricultural economics at Govind Ballabh Pant University of Agriculture and Technology (PUAT), Pant Nagar, and to support the growth of the professional relationship in agricultural economics between PUAT and the University of Illinois. Several faculty members of PUAT are being trained at the Urbana-

Champaign campus, and Illinois staff members act as short-term teaching and research consultants with counterparts at PUAT.

Under the terms of a United States Agency for International Development (AID) contract, the Department is participating in soybean marketing research in association with Jawaharlal Nehru Agricultural University at Jabalpur, India.

Also under an AID contract, the Department has participated in the development of Njala University College in Sierra Leone. Two faculty members serving at Njala helped to develop the curriculum as well as conduct teaching, extension, and research activities.

Active international research and teaching programs on the Urbana-Champaign campus complement the overseas activities of the Department. The research, funded largely through the Office of International Agricultural Programs, concentrates primarily on economic problems of agriculture in Sierra Leone and India. International teaching activities of the Department include a course on agricultural development; one on international comparative agriculture; one each on African, Indian, and Latin-American economic developments; and two courses deal with social change in developing areas.

The project on Strategies for Agricultural Development was continued, though on a somewhat reduced scale. Most of the current activities of this project are in the field of developmental economics. Some of these studies are of a basic nature, particularly those in sector modeling and in simulation. Others, especially the investigation of rice development programs in West Africa, deal with specific aspects of actual problems.

Department of Agricultural Engineering

The Department of Agricultural Engineering has been involved in furnishing advisors and consultants to Indian universities for the past eighteen years as part of contracts of both the College of Agriculture and College of Engineering. It has been instrumental in setting up two of the first three agricultural engineering departments in India and in organizing colleges of agricultural engineering in two new Indian agricultural universities. The Department also furnished consultants to give guidance in research, teaching, and extension at those new universities.

At present the Department is developing a cadre of engineering consultants willing to undertake short-term overseas assignments. Under this arrangement an advisor went on a 1971 assignment in administration and curriculum planning at Jawaharlal Nehru Agricultural University, Jabalpur, India. A second advisor in farm electrification and processing is working with an Indian graduate student whose research is being done at JNAU for a University of Illinois Ph.D. degree. This Indian graduate student completed all other degree requirements at the University of Illinois prior to returning to his home university.

Since the authorization of a graduate program in agricultural engineering in 1949, the Department has awarded nineteen master's degrees to students from seven countries and four Ph.D. degrees to Indian students. Presently, the Department has graduate degree candidates from six foreign countries.

Department of Agronomy

For many years the Department of Agronomy has been directly involved in the agriculture of foreign countries. The Department's program in international agronomy has developed to include (1) research, teaching, and extension activities of staff and graduate students in foreign countries, (2) training of American students for careers in foreign countries, and (3) training of foreign graduate students.

The Crop Evolution Laboratory of the Department of Agronomy is concerned with the study of the origins and evolution of cultivated plants and weeds; it is the only one of its kind in the United States. Extensive collections of major crops from all over the world and their companion weeds and wild ancestors are being assembled for detailed biosystematic studies. Cultivated plants are recent in origin and provide excellent opportunities to study evolution in progress. Techniques are being developed that will allow plant breeders to utilize fully all variability that could contribute to the improvement of major crops. The collections also serve to familiarize foreign students, as well as American students interested in foreign assignment, with the crops with which they eventually will be working. The laboratory further provides opportunities for ethnologists and archaeologists to become familiar with the history and evolution of the crops that made civilization possible.

A significant role is played by the Department of Agronomy in the international soybean research program, PIRIDS. Cooperative variety trials were conducted in Colombia, Ecuador, Brazil, Sierra Leone, Pakistan, India, Thailand, and Indonesia. Seed and plants were supplied by the University of Illinois for these trials and the data were summarized and distributed to those cooperating and to others. Quality characteristics were determined on these samples in the Department of Agronomy.

The Department of Agronomy also conducts a cooperative soil research project in cooperation with Njala University College. The objective of this work is to obtain information on the properties and treatment needs of major soils in Sierra Leone in order to provide a sound basis for improving soil management and increasing crop production.

Departments of Animal Science and Dairy Science

The Department of Animal Science and the Department of Dairy Science have a cooperative program in international animal agriculture.

A course in world animal agriculture has been developed to give students an undertaking of the role of animals in the food supply, economy, and culture of peoples from other nations. Currently the Department of Animal Science has two graduate students studying for doctorate degrees in world animal agriculture. One is conducting thesis research in Indonesia on cattle production and its potential to alleviate protein deficiencies in human diets in East Java. The other is researching the problems of the small swine farmer in Colombia, South America.

Department of Food Science

The Department of Food Science has a major role in cooperative international programs and multidisciplinary research under overseas contracts and the international soybean program, PIRIDS.

A process has been developed which prevents the formation of the "beany" flavor in prototype food products made from soybeans. Such foods are inexpensive, nutritious, and adaptable to the food habits of people in various parts of the world. Emphasis has been placed on developing canned whole soybean products, powdered mixtures of whole soybeans with either fruits or cereals, soybean drinks, and breakfast foods. An essential part of the project will be to determine by nutritional studies the effect of processing variables on the biological value of the protein in the developed foods.

At present this project has eleven workers assigned to it which makes it one of the top priority projects in the Department. The project leader has accepted a two-year assignment at Govind Ballabh Pant University of Agriculture and Technology in India where he will be engaged in scaling-up production techniques for products developed at Urbana-Champaign. Later he will be joined by a doctoral candidate associated with the project. One Indian student at Urbana-Champaign is studying the toxic factor of lathyrism, a crippling nutritional disease in some parts of India, which is caused by eating a specific type of legume.

A new study has been initiated to determine the role of certain natural compounds in soybeans to control oxidation reactions that cause nutritional problems.

Department of Horticulture

In 1970 the interdisciplinary, interinstitutional Tropical Root and Vegetable Crops Program was initiated. This research project involves five staff members from the Department of Horticulture and one member each from the Departments of Agronomy and of Plant Pathology. Cooperative research has been initiated with members of the Faculty of Agriculture of the University of the West Indies in both Trinidad and Jamaica, and with the Federal Experiment Station, Mayaguez, Puerto Rico. Initial emphasis is on tropical sweet potatoes and yams, and on weed control research on tropical root crops and vegetables. Initial efforts for staff exchange under this program were made during 1970 when the leader of the Tropical Root Crops Program of the University of the West Indies spent two months during the summer conducting research at Urbana-Champaign.

New disease-resistant apple germ plasm with the potential for direct use as a new crop continues to be distributed to India through cooperation with the Government Hill Fruit Research Station, Chaubattia, Uttar Pradesh, India. Studies on the dwarfing capability of size-controlling fruit tree root-stocks and the identification of such germ plasm are directly applicable to Indian needs in tropical fruit production and to increasing per hectare production of apples on terraced slopes.

The Department, in cooperation with the Department of Plant Pathology, has developed a new course for graduate and advanced undergraduate students entitled "International Food Crops".

Department of Plant Pathology

The Department of Plant Pathology, in cooperation with the United States Agency for International Development and various Indian plant pathologists, embarked on a five-year cooperative research and student training program July 1, 1968, under Section 211(d) of the Foreign Assistance Act of 1966.

Six American students will have completed the requirements for the M.S. and Ph.D. degrees by June 30, 1973. The program has been broadened by placing a student at the International Institute for Tropical Agriculture at Ibadan, Nigeria. An overall objective of the program is to enhance the competence of the Department in international plant pathology. It is hoped funds will be allocated to continue this or a similar program beyond June 1973.

The Department will continue cooperative work with the Tropical Root and Vegetable Crops Program and PIRIDS when possible.

Division of Agricultural Entomology

The Division of Agricultural Entomology, which is staffed by entomologists of the Illinois Natural History Survey, the College of Agriculture, and two members of the Department of Entomology of the School of Life Sciences, participates in programs at Jawaharlal Nehru Agricultural University (JNAU) and Govind Ballabh Pant University of Agriculture and Technology (PUAT) in India. Several staff members have been assigned as short-term research advisers to these universities or as consultants to the Coordinated Soybean Research Project in India. One staff member is currently on a two-year assignment to GBPATU.

The Division, working with the Department of Entomology of the School of Life Sciences, makes provisions for doctoral thesis research in India for American and Indian graduate students. Under this provision, selected students can elect to do thesis research in India following satisfactory completion of all entomology requirements and the preliminary examination. Students from India are working on advanced degrees in entomology on the Urbana-Champaign campus.

The Division is an active participant in the PIRIDS international soybean research program. Under the auspices of this program, the Division has gathered together in one location all of the world literature dealing with arthropods of soybeans and arthropod vectors of diseases of soybeans and is computerizing this literature for rapid retrieval of information. A synoptic collection of arthropods associated with soybeans is also being developed and the collection and the biodata associated with it is computerized. More than twenty-five thousand specimens are in the collection representing approximately six hundred distinct species of pests, parasites, and predators associated with soybeans. The collection contains species from the United States and sixteen international locations. These two reference collections of scientific information are service-oriented. They support the research of students and staff and enable the Division to respond to requests for information.

Personnel and students associated with the Division are engaged in research on insect behavior, host selection, biology and control, and classification of arthropods. High priority is being given to the publication of a series of bibliographies of the literature on key pest insects of soybeans and to the assessing of actual and potential insect problems on soybeans in temperate, subtropical, and tropical regions.

Office of Agricultural Communications

Since 1952 the Office of Agricultural Communications has been involved in overseas projects, training foreign communications participants, and

giving communications support to various college international programs. At the present time the Office has eight staff members who have had overseas experience.

During 1971 the Office received a two-year MUCIA grant to hire one person as an International Rural Communication Specialist. This person has carried out a broad survey of the international rural communication development field. He is currently drawing up long-range proposals which outline the role of communications in international social and economic development, the role of communication in supporting other international programs, training communication and noncommunication participants, and training Americans for international work. Close liaison is maintained with colleges and departments on campus, with other universities, the United States Agency for International Development, the United States Department of Agriculture, the Department of Health, Education, and Welfare, the East-West Center, and other organizations which are involved in international communication activities.

The Office has recently established an International Development Communication Committee made up of all staff who have overseas experience. In the 1972 spring semester the Office began offering an undergraduate course in communication in agricultural development.

VI. Other Resources for Grant-Related Activities: The funds provided by the original 211(d) grant are not adequate to carry out the plans and scope of the program. Many units of the University of Illinois provided either indirect or direct support this past year.

Administrative services and advice were provided by the: (1) Office of International Programs and Studies; (2) Office of Overseas Projects; (3) Office of International Agricultural Programs; (4) Department of Plant Pathology.

All services for the operation of the teaching classroom and laboratories; the research laboratories, greenhouse, and growth chambers; professor's office and graduate students' office space; and other expenses are provided by the University of Illinois.

More specific support came from:

The Department of Plant Pathology by providing:

1. \$1,565 for general support of the international program.
2. \$1,500 for a 1/4-time secretary.
3. \$1,000 for office supplies and service.
4. \$ 836 for teaching aids and supplies.

Total \$4,901

The College of Agriculture by providing:

1. \$6,837 through regional research funds.
2. \$ 250 for renting approximately 1/2 acre of land for experimental field plots.

Total \$7,087

The Office of International Agricultural Programs by providing:

1. \$2,500 for supplies and expense.
2. \$ 592 for graduate student stipends.

Total \$3,092

The University of Illinois by providing:

\$2,500 from Hackett Fellowship funds.

Thus, over \$17,580 was provided from funds other than 211(d) for direct support of the 211(d) Program in the fiscal year 1971-72. In Fiscal 1971, the amount was \$24,780, for Fiscal 1970, \$15,000, and for Fiscal 1969, \$25,850. This is a total of over \$83,218 for the 4 years of the grant period. This does not include the USAID/Delhi Rupee support funds and those provided by IITA.

1. This does not imply inadequacy to carry out the specific objectives of the grant, however.

VII. Work Plan for 1972-73. The work plan for the remaining year of the grant will consist primarily of maintaining the present educational programs and a phasing out of the grant-supported research, graduate student training, and other activities.

The experience, research materials, and teaching aids gained by the 211(d) Professor will be used in the presentation of formal courses and seminars presented at the University of Illinois. The course on international food crops, insects and diseases will be presented in the Spring 1973 semester in cooperation with the Department of Horticulture and Economic Entomology.

The degree programs of B. L. Kirkpatrick and W. A. Meyer will be completed no later than August 1972. Those portions of the degree programs of J. F. Nicholson, R. L. Slusher, and R. W. Schneider, supported by the 211(d) grant, will be completed no later than June 1973. This will end the possibility of sending graduate students overseas for international experience, unless other funds are found to support such a program. The research results from the work of these five students will be published, to the extent possible, with 211(d) funds. Approximately \$1,417 will be required to publish those manuscripts from the research of the 211(d) students.

It is advisable for the 211(d) Professor to go to the International Institute of Tropical Agriculture, Ibadan to consult and advise R. W. Schneider about his Ph.D. thesis research. This has been requested by Mr. Schneider and his IITA adviser, Dr. Robert Williams. This trip cannot be made unless an additional source of funding can be found.

The 211(d) Professor should attend the annual meeting of his professional society, The American Phytopathological Society, to be held in Mexico City in August 1972. It is truly an international program and since he is the vice-chairman of the International Cooperation Committee of that Society, he should attend the meeting. This will not be possible, unless additional funds are found. State and federal appropriations to the Department of Plant Pathology cannot be used for out-of-state travel.

The estimated amount of money for supplies is minimal. However, it is expected that the actual amount will exceed \$831, since university funds for supplies and expenses from state sources have been drastically reduced the past two years.

Appendix 1. Extract from Dr. Sinclair's Trip
Report for July 21-August 30, 1971

Hawaii. The purposes of the visit to the island of Hawaii were:
(1) to visit for the first time the Hawaii Branch Station at Hilo and become familiar with the research in plant pathology; (2) through a program arranged by Dr. J.E. Hunter, become familiar with diseases of tropical crops; and (3) add to the collection of photographs on diseases of tropical crops used in teaching a formal course.

The purposes of the visit to Oahu island were: (1) to meet with the personnel in the Department of Plant Pathology at the University of Hawaii and become familiar with the research program and visit their new building; (2) meet with some of the personnel at the East-West Center; and (3) become familiar with production methods and disease problems of tropical crops such as: sugarcane, pineapple, various fruits, and ornamentals. Dr. O. V. Holtzmann, Head, Department of Plant Pathology arranged for a meeting of faculty and staff members. Dr. Allen Cook arranged for a tour of the botanical gardens. Sugarcane and pineapple production was observed.

It was the first visit of Mr. Kirkpatrick in a tropical area and his first time to see many of the tropical crops in production. If he is to become experienced in tropical plant pathology, such experiences as this one are necessary.

Thailand. Approximately 8 days were spent in Thailand. The primary reason for the visit was to become familiar with the various plant pathology programs, particularly those dealing with soybeans and soybean diseases. This was of particular value, since Mr. Kirkpatrick will be working in the area of soybean pathology.

The government of Thailand has funded a program in the Ministry of Agriculture for the development of soybean as a commercial crop in Thailand. The project is under the direction of Dr. Arwoot. The plant pathologist in the program is Dr. Praetung, who was a student in my classes at Louisiana State University. Cooperating with Dr. Praetung and others in the program, is Dr. William M. Brown, Jr., USAID/University of Kentucky, stationed in Khon Kaen. Dr. Pairoj, Head, Department of Entomology and Plant Pathology, Kasetsart University and Dr. Brown planned the details of our visit.

The laboratory and teaching facilities of Kasetsart University, Ministry of Agriculture, and various experiment stations in north and northwest Thailand were visited. Two seminars were given. In general the potential of Thailand as a soybean producer appears to be very promising. The fields which we observed indicated that soybeans could be grown on a commercial scale. There were some potential disease problems such as: damping-off of seedlings (Sclerotium rolfsii, Rhizoctonia sp. Aspergillus sp. and others); bacterial pustule of the foliage; virus-like (green mosaic, yellow mosaic, and rosetting-type diseases); downy mildew; nutritional problems; and possibly others. A report of rust on soybean has been made in Thailand, but we did not see any in the fields visited.

It was recommended that a team from Thailand, including Dr. Preatung visit various laboratories in India including: Uttar Pradesh Agricultural University, Pantnagar; J. Nehru Krishi, Vishwa Vidyalaya, Jabalpur; and Indian Agricultural Research Institute, New Delhi and acquaint themselves with the soybean research programs at these institutions. India introduced soybean as an oil crop about ten years ago. It appears that many of the potential problems of soybean production in Thailand have been encountered in India.

New laboratory space is being provided, but it will need to be equipped. I was impressed with most of the physical facilities available for research. It was recommended that two long-range programs should be considered: (1) eradication of the soybean rust pathogen; and (2) soybean seed certification. The most immediate problem will be to identify the disease organisms of soybean and their loss potential.

The possibility of sending three students from Khon Kaen as USAID participants to the University of Illinois was explored with Dr. Brown. There is an active program in soybean research, including plant diseases, at the University of Illinois. The U. S. Department of Agriculture has the Regional Soybean Research Laboratories located on the campus.

India. This was the fourth trip to India by the author. The primary purposes of this visit were:

1. To accompany Bruce L. Kirkpatrick to Uttar Pradesh Agricultural University where he is to study and do research for six months in the department of plant pathology. All correspondence, reports, work plan, and other pertinent information and arrangements concerned with his program are on file. He will be working on soybean diseases and systemic fungicides under Dr. Y. L. Nene and Dr. P. N. Thapliyal.
2. To review the progress, program and termination report of Richard A. Sikora, who began a teaching and research program at U.P.A.U. in 1970 September until 1971 July. Reports of his progress and accomplishments have been sent to the appropriate individuals.
3. To review the progress and program of William A. Meyer, who began his study and research program J.N.K.V.V. in 1971 January for approximately one year. Copies of his progress reports have been sent to appropriate individuals.
4. To make preparations for R. W. Schneider and J. F. Nicholson to study at U.P.A.U. and J.N.K.V.V., respectively, for one year beginning in February 1972.
5. To consult with personnel and assess the development of plant pathology at I.A.R.I., U.P.A.U., J.N.K.V., and other Indian institutions.
6. To increase the experience of this professor in international agriculture.

Approximately four days were spent in New Delhi upon arrival from Thailand. This time was used to clear B. L. Kirkpatrick's air freight, introduce Mr. Kirkpatrick to personnel at USAID, Ford Foundation, I.A.R.I., and other agencies. The programs of R. A. Sikora and W. A. Meyer were reviewed with Mr. Ronald Pollock, USAID. The rust epidemiology and forecasting was reviewed with Dr. Eugene Saari, Ford Foundation. Review of research programs with the personnel at I.A.R.I. was accomplished.

Approximately one week was spent at U.P.A.U. This time was used to complete the formalities of B. L. Kirkpatrick's program. Copies of his work plan, his letter of admission to U.P.A.U., and other pertinent information has been distributed to all interested persons.

The tentative work plan and housing arrangements for Mr. & Mrs. R. W. Schneider were discussed with Vice-Chancellor D. P. Singh, Dean Rao, Dr. Y. L. Nene, and briefly with M. D. Thorne. Copies of letters and other material concerning Mr. Schneider's program have been distributed.

A final review of the accomplishments of R. A. Sikora was made with both the faculty, staff and administration of U.P.A.U., as well as with the U. I. faculty members on the USAID team. There was unanimous agreement that Dr. Kikora's program was a successful one. Pertinent material, copies of his final report, and other items have been distributed.

Conferences with faculty members, field trips, meetings with graduate students, etc., were accomplished. The department now has two glasshouses for research and teaching. Remodeling in the department of laboratory and office space is about completed. The department has added several new staff members, and it is expected to be fully staffed within the next two years. The facilities are overcrowded, but this is expected to be eased when the department of entomology moves into its new quarters sometime in the future. Several seminars were presented.

The period, 18 through 26 August was spent in Madhya Pradesh State spending most of the time at J.N.K.V.V., but also visiting branch stations of J.N.K.V.V. and demonstration soybean field plots in Bhopal, Sehore, Indore, and near Nagpur.

While at J.N.K.V.V., the progress of W.A. Meyer was reviewed. His study program got off to a slow start, but his accomplishments to date are outstanding. He has a program of field and laboratory work that promises to contribute significantly to the field of soybean pathology and be of value both in India and the U.S.A. Copies of his reports, program outline, and other pertinent information have been distributed to all concerned. The graduate student from J.N.K.V.V., O. D. Dhingra, who is now studying in the department of plant pathology, worked with Mr. Meyer. The two men will continue this relationship when Mr. Meyer returns in January 1972.

The tentative work plan and housing arrangements for Mr. & Mrs. J. F. Nicholson and infant daughter were discussed with Vice Chancellor Negi, Prof. L. K. Koshi, Dr. M. N. Khare, and M. B. Russell. Mr. Nicholson has been accepted as a graduate student at J.N.K.V.V. beginning in February 1972. Copies of pertinent material has been distributed.

The facilities in the department of plant pathology at J.N.K.V.V. are improving slowly. More of their equipment is now in working order. There is more glassware and other expendable items available for research and teaching. There has been some remodeling. There is a new screened-in house for growing plants. The glasshouse is not yet completed. There is field space available, if it is needed. There is much to be done, but progress is being made.

Visits to the experimental field plots were made, discussions were held with various faculty members and students concerning their research problems. Several seminars were presented.

KANSAS STATE UNIVERSITY

COLLEGE OF AGRICULTURE

DEPARTMENT OF GRAIN SCIENCE AND INDUSTRY

ANNUAL TECHNICAL REPORT OF 211(d) PROJECT

This report was prepared prior to receipt of the AID "Guidelines."
Supplemental material called for in the "Guidelines" appears on pp. 51-53.

1971-1972

Supplement to
211(d) Annual Report

June 30, 1972

Title: Grain Utilization in India

Grantee: Kansas State University
Department of Grain Science and Industry
Food and Feed Grain Institute

Director: Dr. David R. Lineback

A. Statistical Summary:

Period of Grant: July 1968 to June 1973. Amount of Grant: \$200,000
Expenditures for Report Year: \$50,575 Accumulated: \$129,201
Anticipated for Next Year: \$36,299

B. Narrative Summary

Two students completed research projects at the Central Food Technological Research Institute, Mysore-2A, India during the report period. One project concerned quality evaluation of Indian wheats. Physical, chemical, milling, rheological and baking tests were conducted on 33 Indian varieties of wheat (54 samples) collected from two crop years. A number of the recently introduced high-yielding Mexican varieties of wheat and a few Indian varieties were found to have high loaf volume potentials when measured on a constant protein basis. The second project involved application of insect control chemicals to three grains (rice, wheat and sorghum), milling of these grains and preparation of traditional foods using methods commonly employed, and analysis for the presence of chemical residues in the milled products and prepared foods. Both of these projects were of mutual interest due to the expanding use of chemical for grain storage in India and to the rapidly expanding milling and baking industries in India.

A very significant relationship has been established between Kansas State University and the Central Food Technological Research Institute in Mysore during the life of the grant. This is the most outstanding accomplishment of the grant to date and has significantly increased the competency of Kansas State University to render assistance to India and other developing nations in food grain utilization and to train graduate students in food grain utilization in such nations. This relationship has been strengthened by exchange visits of scientists from each institution. Many areas of endeavor have been involved including information exchange, consultation, stimulation and initiation of research of mutual interest relating to grain utilization in India and other developing nations. The relationships between these two institutions and between scientists who now know each other on a personal basis promise to be very useful for mutual cooperation in the future, providing international political situations as interpreted by AID do not prevent future exchange of personnel.

KANSAS STATE UNIVERSITY
DEPARTMENT OF GRAIN SCIENCE AND INDUSTRY
Manhattan, Kansas

FOURTH ANNUAL REPORT AID 211(d)
GRANT TO DEVELOP SPECIALIZED COMPETENCIES
ASSOCIATED WITH GRAIN UTILIZATION IN INDIA - 1971-72
June, 1972

I. SUMMARY

The 211(d) program has progressed during 1971-72 in the manner planned and presented in previous annual technical reports, with the exception of the plans for Mr. Alvin Siegel to conduct his Ph.D. dissertation research at the Central Food Technological Research Institute (C.F.T.R.I.) in Mysore. Mr. Patrick Finney completed his research investigation at C.F.T.R.I. concerning a baking quality evaluation of Indian wheats and returned to Kansas State University (K.S.U.) to write his dissertation. Writing of the dissertation is nearly completed and Mr. Finney should complete the requirements for his Ph.D. degree in the near future. Mr. Merrick Lockwood continued his research investigation at C.F.T.R.I. concerning the application of chemical agents to grains and the presence of residues from these agents in food products prepared from the grain. The laboratory work in this investigation was completed in June, 1972 and Mr. Lockwood will be returning to Kansas State University in July, 1972 to write his dissertation and to complete requirements for his Ph.D. degree. Mr. Alvin Siegel completed the course requirements for his Ph.D. program during 1971-72 and took his preliminary examinations for the Ph.D. Upon completion of these, he was ready to depart for C.F.T.R.I. to begin his research work. However international politics forced cancellation of these plans and alternative plans have been developed for Mr. Siegel to do his Ph.D. dissertation research at the Institute of Food Research and Product Development, Kasetsart University, Bangkok, Thailand.

Expenditures for the past year include major items for travel, salaries and equipment. Travel billings were finally received from previous years of the grant (estimated expenditures for these items were included in the annual technical reports for those years) and are reflected in the expenditures for 1971-72. The 211(d) professor and Dr. R. Carl Hoseney, associate professor, Department of Grain Science and Industry, Kansas State University, travelled to Mysore in December, 1971-January, 1972 to consult with the two students doing research there and with the Indian scientists co-directing their work, to evaluate the progress of their programs and to complete arrangements for the third student to study there. Travel expenses and per diem for the return of Mr. Finney, his wife and infant child from India, are included. Major items of research equipment (listed in the third annual technical report) purchased from U.S. manufacturers and shipped to India for use by the two students in their research projects were paid for during the current fiscal year. Some equipment was purchased for use at Kansas State University in research generated by work of the students in India.

Dr. H. A. B. Parpia, Director, Central Food Technological Research Institute came to Kansas State University for a brief visit during May, 1972 under the provisions of the 211(d) grant. During his short visit at the University, he consulted with students and faculty members and presented a seminar. Arrangements for the cooperative program at C.F.T.R.I. had been made through Dr. Parpia, who has had considerable interest in the program and in the students during their time in Mysore.

The objectives of the 211(d) program have been adhered to and the program has developed nearly as planned. Interest in international agriculture has continued to be stimulated among undergraduate students, graduate students and faculty members. Particular interest and discussions have been directed to

the uniqueness of the 211(d) concept and the flexibility of the program with regard to selection of research problems and areas, a feature which was especially utilized this year in the case of Mr. Siegel. Experiences gained from the 211(d) program have been used to enrich course content in several existing courses by inclusion of material with international orientation. Personnel involved with the program have continued their interchanges and cooperation with the South Asia Center, the International Activities Office and programs of the International Agricultural Office.

Plans are now complete for the remaining year of the 211(d) grant. Emphasis will continue to be placed upon graduate student training in food grain utilization in India and other developing nations. Two students will complete their work in the very near future and the third student will initiate his research. Current plans are to request a one-year extension of the grant without additional funding to allow the third student to complete his research and the requirements for his Ph.D. degree. This emphasis is considered to be of maximum importance and benefit, yielding the greatest return from the current 211(d) program and increasing the competency of Kansas State University to render assistance to India and other developing nations in food grain utilization.

II. GRANT OBJECTIVES

The basic objectives, as stated in the contract, are as follows: "The basic objectives are to train graduate students in food grain utilization in India and other developing countries and to further develop the competency of Kansas State University in these areas. The University considers international activities of this nature a legitimate concern and function. Training and research activities in this area are under way but assistance, as requested

in this grant, will enable the University to engage in new endeavors and expand its research and graduate instruction program so as:

- A. To increase the capability of Kansas State University to render assistance to India and other developing nations in food grain utilization.
- B. To enlarge the pool of scientists trained in grain handling, processing, storage and marketing interested in and capable of assisting India and other developing nations.
- C. To increase professional awareness of the increasing importance of grain storage, handling, processing and marketing in developing countries.
- D. To encourage college students to seek careers in international service in the broad area of grain utilization.
- E. To provide an opportunity for graduate students to obtain research experience on problems of particular relevance to India and other developing countries by assisting with research activities carried out fully or in part in India.
- F. To stimulate and encourage faculty and other professional staff to consider careers in international service and to increase faculty interest in and university commitment to agricultural problems of India and other developing countries by drawing upon their special relevant competencies in training and research."

III. MAJOR ACCOMPLISHMENTS

The work plan outlined in annual Technical Report No. 3 was followed and realized. Dr. H. A. B. Parpia, Director, Central Food Technological Research

Institute (C.F.T.R.I.) came to Kansas State University, May 20-24, 1972, under the provisions of the 211(d) Grant. During this period he presented one formal seminar, "Some Aspects of Food Research at C.F.T.R.I.", and consulted with students and faculty from several departments of the university. He had discussions with several staff members from the Department of Grain Science and Industry concerning the 211(d) program and interests generated by it. Arrangements for the cooperative program between C.F.T.R.I. and Kansas State University were made through Dr. Parpia. He has been most interested in the program, its implications and effects, and has spent considerable time with the students studying at C.F.T.R.I. One of the most significant accomplishments of the 211(d) grant has been the relationship which has developed between Kansas State University (Department of Grain Science and Industry) and C.F.T.R.I. This relationship would not have developed without the 211(d) Grant. Discussions during Dr. Parpia's visit to Kansas State encompassed such areas as mutual research interests, staffing problems at C.F.T.R.I. concerning which personnel at Kansas State could advise, grain utilization and food production problems in India, the possible implications and effects of international politics on reciprocal scientific relations, and mutual areas for cooperation between the two institutions. This relationship has grown stronger each year and considerable exchange of correspondence and information now occurs. If programs such as the current 211(d) Grant were maintained, relationships such as these could be greatly strengthened at a minimal expense with mutual benefit to both countries.

Plans for the graduate students involved in the program progressed as expected, with the exception of Mr. Siegel, and are summarized below.

1. Mr. L. Merrick Lockwood continued his Ph.D. dissertation research under the supervision of Dr. S. K. Majumder in the Infestation Control and Pesticide Discipline at C.F.T.R.I. Samples of wheat and rice were obtained

and, together with the sorghum sample obtain previously, were treated with three to four different concentrations of malathion, gardona or sumithion. A bioassay involving confused flour beetles and a lepidopterous grain pest was used to determine the lowest effective concentration of each chemical. Each grain was then treated with the lowest effective concentration of each chemical and with multiples of this concentration. Samples of the grain were removed after varying periods of storage and milled by procedures commonly used in India. Commonly used food products were prepared from each milled grain by methods normally used in India. The milled grains and food products prepared from them were analyzed for chemical residues.

The laboratory research portion of the investigation was completed in June, 1972. Mr. Lockwood and his family are returning to the U.S. in July, 1972. Following his return, he will complete the writing of his dissertation and complete the requirements for his Ph.D. degree. A paper covering the results of his work in India has been submitted for presentation at the National Meeting of the American Association of Cereal Chemists, October 29-November 2, 1972 at Miami Beach, Florida.

2. Mr. Patrick L. Finney completed his research investigation at C.F.T.R.I. and returned to the U.S. with his family in April, 1972. Since his return, he has been writing his Ph.D. dissertation. Work on this is nearly complete. A paper covering the results of his investigation in India has been submitted for presentation at the National Meeting of the American Association of Cereal Chemists, October 29-November 2, 1972, at Miami Beach Florida. Upon completion of his Ph.D., Mr. Finney plans to do postdoctoral work under Dr. R. Carl Hoseney, Department of Grain Science and Industry, Kansas State University, in the area of baking quality evaluation. This postdoctoral fellowship is a direct out-growth of Mr. Finney's experiences and

training in India on the 211(d) program and will increase his competence and experience in this area.

While at C.F.T.R.I., Mr. Finney conducted quality evaluation studies on 35 varieties of Indian wheats (54 samples in all) from two different crop years. These samples were obtained from the major wheat-growing areas of India through cooperation of Indian plant breeders and experiment stations. The wheats were milled by Mr. Finney on a Buhler mill in the Discipline of Flour Milling and Baking Technology at C.F.T.R.I. Milling data were obtained for each of the wheats milled. Wheat samples ranged from hard through soft wheats. The flours obtained from these wheats were used to bake leavened bread. Three different baking formulae were used in evaluating the breadmaking potential of each wheat flour. The flours were characterized by appropriate standard tests and the doughs derived from these flours were also adequately characterized by accepted rheological tests. Coupled with the baking tests, this investigation resulted in a complete set of data for each wheat sample for each stage of the grain processing and utilization (breadmaking) sequence. This information will be made available to the breeders cooperating in the study as well as being published in suitable scientific journals. It was found that certain Indian wheats, particularly Kalyan Sona (developed at CIMMYT, Mexico and now grown as the major wheat variety in India) was equal to or superior to a regional baking standard flour from the U.S. used as a standard in the investigation. This latter flour is a composite flour from medium-strong to strong wheats grown in the Southern and Central Great Plains region of the U.S. in 1969. The information obtained from this investigation should be very useful in determining the suitability of various varieties of Indian wheats for production of bread. The use of bread is increasing at a rapid pace throughout India.

3. Mr. Alvin Siegel completed the course requirements for his Ph.D. program and took his preliminary examinations. Arrangements had been completed for him to study in the Discipline of Protein Technology at C.F.T.R.I. on a problem involving studies on the preparation, acceptability and nutritional evaluation of cereal-based foods for children. These final arrangements had been made during a visit to Mysore in January, 1972 by the 211(d) professor. Dr. H. A. B. Parpia had indicated the willingness and desire of the Institute to have another student under the collaborative arrangement between the two institutions and had signified his pleasure with the first two students and the progress of the relationship between C.F.T.R.I. and Kansas State University.

Shortly before the time planned for his departure to India, while waiting issue of the necessary visa, a cable was received by AID/Washington indicating that no new 211(d) personnel would be assigned to India. This necessitated a change in plans for Mr. Siegel. Talks with personnel at Kansas State University and with Dr. Irwin Hornstein of the nutrition area of AID/Washington resulted in a recommendation that Mr. Siegel do his Ph.D. dissertation research with Mr. Amara Bhumaratana at the Institute for Food Research and Product Development, Kasetsart University, Bangkok, Thailand. It so happened that Mr. Bhumaratana was in Washington at the time attending meetings and telephone conversations were held with him and Dr. Hornstein. Dr. Hornstein strongly recommended that Mr. Siegel work with Mr. Bhumaratana and the latter indicated his willingness to direct Mr. Siegel in research work. A tentative project was agreed upon, to be finalized in later meetings in Bangkok, which was nearly identical to that which Mr. Siegel had planned to do in India. This was a major reason for selection of Thailand as the location for Mr. Siegel's research. This would enable experiences in India to be capitalized on and would further enhance the competency of Kansas State University to render assistance to

developing nations in food grain utilization.

Mr. Siegel plans to proceed to Bangkok as soon as the necessary approval has been obtained from AID/Washington and the necessary visa has been issued. He will spend about 18 months there doing the research and will then return to the U.S. to complete the writing of his dissertation. A one year extension of the present grant without additional funding will be requested to enable him to complete his Ph.D. degree under these arrangements.

A. Development of Teaching Competence

Kansas State University has a long history of active international involvement. The Department of Grain Science and Industry has an excellent international reputation for its research and training functions in the field of grain science. The graduate student body of this department currently is about 50-60% international students. The staff and faculty of this department are in almost daily contact with foreign students and visitors.

The 211(d) program has been used to enrich the teaching program of this department and the services of those involved in the 211(d) program have been made available to other departments of Kansas State University for use in their teaching programs. It is strongly believed that this approach is of more value to the University and its students than the creation of new courses specifically dealing with international agriculture. As the experiences of students and staff involved in the 211(d) program are incorporated into their various teaching assignments, many more students will benefit from these experiences than would the few enrolling in any one new course. The 211(d) professor has incorporated experiences from the 211(d) program into the two courses he teaches related to food science and into his involvement in the food science interdepartmental program at Kansas State University. Graduate students returning from their work in India will be used during the next academic year in a series of technical and

social seminars relating to their work and experiences in India. Development and improvement of teaching competence occurs as the experiences and competence of teaching faculty are increased. This is being done through the 211(d) program by exposing more personnel to the problems of grain utilization and production in developing nations.

B. Development of Research Competence

The relationship between Central Food Technological Research Institute and Kansas State University was further strengthened and developed during the year. Considerable exchange of technical information and experience is occurring between individuals in both institutions via the 211(d) program. New areas of mutual research interests are becoming apparent which are increasing the research competency of scientists at Kansas State University by opening new or expanded areas of research. During the course of Mr. Finney's work on wheat quality evaluation, several Indian wheats were found to give unusual responses 2. their breadmaking performance based on what would have been expected from some of the quality parameters measured. Several of these wheats have been imported for further investigation at K.S.U. to determine why these unusual responses, compared to American varieties and their behavior, occurred. Using standard baking tests, Mr. Finney was able to achieve loaf volumes comparable to but slightly less than those obtained at Kansas State under similar conditions. This was further investigated at Kansas State University and the lower loaf volume was found to be due to the use of buffalo milk solids in India rather than the normal nonfat dry milk solids used in the U.S.

Scientists from Kansas State University and C.F.T.R.I. have exchanged information and ideas on potential areas for collaborative research, for information exchange and for consultation. If the relationship between these two institutions and their staff is allowed to continue to develop, significant

areas of mutual cooperation are bound to emerge. Many of these may be incorporated into existing research programs at K.S.U., such as the development of protein-enriched cereal-based foods, and others will require initiation of new research programs. All of these will increase the research competency of the scientists involved, particularly in the areas of food grain production and utilization in developing nations.

C. Development of Competency for Consultation and Service

As indicated in the third annual technical report, experiences gained in India by students and staff participating in the 211(d) program increase their competence for consultation and service in the following ways:

1. Information and knowledge gained from these experiences constitute a pool of knowledge and information concerning international agriculture, particularly grain utilization in developing nations, and food problems which can be made available to the university community.

2. The most unique concept of the 211(d) program is the ability to formulate a research project in an area of mutual interests through direct cooperation with Indian colleagues or colleagues in other developing countries. This observation was also voiced on several occasions by Dr. Parpia and cannot be stressed enough. The experiences gained through such a venture are not available in the University other than through the 211(d) program. It is probable that the 211(d) concept will, in the long run, prove to be the most viable, least expensive vehicle to foster establishment of significant long term relationships between institutions and scientists in developing nations and their counterparts in the U.S. without the political implications of technical assistance teams.

3. Experiences of those involved in the 211(d) program are daily utilized through lectures, seminars, contact with international students and discussions

with other faculty members having interests in India and other developing nations. Again for the second year, the 211(d) professor was interviewed concerning the 211(d) program following his visit to India. The interview was used for the "Agriculture Today" program of the University radio station (KSAC) and was distributed for use throughout the state to inform Kansas area farmers and ranchers of the program and the implications for Kansas agriculture.

4. Participants involved in the 211(d) program cooperate with the University's International Activities Office, the South Asian Institute, and the International Agricultural Programs Office.

5. Conferences with staff members who have returned from assignments abroad or about to leave for foreign duty are common.

Dr. Lineback made his second visit to India during December, 1971-January, 1972, to coordinate and evaluate the research of the two graduate students studying at C.F.T.R.I., to consult with Indian scientists and to complete arrangements for a third student to study at C.F.T.R.I. under the 211(d) program. He was accompanied by Dr. R. Carl Hosenev, Associate Professor, Department of Grain Science and Industry whose trip was made under the provisions of the 211(d) grant. Dr. Hosenev is a nationally and internationally recognized expert in cereal chemistry and wheat quality evaluation. However, he had not been exposed to many of the problems and experiences of grain utilization in developing nations, even though many of these would have direct implications for his research. He also was admirably qualified to evaluate and assist with the research of Mr. Finney. This is one of the finest examples of the use of the 211(d) program to increase the teaching, research and consulting competence of K.S.U. by increasing these capabilities of a faculty member. Dr. Hosenev derived great benefits from the trip, his discussion with scientists at the institutions visited, and the experiences he had involving cereal grain production and utilization in a

developing nation with the food problems attendant to such an area. This has increased the competency of Kansas State University to assist with food grain utilization in developing nations by more effectively equipping one of its younger faculty members to work in this area. This is one aspect of the 211(d) program which should be encouraged and used for it truly achieves the objectives of the grant and will have a lasting impact. The itinerary for the trip included:

- December 29 Flour Milling and Baking Research Association,
Chorleywood, England
- December 30 Station of Biochemistry and Physicochemistry
of Cereals, National Institute of Agronomic
Research, Massy, France
- January 1-10 Central Food Technological Research Institute,
Mysore, India
- January 12 Bread Research Institute of Australia and
C.S.I.R.O. Wheat Research Unit, North Ryde

Visits to the Flour Milling and Baking Research Association, Chorleywood, and the Station of Biochemistry and Physicochemistry of Cereals, Massy, enabled Drs. Hosney and Lineback to consult with scientists active in the fields of cereal chemistry and baking. Scientific areas of mutual interests were thoroughly discussed, information shared and areas pertinent to the 211(d) program reviewed. Previous correspondence had enabled appointments to be scheduled with Dr. C. T. Greenwood and his staff at Chorleywood and with Drs. Mercier, Cerning and Charbonniere at Massy.

The majority of the time at C.F.T.R.I., Mysore, was spent in consultation with the two students there and with the Indian scientists co-directing their work. By virtue of his research interests, Dr. Hosney spent the major portion of his time in consultation with Mr. Finney and Mr. G. S. Bains (Head, Discipline of Flour Milling and Baking Technology) evaluating the data collected during the course of Mr. Finney's investigation and discussing problems pertinent to quality

evaluation of wheat. Dr. Hoseney presented a formal seminar to personnel at C.F.T.R.I. Dr. Lineback spent the major portion of his time in consultation with Mr. Lockwood and Dr. S. K. Majumder (Head, Infestation Control and Pesticide Discipline) evaluating Mr. Lockwood's preliminary data and completing plans for collection of the remainder of the data. A field trip was made to witness the rice harvest in an area near Mysore City. This enabled both Dr. Lineback and Dr. Hoseney to become more familiar with some of the problems of a labor-intensive set of cultivation and harvest practices and the implications this has for grain utilization. Discussions were held with other staff members of C.F.T.R.I. particularly Dr. H. A. B. Parpia, concerning research at the Institute, possible areas for mutual collaboration and support, and future plans for the 211(d) program (including final arrangements for the third student in the program to study there).

One of the most informative and worthwhile aspects of this trip was the visit to the Bread Research Institute of Australia at North Ryde. This Institute has had extensive experience with the establishment of modern breadmaking facilities in India and is also doing excellent, extensive research in cereal chemistry. A number of areas of mutual interest relating to the 211(d) program were thoroughly discussed. Problems relating to grain utilization in developing nations and the implications that current cereal chemistry research and food science research have for these problems was discussed.

D. Undergirding of Other Indian Programs of CUSURDI Universities

Arrangements have been made for a student being trained at Ohio State University to complete a portion of his training in the Department of Grain Science and Industry. Mr. V. K. Chaudhary, Lecturer in Cereal Technology in the Department of Food Science and Technology, Punjab Agricultural University, Ludhiana, India, is enrolled at Ohio State University for a Ph.D. degree. The

main purpose of his program is to prepare him for cereal and baking technology so that he can continue the program initiated at his home university by Dr. Donald C. Abbott of Oklahoma State University, who is serving a one-year assignment at Punjab Agricultural University on the Ohio State University/USAID contract. It was desired for Mr. Chaudhary to receive a portion of his training at Kansas State University. Arrangements have been completed for him to spend two semesters studying in the Department of Grain Science and Industry, utilizing the unique capabilities of this department to train personnel in the area of baking science and technology. Dr. Abbott also visited with Mr. Finney in Mysore where they discussed the work Mr. Finney was doing, particularly that involving wheat samples from Ludhiana.

E. Involvement of Other University Resources

Many divisions of Kansas State University provide either direct or indirect support to the 211(d) program. Administrative services and advice are provided by the various international programs offices that have extensive overseas projects. In addition, the overall staff of the Department of Grain Science and Industry contributes in innumerable ways to the support of the 211(d) project, by providing office space, secretarial services, library facilities, as well as giving advice and encouragement to the 211(d) students.

IV. INTERNATIONAL PROGRAMS OF THE UNIVERSITY

Kansas State University is committed to the concept that international activities are a legitimate concern and function of the university. It has a long history of involvement in international agriculture and continues its

high degree of interest and involvement in international programs of this nature. These programs are diverse in nature and only the most relevant will be cited in this discussion. It must be realized that a commitment to teaching and training foreign graduate students represents a major commitment of the resources of a university. Kansas State has been a center for such activity and it has only recently become necessary to place limitations upon the number of foreign graduate students enrolled in the graduate programs of this University. This was necessitated by current economic conditions in the United States as reflected by decreasing financial support for graduate education and research. The first international assignment of a KSU faculty member was to Egypt in 1927 and involvement in international technical assistance programs has continued since then.

The University has been involved in India on a university-wide basis since 1956 when it finalized a contract with the International Cooperation Administration (now USAID). The university has staffed and operated a program to aid in the development of Andhra Pradesh Agricultural University at Hyderabad. A large number of KSU faculty have served abroad under the provisions of this program. This program is currently being concluded with the last KSU faculty member scheduled to leave Hyderabad in September, 1972. Dr. Charles Deyoe of this department spent about six weeks in November-December, 1971 as a consultant concerning the establishing of a Feed Technology curriculum at Andhra Pradesh Agricultural University (A.P.A.U.). This was a direct consequence of training a student from A.P.A.U. for a Ph.D. in Grain Science. This student returned to the faculty at A.P.A.U. and initiated consideration of such a curriculum, similar to that he had studied here at KSU. During his visit to Hyderabad in April, 1971, Dr. Lineback gave a seminar emphasizing the Feed Science and Management curriculum in the Department of Grain Science and Industry, KSU.

In 1963 Kansas State University signed a contract with AID for aid in developing Ahmadu Bello University in Nigeria. This program involves assistance in broad areas of agriculture and veterinary medicine. The program has been in operation since that time with numerous KSU faculty members having served there on two-year or short-time assignments. Five faculty members departed from KSU for assignments in Nigeria during the current year.

The Department of Grain Science and Industry has continued its broad involvement in areas related to grain processing utilization. Training and research programs in grain handling and processing have been continued on an international basis under contracts with AID. For the third consecutive year a short course in Grain Storage and Marketing is being held in this department during June-July, 1972 under the provisions of Contract AID/csd-1588. Participants from Central and South America, Nepal, Indonesia and Liberia are attending the short course. Under this same contract, programs involving grain storage, transportation and processing were continued and staff members from this department and the Department of Economics travelled to Viet Nam, Indonesia, Honduras, Guatemala, Panama, Senegal, Mali and Mauritania to consult on problems pertinent to these areas. During this same period, the Department of Grain Science and Industry has continued its extensive research program concerning nutritional improvement of cereal-based foods under the provisions of Contract AID/csd-1586. Staff members went to Lyallpur, Pakistan to conduct acceptability studies with Pakistani colleagues involving protein-enriched cereal-based food products developed from this research.

The South Asia Center of the university has continued its extensive involvement in matters pertaining to cultural, social, geographical, political, economic and historical aspects of this area of the world. This Center has become the center for international instruction in the University in the areas outlined

above. Courses, such as the two in Introduction to the Civilization of South Asia, are extensively utilized by undergraduate and graduate students desiring training in this area. Courses are co-listed among several departments.

V. EXPENDITURES

	Original	Actual Expenditures				Estimated Expenditures	
	Budget 1968-73	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74 ¹
Faculty Salaries	\$ 98,000	\$16,887	\$20,277	-0-	\$14,605	\$18,500	\$19,500
Graduate Stipends	54,000	700	8,400	\$13,792	17,280 ²	8,000	7,000
Exchange Professor	7,000	-0-	-0-	648	420	799	500
Travel (Mission Payments)	25,000	713	606	3,164	1,436 ³ 10,864	6,000	5,500
Equipment, Supplies & Other	16,000	73	780	12,586	5,970 ⁴	3,000	2,000
	<u>\$200,000</u>	<u>\$18,373</u>	<u>\$30,063</u>	<u>\$30,100</u>	<u>\$50,575</u>	<u>\$36,299</u>	<u>\$34,500</u>

1. One-year extension of grant being requested without additional funds. Budget is predicated upon this being granted.
2. Graduate stipends include the following:

L. Merrick Lockwood	\$6540
Patrick L. Finney	\$6540
Alvin Siegel	<u>\$4200</u>
	\$17,280
3. 1971-72 Travel includes expenses of 211(d) professor to annual 211(d) review in Washington, Dr. Lineback's and Dr. Hosenev's trip to India, and the return of Mr. Finney with his wife and child from Mysore. The Mission payments reflect the official costs received from AID for the above trips and those in previous years (estimated in previous annual reports).
4. All major items were purchased from U.S. Manufacturers. The items costing above \$100 are listed below. The first (laboratory sifter) was purchased for the research laboratories at Central

Food Technical Research Institute, Mysore, India for use in experiments being conducted in connection with the research program of a 211(d) student. The second item (microscope) was purchased for the research laboratories of the Department of Grain Science and Industry, Kansas State University for use in research generated by the 211(d) work in India.

Laboratory sifter	\$490.00	Great Western Mfg. Co.
Microscope	702.00	Scientific Products

Other costs included a portion of the equipment itemized in the third annual technical report which was paid with funds during this fiscal year.

VI. PLAN FOR SUBSEQUENT YEARS

During 1972-73, the last year of the original grant, Mr. Lockwood will complete the requirements for his Ph.D. degree and be terminated from the program. Mr. Siegel will initiate the research for his Ph.D. at the Institute for Food Research and Product Development, Kasetsart University, Bangkok, Thailand. The 211(d) professor will travel to Thailand to complete arrangements for the research problem and to consult with Thai scientists.

A one year extension to the present grant is being requested without additional funding. This will allow Mr. Siegel to complete his research work in Bangkok, return to Kansas State University to write his dissertation, and complete the requirements for his Ph.D. degree. Current plans are for his research to be completed by January, 1974, allowing six months to write his dissertation and complete his degree requirements. The 211(d) professor would make one trip to Bangkok during 1973-74 to supervise and evaluate the data acquisition of the research program and to consult with Thai scientists co-directing the work.

Supplementary material - KSU Project (p. 35)

C. II. The basic objectives "to train graduate students in food grain utilization in India and other developing countries and to further develop the competency of Kansas State University in these areas" have received about equal emphasis during the period of the grant and have not been significantly modified. One of the major means for increasing the competence of a university is through the training of graduate students in the designated area. These two mutually compatible objectives form the heart of the present grant and will continue to do so.

III. Table I is appended.

TABLE I

DISTRIBUTION OF 211(d) GRANT FUNDS AND CONTRIBUTIONS
FROM OTHER SOURCES OF FUNDING

Review Period: July 1, 1971 to June 30, 1972

Activity	211(d) Expenditures			Non 211(d) Funding Amount
	Period Under Review	Cumulative Total	Projected Next Year	
Research	\$32,270	\$83,000	\$23,500	\$128,000
Teaching	6,025	16,201	4,500	24,000
Consultation	12,280	30,000	8,299	48,000

There is no way to estimate in any reasonable accuracy the contribution of non-211(d) funding.

TABLE II

EXPENDITURE REPORT
(Actual and Projected)

UNDER INSTITUTIONAL GRANT AID/csd-1931

Review Period: July 1, 1971 to June 30, 1972

	Expenditures to Date		Projected Expenditures Year		Total
	Period Under Review	Cumulative Total	5	6*	
Faculty salaries	\$14,605	\$51,769	\$18,500	\$19,500	\$89,769
Graduate stipends	17,280	40,172	8,000	7,000	55,172
Exchange professor	420	1,068	799	500	2,367
Travel	12,300	16,783	6,000	5,500	28,283
Equipment, supplies, & other	5,970	19,409	3,000	2,000	24,409

*Predicated on a one-year extension to the present grant without additional funding beyond that of the original grant.

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

DEPARTMENT OF AGRONOMY

ANNUAL TECHNICAL REPORT OF 211(d) PROJECT

This report was prepared prior to receipt of AID "Guidelines." Absence from the country has delayed preparation of supplementary material.

1971 - 1972

211(d) Annual Report

June 30, 1972

TITLE: A Grant to Develop Within the University of Missouri, Columbia
Specialized Competency in the Breeding of Agronomic Crops of India.

DIRECTOR: J. M. Poehlman, Professor of Agronomy, University of Missouri, Columbia.

A. STATISTICAL SUMMARY:

Period of Grant: June 1, 1968 to May 31, 1973.

Amount of Grant: \$200,000.

Expenditures for Report year: \$34,754. Accumulated: \$133,013.

Anticipated for next year: \$47,920.

B. NARRATIVE SUMMARY:

This grant is one of six separate disciplinary grants being coordinated through the Council of United States Universities for Rural Development in India.

The activation of this grant has been built around a faculty member to conduct research in plant breeding, both in the U.S. and overseas, supervise graduate students, and carry out other activities designed to develop competence in the Department of Agronomy, University of Missouri, for continued consultation and service in crop breeding research on an international scale.

The teaching program of the Department has been strengthened with addition of courses pertaining to tropical agriculture, and the depth of existing course offerings has been broadened to include international agronomic problems. A textbook "Breeding Asian Field Crops" has been completed and published.

Graduate students on the 211(d) program are conducting thesis research in India on mungbeans in order to study problems relevant to Asian agriculture. Through our graduate student research we have developed an International Mungbean Testing Nursery to identify strains adapted to India and countries of Southeast Asia. We are seeking to identify the genetic variability in mungbeans, the parameters for evaluating yield and adaptation, and to find germplasms superior in these characteristics. Significant findings thus far include varieties with photoperiod insensitivity, resistance to disease, and superior seed quality.

I. INTRODUCTION

This grant is one of six separate disciplinary grants being coordinated through the Council of United States Universities for Rural Development in India. The UMC grant is focused on the development of educational competence and research expertise in plant breeding as related to agricultural development in India.

The period covered by this report is from July 1, 1971 through June 30, 1972.

II. GRANT OBJECTIVES

The overall objective of this grant is to increase the general competency of the University of Missouri, Columbia, to generate knowledge and render assistance in the international area of plant breeding, and to establish this area of specialization as a legitimate and continuing function of the University.

The specific objectives of the grant are:

1. To increase the capability of the University of Missouri to render assistance to India (and other developing nations) in the general area of plant breeding.
2. To increase the pool of scientific manpower trained in plant breeding interested in and capable of assisting India (and other developing nations).
3. To create a professional awareness of the international dimensions of plant breeding.
4. To stimulate interest of plant breeders in international service careers as employees of private or public entities.
5. To encourage college students to seek training leading to careers in international plant breeding under private or public auspices.
6. To provide an opportunity for graduate students to obtain research experience on problems of particular relevance to the developing countries (to the maximum extent feasible, by assisting with research activities carried out wholly or partially in India.)
7. To increase interest in and knowledge about the agricultural problems of India by drawing upon all relevant special competencies of staff members of the Department of Agronomy and other departments of the University.

The activation of the grant objectives has been built around a faculty member who will teach, conduct research both in the U.S. and overseas, supervise graduate students, and carry out other activities pursuant to the grant objectives. The activities are designed to create a professional awareness of the service opportunities in the international area of plant breeding, to train graduate students for careers devoted to assisting developing nations in the discipline

of plant breeding, and to provide research experiences overseas (in India) which will assist in the personal development of the professor and the graduate students and thereby increase their competency to understand the agricultural production problems of developing nations and to contribute toward the solutions of those problems.

III. MAJOR ACCOMPLISHMENTS (1971-72)

At the University of Missouri, Columbia, we are accomplishing the overall objective of this grant, "to increase --- competency --- to generate knowledge and render assistance in the international area of plant breeding" by active participation in plant breeding research on an international scale. In the process we are generating new knowledge, increasing the perspective of our plant breeding staff, training graduate students with broad experience in international agriculture, fostering international cooperation among plant breeders, and increasing our competency through participation in these activities.

This grant program was initiated by the grant professor offering assistance to the Orissa University of Agriculture and Technology, Bhubaneswar, India (where UMC has an Agricultural University development contract) and the State Department of Agriculture of Orissa in development of wheat and pulse breeding projects. The assistance would be in the form of informal consultative discussions between the grant professor and OUAT staff assistance in obtaining for OUAT genetically broadbased breeding materials, and by sending graduate students to work with the Orissa professor. In the process we would use these crops as vehicles to generate thesis research relevant to India for graduate students. The mungbean (*Vigna radiata* (L.) Wilczek) was chosen as the species on which to concentrate since it was the principal pulse crop in Orissa. The extensive wheat improvement programs at CIMMYT (Mexico) and in India made it relatively easy to accumulate breeding materials for OUAT to initiate the wheat project. With mungbeans there is a paucity of basic information regarding the species. Breeding materials had to be identified which could be used to develop a broad-based program for genetic improvement. This has necessitated extending the search for germplasm to other countries of Southeast Asia where mungbeans are grown and to expanding our observations in order to identify characteristics basic to the adaptation of strains of this species. As a result we have been involved in mungbean research during the current year to a greater extent than with wheat.

In this report the activities of the Professor and each student will be reviewed briefly first. In the sections to follow we will explain how these activities are contributing to the development of competence at UMC in teaching, research, graduate student programs, and consultation service, thereby fulfilling the grant objectives.

Activities in 1971-72

In the previous technical reports, Dr. J. M. Poehlman, Professor of Agronomy (Plant Breeding), was identified as the International Professor on this project. Professor Poehlman has continued to be identified with the 211(d)

project in 1972 with one-half of his salary paid from the grant and the remainder from University of Missouri salary funds. During the year he taught a course in "Field Crop Breeding", supervised the seminars for graduate students in plant breeding and genetics, served as major advisor to seven graduate students, organized a cooperative International Mungbean Testing Nursery with assistance of graduate students supported by this grant, distributed seed of superior strains to eight foreign countries, traveled to Romania on invitation of Romanian Ministry of Agriculture to lecture on wheat and soybeans, and served on Departmental and other committees.

Mr. John M. Yohe (Ph.D. student) spent the period November through May in India conducting thesis research on mungbeans. He presented papers on his research at the American Society of Agronomy Annual Meeting, New York; Kasetsart University, Bangkok; and OUAT, Bhubaneswar.

Mr. Earl Watt completed an M.S. thesis, June 1972, on inheritance of height in Mexican semidwarf and standard wheat varieties. He will evaluate local and introduced strains of mungbeans at Columbia in the summer of 1972 and develop breeding materials for a Ph.D. thesis to combine disease resistance and short photoperiod response of varieties adapted to Orissa, India, with high yield and seed quality of strains from the USDA collection.

Mr. Richard Swindell started graduate study in June, 1971, on a fellowship provided by the UMC Graduate School. He is developing an M.S. thesis concerned with heterosis and inheritance of high yield components in mungbeans. He has identified a tetraploid strain of mungbean from the USDA collection which is highly resistant to mildew and bean yellows mosaic virus.

Mr. Moheb Bashandi is studying photoperiod response of mungbean strains. Photoperiod response appears to be a major factor in genetic adaptation of strains of mungbeans to different production areas and limits the latitude at which they can be grown successfully. Mr. Bashandi has identified a strain originating from Orissa to be photoinensitive. This study will be his M.S. thesis research.

Mr. Mohamed Elmigra (a Libyan student supported by Friends of the Middle East) has completed an M.S. thesis study on the relationship between coleoptile length and culm length in crosses among standard and semidwarf wheat varieties. Most semidwarf wheat varieties have short coleoptiles which result in poor seedling emergence when planted in dry soil. This may reduce the usefulness of such wheats in rainfed areas of Libya (and Orissa).

A. Development of Teaching Competence

Teaching competence is improved by increasing the breadth of the course offerings, by increasing the depth and relevancy of specific courses, and by stimulating interest of teachers and students in the area of concentration. The USAID grant from 211(d) funds to UMC has enhanced the teaching competency of the Department of Agronomy in each of these respects.

The breadth of course offerings has been augmented by two new courses pertaining to international agronomy. During 1971-72, a seminar was developed and taught on the 'Philosophy of Extension' by Professors Faloon, Murphy, Upchurch, and Sechler. All of these men have had overseas tours in India on UMC contracts. This course was developed primarily for foreign students in Agronomy and was designed to teach the foreign student an awareness of the linkages between a successful agricultural extension program and the relevance of the research and teaching programs in an agricultural university.

A new course, Agronomy 202, International Agronomy, was developed and approved by the College of Agriculture and the Graduate School and will be taught for the first time in 1972-73. The purpose of this course is to acquaint the undergraduate student with basic differences in temperate and tropical climate agronomy.

The depth of our course offerings, with respect to the international dimension has been enhanced as a result of the 211(d) program. An example is in the plant breeding courses taught by the International Professor. This development resulted from increased perspective and experiences provided through the opportunity for travel, study, and participation in plant breeding research in India and other countries. Principles and examples in breeding of rice, wheat, sugarcane, and pulses as related to food production in underdeveloped countries are developed and illustrated with slides taken in India and other countries. Another example is in our graduate student seminars. Research being conducted with Mexican spring wheats and with the pulse crops provide new and timely knowledge, which is giving an international dimension to the graduate school teaching program.

The interest and perspective of the students has also been broadened. For example, research on the pulse crops requires the student to think about their potential areas of adaptation. Often, for the first time, he is intimately concerned about the economy of the tropical areas of the world, and considers how the climates and soils of those areas differs with the climate and soils of the areas with which he is already familiar. It leads him to read foreign journals, converse with his fellow graduate students from tropical countries, and this interest does not stop there, but permeates the interests of other graduate students not on this program. The knowledge that the student is working with a crop that is little known, and that he may have the opportunity to make some major contribution which will improve the welfare of the cultivator in an underdeveloped country, makes his research relevant and exciting, all of which provides a powerful teaching tool not available otherwise.

The Department of Agronomy is broadening its perspective and enhancing its competency by inclusion of foreign nationals on its staff. These include one Associate Professor (from England), three Visiting Professors (from Australia, Denmark, and Wales), one Post Doctoral (Italy), and two Research Associates (Taiwan). These appointments give a greater international representation to our teaching and research staff.

B. Development of Research Competence

The competence of the Department of Agronomy to participate in International Agricultural research activities continues to grow. This competence has been enhanced by the 211(d) grant since it provides an opportunity for the International Professor and his students to actively participate in and contribute to the development of wheat and pulse breeding projects in India and elsewhere.

The arrangement for cooperative research and training of graduate students at the Orissa University of Agriculture and Technology, Bhubaneswar, Orissa State, India, was reported in previous Annual Technical Reports and earlier in this report. OUAT was selected because the University of Missouri, Columbia, has an AID contract to assist with development of that Indian university. Informal cooperation was established between Dr. Poehlman and Dr. Sinha, Chairman, Department of Agricultural Botany, OUAT, with Dr. Sinha serving as the students' overseas research advisor.

(1) Research on Wheat

The third Annual Technical Report described the assistance that has been given to OUAT by the International Professor in developing a wheat breeding program for Orissa. The best breeding materials from CIMMYT and India were assembled, the major breeding objectives identified, and crosses were made in India among Mexican and Indian spring wheats and at Columbia between Mexican spring wheats and U.S. winter varieties. Segregates from these crosses are being examined both in India and Missouri. During the 1971-72 season this program was carried forward in Orissa with minimum assistance from us. Two problems identified in Orissa were studied in M.S. theses problems. Mr. Watt (supported by this project) confirmed the observation that height inheritance in a Stadler (tall winter variety) x UP 302 (dwarf Indian variety) did not follow the simple recessive gene theory popularly accepted by wheat breeders. Mr. Elmigra (support by Friends of Libya) confirmed a relationship between coleoptile and culm length in crosses of standard x semidwarf wheat varieties. The thesis research of Mr. Elmigra is another positive example of how this grant has increased competency at UMC. Mr. Elmigra wanted a thesis research problem pertaining to wheat since this is the crop with which he expects to work when he returns to Libya. With our Orissa experience we were able to identify a problem relevant to the conditions under which he will be working in Libya and to utilize germplasms that will be adapted to his production areas.

The impact of the Orissa cooperation on Missouri wheat improvement may be far-reaching also. The most exciting development has been the identification of superior semidwarf winter types coming from a cross of a three-gene dwarf spring variety from India and a winter wheat from our nursery. Previous crosses of this type have been notoriously unrewarding. Through the 211(d) program we were able to observe these advanced wheat types in an area where they were adapted and to recognize their useful characteristics. This led us to evaluate them in Missouri, even though they were unadapted, and to utilize them in the Missouri program. The three-gene dwarf parent used in this cross came to us

from India. The utilization of these wheats may necessitate our changing cultural practices for growing wheat. This is being studied in an M.S. thesis at the University of Missouri under the direction of Dr. Dale T. Sechler. Dr. Sechler also has an M.S. student studying the stability of plant characters associated with nitrogen responsiveness in wheat and a non-thesis student from Brazil studying wheat breeding procedures. All of these studies have evolved as a result of our India experiences. In the process our knowledge of wheat and its breeding potential is being broadened and our competency as plant breeders enhanced.

2. Research on mungbeans

During the current year more of our activity has been devoted to mungbeans than to wheat. In the Third Annual Technical Report the evaluation of 321 strains of mungbeans at Columbia in 1970 was reported. The results have been summarized and distributed to mungbean research workers in the U.S. and foreign countries. In 1971, 160 strains were regrown and 43 new strains tested at Columbia. The results of the 1971 tests have been summarized and distributed, also. Mr. John Yohe, a graduate student, grew these strains in Orissa, India, during the winter of 1971-72 and they will be grown again by Dr. R. C. Misra, Pulse Specialist, Orissa, during the 1972 Kharif season. As a result of a paper presented by Mr. Yohe at the annual meeting of the American Society of Agronomy, seed of strains superior in our tests have been sent to 11 locations in 8 countries.

Our experiences in Missouri, Mr. Yohe's experience in Orissa, and data sent to us by those to whom we sent seed of mungbean strains permit us to make some generalizations at this time regarding developments from the mungbean research. These follow:

(a) Basic research on this species is rather meagre, particularly regarding genetics of characteristics useful in developing a viable breeding program.

(b) Characteristics we have found useful in evaluating yield potential are plant size on which to hang a large number of pods (measured by plant height and spread of branches), number of pods, number of seeds per pod, and seed size. Adaptation to photoperiod and disease resistance are essential for the plant to reach its yield potential.

(c) Genetic diversity within the species is greater than originally reported. Most breeders in Southeast Asia are working with a very narrow range of genetic diversity, which has given rise to opinions that wide genetic diversity does not exist.

(d) Photoperiod response is an important characteristic in adaptation to particular latitudes. We doubt that we can, in the field at Columbia, identify the strains adapted to very low latitudes, or for growing during short winter months in tropical climates. Using controlled environmental chambers we have identified what appears to be a photoperiod insensitive strain.

(e) We have identified a tetraploid strain which has shown near immunity to mildew, a foliar disease, at Columbia and Orissa, and resistance to bean yellows mosaic (BYM) disease in Orissa. The latter is the most serious disease of mungbeans in India and severely limits the production of the species in that country.

In order to broaden our knowledge of the genetic adaptation of strains of the mungbean species we have organized and distributed an International Mungbean Nursery which will be grown this summer at 7 locations ranging in latitude from 10 to 49 degrees North. From the performance records of the strains at the various locations we hope to learn more about the specific adaptation of particular strains.

During the summer we will have two M.S. theses studies and two Ph.D. theses studies in progress. Three of these studies are concerned with more specific identification and inheritance of yield components in particular strains and how these may be combined into germplasm pools for distribution to mungbean breeders throughout the world. The fourth thesis is a growth chamber study of photoperiod sensitivity.

3. List of Papers and Publications

Yohe, John M. and J. M. Poehlman, 1971. Breeding Mungbeans, a Food Grain Legume in India (Abstract). Transactions, Missouri Academy of Science 5:126.

Yohe, John M. and J. M. Poehlman. 1971. Breeding mungbeans: A Food Grain Legume in India. Agronomy Abstracts, 1971 Annual Meetings, American Society of Agronomy. p. 18.

Yohe, John M., Earl E. Watt, Moheb M. H. Bashandi, Dale T. Sechler, and J. M. Poehlman, 1971. Evaluation of Mungbean Strains at Columbia, Missouri, in 1970. UMC, Dept. of Agronomy Misc. Pub. 71-4. 34 pages.

Yohe, John M., Richard E. Swindell, Earl E. Watt, Moheb M. H. Bashandi, Dale T. Sechler, and J. M. Poehlman. 1972. Evaluation of Mungbean Strains at Columbia, Missouri in 1971. UMC Dept. of Agronomy Misc. Pub. 72-9. 21 pages.

Watt, Earl E. 1972. The Inheritance of Height in Semidwarf Wheat, Triticum aestivum L. M.S. Thesis, University of Missouri, Columbia.

4. How does this Research Contribute to the Grant Objectives?

The overall objective of this grant as stated earlier is "to increase the competency of UMC to generate knowledge and render assistance in the international area of plant breeding." Using a major cereal grain, wheat, and an important and widespread grain legume, mungbeans, as the vehicles of our research efforts, we are generating new knowledge useful to the breeder of these species and assisting breeders on four continents to use it. Our thesis is that competency is developed by active participation in a program where results can be assessed, mistakes recognized and corrected, and accomplishments recorded. We believe that the results demonstrate that this project is beginning to mature and that substantial competency is being achieved.

C. TRAINING OF GRADUATE STUDENTS

During 1971-72 there were 57 graduate students in the Department of Agronomy. Of these, 18 were foreign nationals. Six were supported by AID funds; one each by Governments of Brazil, Thailand, Nigeria, and Liberia; four on Agronomy Department funds, and three on personal funds.

The International Professor served as advisor to seven of these students, four of whom (Mr. Yohe, Mr. Watt, Mr. Swindell, and Mr. Bashandi) are currently associated with this project. Their activities have been previously described as well as those of Mr. Elmigra from Libya. In addition, Dr. Praphase Weerapat, a Rockefeller scholar, received a Ph.D. degree in August of 1971 and returned to Thailand as Rice Breeder in the Thailand Ministry of Agriculture. His thesis concerned the inheritance of resistance to barley yellow dwarf virus disease in oats. Dr. W. A. Elliott completed his Ph.D. degree in June, 1972 under the supervision of Dr. Poehlman and has accepted a position as wild rice (*Zizania aquatica*) breeder in the Department of Agronomy and Plant Genetics, University of Minnesota. Dr. Elliott's thesis concerned the genetic improvement of seed size in barley. Two other recent Ph.D. graduates advised by Professor Poehlman are now in plant breeding positions. Dr. Shu-Ten Tseng (1976) is rice breeder for the Rice Growers Association, Biggs, California, and Dr. George A. Berger (1971) is developing a soybean breeding program for Northeast Arkansas State University, Jonesboro, Arkansas.

D. DEVELOPMENT OF COMPETENCE FOR CONSULTATION AND SERVICES

The 211(d) grant is making it possible for the International Professor and other members of the Department of Agronomy staff to actively participate in a wide range of consulting and service activities with International dimensions. Some examples will be cited:

Professor Poehlman was one of five Land Grant College Professors to be invited by the Romanian Ministry of Agriculture and the U.S. Department of Agriculture to visit the State Farm System of Romania and consult with Ministry officials during August of 1971. Professor and Mrs. Poehlman traveled as guests of the Romanian government and Professor Poehlman gave eight lectures on wheat and soybean improvement.

Mr. Yohe was invited to give seminars at Kasetsart University and at the Orissa University of Agriculture and Technology on his mungbean research.

Unsolicited requests of seed of superior mungbean strains have been received during the past year from nine research workers in seven countries and four continents. All of these requests have been filled.

A request was received for a list of mungbean research papers from an experiment station where library facilities on this crop were inadequate. The bibliography is in the process of preparation.

E. UNDERGIRDING OF OTHER INDIAN PROGRAMS OF CUSURDI UNIVERSITIES

Developing cross linkages among the separate 211(d) programs of the six CUSURDI universities has been difficult for several reasons:

- (a) Each university was given a separate discipline in which to focus their activities.
- (b) Although cooperation among the disciplines would be useful in certain instances, the separation of the concentration area in different universities, each of which has a different focus for its activities, makes close cooperation difficult.
- (c) The 211(d) students have gone to different institutions in India so that no overseas tie is obtained.
- (d) The size of the grant to each institution has made it necessary to make very specific and direct approaches to the problems under study and has not permitted attacking the problems on the broad interfaces which requires the interdisciplinary approach.

Many examples of the desirability of linkages may be cited for our work. For example, the need for cooperation with pathologists in regard to mungbean diseases, or the need for assistance from food and nutrition specialists on the improvement of nutritive value of the mungbean. But due to the difficulties cited above we have sought help from other specialists (both intra- and interdepartmental) in our own institution rather than from other CUSURDI institutions. This has certain advantages for it does result in a wider involvement within our own institution.

F. INVOLVEMENT OF OTHER UNIVERSITY RESOURCES IN THE 211(d) PROGRAM

The purpose of the 211(d) grant was to make it possible to initiate teaching and research in plant breeding with an international dimension at UMC and to utilize these activities to develop competency for carrying out such activities on a larger scale. A program of this nature is usually difficult to initiate and finance in a state-supported institution, but once established it will often develop into an ongoing program. The purpose here is to illustrate ways in which the University of Missouri, Columbia, and its College of Agriculture are giving support to the activities of this project. A few examples will serve as illustrations.

- (a) The University in 1971-72, for the second year, assumed one-half of the salary of the International Professor.
- (b) The College of Agriculture is funding a project on "Breeding Agricultural Crops of India" which supplements the research of the grant project.
- (c) The Agricultural Experiment Station has developed and presented to USAID a proposal for "Developing an International Mungbean Project."

(d) The services of the Agricultural Experiment Station Laboratories have been utilized to analyze protein and lysine on 126 strains of mungbeans and 17 amino acids on 53 strains.

(e) Computer service has been supplied for processing mungbean data without cost to the project.

(f) The excellent facilities of the University of Missouri Library has been utilized to develop a bibliography of mungbean literature. New books on international agronomy and plant breeding are being added by the library upon request.

(g) Facilities for field and greenhouse research and utilities and laboratory facilities for growth chamber studies are provided.

(h) Staff members of other departments as well as Agronomy Departmental staff have given freely of time and assistance for consultation on matters pertaining to diseases, nutrition, genetics, and fertilization of the mungbean.

Institutions other than the University have facilitated our program also. They include the USDA Plant Introduction section that has supplied seed of strains from the USDA collection and has identified strains that we are growing; the USDA Plant Quarantine office by facilitating the importation of seeds from other countries, the State Board of Agriculture for issuing Phytosanitary Certificates for seed being exported, and the Nitragin Company, Milwaukee, Wisconsin, for supplying root nodule inoculation without cost.

An exact dollar value on the University contribution would be difficult to calculate due to the various costs pertaining to administration and physical facilities, however, it can be safely assessed as being double that expended directly from the 211(d) grant fund.

IV. INTERNATIONAL PROGRAMS OF THE UNIVERSITY

The University of Missouri, Columbia, is developing as a strong resource for international expertise and information. Examples of activities will be cited here to demonstrate commitment in this area of education:

(1) While the International Professor was serving as Chairman of a campus-wide committee on International Programs and Studies, an "Office of International Programs" was established and a Director to coordinate the campus-wide activities employed.

(2) An Assistant Dean for International Programs has been employed recently in the College of Agriculture.

(3) The College of Agriculture has had an "Agricultural University Development Program" in India since 1956 and "Agricultural Production Promotion Projects" in Orissa and Bihar states of India. Forty-five UMC staff members have served on these projects and 140 Indian participants have received training on this campus.

(4) A strong international resource is developing in the Department of Agricultural Economics. These include:

Two courses in International Agricultural Development

One staff member recently conducted an agricultural policy seminar at Washington, D.C. for agricultural leaders in developing countries.

One staff member is currently on leave developing a book on institution building. During the past year he also participated in an Asian Agricultural university seminar in Indonesia and the North Carolina Team Leader's Handbook Seminar in Peru.

One staff member spent four months as consultant to the Nepal Government on farm management.

One staff member has just returned after serving as project specialist for the Ford Foundation in Brazil.

(5) Examples of other College of Agriculture staff who have been active in international agricultural activities during the current year include:

A forestry staff member at a world conference on forestry education in Stockholm.

A forestry staff member who served with FAO surveying forestry resources in Surinam.

An agricultural engineering staff member who consulted on agricultural engineering education at a university in Greece.

(6) UMC has long maintained a strong South Asian studies program. This is an interdisciplinary program with courses in Indian language, political science, literature, anthropology, history, and geography. An Indian national serves as resource librarian developing the South Asian collection of books for the University Library.

(7) A partial listing of other programs include:

A program to train medical technicians in South Viet Nam.

A college of education exchange program with the University of Reading, England.

A visiting professor exchange program in history with University of Saarbrücken in Germany. The first exchange of staff will be in 1972-73.

A veterinary science exchange program with Yugoslavia.

A journalism exchange program with Belgium.

V. EXPENDITURES

The original budget, actual expenditures for 1968-69, 1969-70, 1970-71, and 1971-72, and projected expenditures for 1972-73 are given below:

	<u>Original budget</u>	<u>1968-69</u>	<u>1969-70</u>	<u>1970-71</u>	<u>1971-72^a</u>	<u>1972-73^b</u>	<u>Totals</u>
Salaries	114,000	24,209 ^c	25,445	16,593	15,603	19,000	100,849 ⁵⁰
Stipends	52,000		4,229	7,300	7,223	12,000	30,755 ²
Travel	21,000	986	1,217	1,367	8,860	10,920	12,502 ^{23,350}
Equipment, supplies, misc.	13,000	9	236	11,825	3,068 ^d	6,000	21,136 ⁸
SUBTOTALS	200,000	25,204	31,127	37,085	34,754	47,920	176,090
International tickets purchased but not charged to account (estimated)							4,843
TOTALS	200,000						180,933
Estimated balance at end of May 31, 1973							19,067

^a The expenditures for 1971-72 are for the 11-month period July 1, 1971 through May 31, 1972 to conform with the new reporting period requested in letter of May 5, 1972 from Wm. H. Naylor, Jr.

^b Estimated for period June 1, 1972, through May 31, 1973.

^c Stipends paid in 1968-69 are included in this item.

^d Equipment, supplies and miscellaneous:

(1) Equipment purchased in 1971-72 with cost in excess of \$100: None

(2) This item includes cost of chemical analyses of mungbean samples which was \$2,198.

VI. WORK PLAN AND BUDGET FOR 1972-73, 1973-74

1. Plans for 1972-73

Recent events in India make it necessary to change our original plans for sending students to India to conduct thesis research. Mr. Earl Watt had requested admission to OUAT and it was planned that he spend the period September, 1972 through May, 1973, in India. The International Professor plans to travel to Thailand, the Philippines, and other Southeastern Asia countries conducting research on mungbeans in August and September to develop arrangements for Mr. Watt to conduct research on his thesis problem. Our preference would be for him to go to Thailand and we believe suitable arrangements may be made through the Rice Department, Ministry of Agriculture, or through Kasetsart University in Bangkok.

Mr. John Yohe will continue his thesis research on plant type in mungbeans at Columbia, Missouri, during the summer of 1972 with probable completion date of his Ph.D. program in May, 1973.

Mr. Moheb Bashandi will continue his M.S. thesis on the photoperiod sensitivity in mungbeans with probable completion date of January, 1973.

Mr. Richard Swindell will conduct thesis research on yield components in mungbeans during the summer of 1972 with probable completion date of May, 1973.

We will continue the cooperative nursery program on evaluation of mungbean strains with Thailand, Philippines, Korea, Canada, Colombia, Nigeria, and Ethiopia and on basic studies to learn more about the characteristics of the mungbean plant that affects its adaptation and production in different areas of the world. This research will be used as the vehicle for involvement in a plant breeding program with international dimensions.

2. Plans for 1973-74

A request has been made to AID for permission to move forward the date for termination of the grant from May 31, 1973 to May 31, 1974. This change is being requested because the sudden termination of the work in India is causing us to make adjustments in the program. While we are expecting that plans may be completed for Mr. Watt to go to Thailand during 1972-73 to conduct the research that had been planned for India, these plans have not been completed at this time. Should we be unable to get these completed for Mr. Watt to grow his thesis materials in Thailand during the months optimal for his experiment, it might be necessary for him to wait until 1973-74.

Also, we would like to send Mr. Richard Swindell to Thailand or the Philippines for conducting research during 1973-74. The 1972-73 budget as planned would leave about \$19,000 unspent which could be utilized for his expenses during 1973-74.

The proposed budget for 1973-74 is as follows:

	<u>1973-74</u>
Salaries	5,800
Stipends	4,200
Travel	7,000
Equipment, supplies and miscellaneous	2,067
TOTAL	<u>19,067</u>

Table I

Distribution of 211(d) Grant Funds and Contributions From Other Sources of Funding*
 Review Period July 1, 1971 to June 30, 1972

Grant related	211(d) Expenditures				Non 211(d) Funding amount
	Period Under Review	Cumulative Total	Projected Next Year	Projected to end of Grant	
Research	14,754	63,013	20,920	20,920	
Teaching	24,000	70,000	27,000	27,000	
Total					

* These figures are your best estimates

Table II

Expenditure Report

(Actual and Projected)

Under Institutional Grant #AID/csd - 1921

Review Period July 1, 1971 to June 30, 1972

(Line Items to Conform to Budget in Grant Document)	Expenditures to Date		Projected expenditures Year 5	Total
	Period Under Review	Cumulative Total		
Salaries	15,603	81,850	19,000	100,850
Stipends	7,223	18,752	12,000	30,752
Travel	8,860	17,273	10,920	28,193
Equipment, supplies and miscellaneous	3,068	15,138	6,000	21,138
			Total	180,933
Estimated Balance at end of May 31, 1973				19,067
			Total	200,000

THE OHIO STATE UNIVERSITY

COLLEGE OF AGRICULTURE AND
HOME ECONOMICS

DEPARTMENT OF AGRONOMY

ANNUAL TECHNICAL REPORT OF 211 (d) PROJECT

CONTRACT AID/csd - 1928

July 1, 1971-June 30, 1972

Supplementary material called for in the AID
"Guidelines" appears as Appendix 2, pp. 87-90.

Title: SOIL-PLANT-WATER RELATIONS

September 1, 1972

Grantee: Agronomy Dept., The Ohio State University, Columbus, Ohio

Director: Dr. Trevor G. Arscott

A. Statistical Summary:

Period of Grant: July 1, 1968 to July 1, 1973. Amount of Grant \$200,000.
Expenditures for Report Year \$43,142.36. Accumulated \$131,142.26.
Anticipated for next year \$35,500.

B. Narrative Summary:

- (1) Three research assistants assigned to India successfully completed their theses research. Two assistants were assigned to the Soils Dept., Punjab Agricultural University, and the third one was assigned to the Soils Dept. at Mysore University of Agricultural Sciences. Each assistant was actively engaged in mineral nutrition of plants, and two assistants conducted field-plot experiments.

Two members of our resident faculty became significantly involved in research on soils from that country. Our soil mineralogist is investigating the clay mineralogy of some major soil categories of India soils; and our specialist in soil genesis is making certain physical and chemical analyses of these same soils. The information being obtained by these investigators is generally lacking on soils of the developing countries.

- (2) The most significant accomplishment during the grant has been the development of expertise and capability in international agriculture in the area of soil-plant-water relations. This is being accomplished by two principal means: The first was the establishment of two professorships in international agriculture, one supported by AID 211 (d) grant funds and the other by University sources. These professors devote most time to teaching, research and administrative duties in soil-plant-water relations. The second was the increased involvement of other resident faculty members in research and teaching of the same subject area. The latter has been particularly aided in two ways. One is the AID 211 (d) project support of research assistants, who participate in research abroad under the supervision of faculty advisors. The second means is the interest in world agriculture that is generated among faculty members because of greater exposure to conditions abroad. Greater exposure has been possible because of visitations by international scholars and as a result of overseas consultantships and AID assignments.

The Department of Agronomy has strengthened its teaching program by initiating two courses on crops and soils of the tropical and subtropical regions. These represent eight quarter-hour credits for advanced undergraduate and graduate students. Student interest in these courses is high and enrollment continues to be firm. Another significant accomplishment is the continued injection of international components into our regular course offerings in crops and soils. These components are added because subject matter cannot be given a thorough treatment without them. The major incentive for course modifications is greater exposure of teaching faculty to world agriculture. Our research program has been greatly enhanced by the initiation of research on tropical soils by six of its resident faculty. Emphasis has been placed on clay mineralogy identification and on soil characterization by specialized laboratory facilities that are not readily available in developing countries.

THE OHIO STATE UNIVERSITY
211(d) PROJECT

SOIL-PLANT-WATER RELATIONS

I. SUMMARY

The objective of The Ohio State University program is to develop an expertise and capability in international agriculture in the area of Agronomy, specifically soil-plant-water relationships. The educational role of the University is pursued through the involvement of its faculty in research and teaching in the international sector. The College of Agriculture continues to support the 211 (d) program in soil-plant-water relations, and the University expanded its overall involvement in international activities during the year.

The greatest single activity during the year was the thesis studies of three research assistants assigned to India. The major objective of this activity was to provide greater faculty involvement in foreign agricultural research through the work of graduate advisees. After making prior arrangements with appropriate Indian university faculty, two assistants were assigned to the Soils Department, Punjab Agricultural University, and the third assistant was assigned to Mysore University of Agricultural Science. They will return to the campus by September 1972. Each assistant has been actively engaged in mineral nutrition of plants, and two assistants conducted field-plot experiments with wheat. There are many indications that their programs were quite successful.

As a direct consequence of the research assistant programs in India, two of our resident faculty are significantly involved in research on soils from that country. Our soil mineralogist is making extensive investigations on the clay mineralogy of some major soil categories of India soils, and our specialist in soil genesis is making certain physical and chemical analyses on these same soils. The information being obtained by these investigators is generally lacking in soils of the developing countries, and these data can be used to properly classify the soils in accordance with known physical, chemical and mineralogical data.

We have strengthened our recently-initiated courses on "Crop Production in the Developing Countries" and "Tropical and Subtropical Soils." These two courses deal primarily with crops and soils of tropical and subtropical regions. Student interest in these courses remains high. During 1971, we made valuable additions to teaching aids and accumulated a tropical soils monolith series. A third course, "Agroclimatology", was introduced in 1971 with a considerable input of international agriculture. Much of this course is devoted to world climates and their significance in crop production and soil management.

Perhaps the most significant (but less visible) advance in teaching competence is the continued injection of international components into our regular course offerings in crops and soils. These components are not added because of any formal effort to recognize soil and crop management in other parts of the world but because subject matter cannot be given a thorough

treatment without them. The major incentive for course modifications appears to be greater exposure of teaching faculty to world agriculture.

Our 211 (d) grant program sponsored a study visitation of one faculty member to a tropical country and another to a symposium on aquatic weed control. The program also assisted in bringing an eminent soil scientist to the campus for a series of lectures. Three other internationally-known agricultural scientists were visiting lecturers during the year.

The 211 (d) professor visited the three research assistants in India and consulted with their Indian advisers. He also visited with scientists of the Indian Salinity Institute and gave a lecture at Mysore University of Agricultural Sciences. Stop-over visits were made at the Agricultural Engineering and Soils Laboratory in Thailand and at the University of Thessalonika.

For the coming year, emphasis will be placed on completing the research studies of three research assistants in India. Two guest lecturers are being invited to discuss research in lesser developed countries. A symposium on soil-plant-water relations in the developing countries is also being planned. We are asking for a 2-year extension of the project beyond 1973 in order to utilize about \$33,000 in carryover funds.

II. OBJECTIVES

The objective of the 211 (d) program is to develop within the Ohio State University an expertise and capability in international agriculture in the area of Agronomy, specifically soil-plant-water relationships. The program encourages professional interest and involvement of appropriate faculty in foreign agriculture. The educational role of the University is pursued through the continued involvement of its faculty in research and teaching in the international sector. This involvement permits the University to acquire and disseminate new knowledge and to develop internationally-trained personnel. To fulfill its objective the University is gaining research experience in India, establishing working relationships with Indian agronomists and acquiring knowledge of the agriculture of a developing country.

III. MAJOR ACCOMPLISHMENTS

A. Development of Teaching Competence

1. We have continued to strengthen our recently-initiated courses on "Crop Production in the Developing Countries" and "Tropical and Subtropical Soils". These courses represent 8 quarter-hour credits for advanced undergraduate and graduate students. The courses deal primarily with crops and soils of the tropical and subtropical regions and were introduced to extend the international aspects of the Agronomy Department's instructional program. We have made valuable additions to the visual aids, including a goodly number of color slides showing crops and soils from many countries. We are also

accumulating a soil monolith series to represent soils of tropical and subtrpical regions. Three monoliths were received from the State of Hawaii during 1971, being accompanied by a suitable slide set and other descriptive material.

As with all courses, the success of these also depends on the quality of instruction. We are most fortunate to have excellent teachers for these courses, and student interest remains high. The crop production course is taught by Dr. L. D. Bayer, who was Research Administrator for the Hawaiian Sugar Planters Association for 20 years. More recently he was on a 2-year AID assignment in India as Chief-of-Party. The soils course is taught by our 211 (d) professor, who has ten years' research experience in Central America.

2. A third course was initiated in 1971 with a considerable input of international agriculture. This is "Agroclimatology", a graduate-level, 3 quarter-hour-course taught by Dr. Bayer. Much of this course is devoted to world climates and their significances in crop production and soil management. A total of 28 students registered for this course during its initial offering. A visiting climatologist from India, Dr. H. S. Mavi, was particularly helpful in gathering pertinent climatological data on monsoon areas of Asia.

3. Perhaps the most significant (but less visible) advance during the year was the continued injection of international components into our regular course offerings in crops and soils. In many instances the new component is the addition of illustrative subject matter taken from various countries. For example, the instructor in Soil Physics describes management practices on alkali-saline soils in the Punjab to illustrate the undesirable effects of high sodium and salt contents of soil. These components are not added because of any formal effort to recognize soil and crop management in other parts of the world. Rather, the additions are made because subject matter cannot be given a thorough treatment without the international component. This is a direct result of the technological developments in the agronomic field on a world basis. Thus courses dealing with grain production would be considered incomplete without emphasis being placed on the breeding and cultural practices being performed in other countries.

The incentives for such course modifications are varied, but the common denominator is greater exposure of faculty members to world agriculture. The University AID contract programs have made possible the direct involvement of many faculty members by overseas assignments. The AID 211 (d) grant program has been most helpful in encouraging on-campus participation in foreign agriculture. The latter program links home campus activity with overseas research by sponsoring research assistants who do most of their thesis work in a developing country; bringing foreign scientists to the campus; and by sponsoring travel of teaching faculty for study, visitation, and symposia on foreign agriculture.

4. In the course entitled "Under graduate Seminar", we have continued the special section to familiarize upper class undergraduates with the potentials, opportunities, requirements and rewards of international agronomy. This section is under the direction of the AID 211 (d) professor.

5. Library acquisitions pertaining to international agronomy have continued throughout the year. Emphasis has been placed on information from India. Special lists of the government of India's newly-released reports are received monthly and the appropriate publications ordered. These books and scientific articles are added to the Agronomy Library India shelf.

6. The Agronomy Department and the 211 (d) grant program were honored to jointly support a series of five seminars in 1971 by the eminent soil scientist, Dr. Hans Jenny. This scientist is a pioneer in soil genesis and chemistry in America, and he is particularly qualified to bring his international experience to bear on soils of the world. These seminars were attended by some 35 graduate students and 20 faculty members.

During the year, three other internationally-renowned agricultural scientists have acted as visiting lecturers to the College. All three scientists were able to spend time with students and faculty members and to emphasize the international aspects of their particular specialties. These included Dr. Douglas Ensminger, economist with the Ford Foundation in India for 19 years; Prof. G. Wallace Giles, engineer with the Ford Foundation for 5 years; and Dr. Morris A. Huberman, forester and division chief, United Nations Development Program. In the forthcoming year, arrangements have been made to sponsor a seminar lecture on reclamation of alkali-saline soils of the Indo-Gangetic Plain by Dr. I.P. Abrol of the Central Government Salinity Institute at Karnal, India.

B. Development of Research Competence

1. The major thrust during 1971 was the AID 211 (d) sponsorship of three American research assistants to do thesis research in India. The primary objective of this activity is to provide greater faculty involvement in foreign agricultural research through the work of graduate advisees. A second objective is to accumulate greater knowledge of soil-plant-water relations in a developing country like India. Each of the assistants is now completing a one-year assignment and will return by September 1, 1972. Two assistants are stationed at Ludhiana (Punjab), while the remaining one is stationed at Bangalore (Mysore). The two assistants in the Punjab are primarily supported by AID rupee funds. Prior arrangements were made by the 211 (d) professor for Indian university faculty to serve as advisors during their stay in India. While a more thorough analysis of their activities will be made when they return, there are many indications that their programs are quite successful.

Mr. Gary Alsdorf is one of the assistants in the Punjab. He is doing laboratory and field-plot research on the role of zinc in soils and plants. The Soils Department Chairman of Punjab Agricultural University, Dr. N.S. Randhawa, serves as his advisor. Mr. Alsdorf has worked closely with scientists at the Indian Central Government Salinity Institute at Karnal. He was instrumental in establishing a laboratory at Ludhiana for zinc determinations in soils and plants. A very complimentary letter has been received from the Department of Soils' Chairman concerning Mr. Alsdorf's contribution to their research program in minor elements.

The research area studied by Mr. Alsdorf is of considerable practical interest to many areas of India. Zinc deficiency in crops is merging as a major problem in the sandy-textured and alkaline soils of the Indo-Gangetic Plain. The deficiency is more prevalent where multi-cropping is practiced, suggesting that zinc is being mined from these soils by crop removal of this element. Thus the problem is likely to advance into regions where the "green revolution" has been most successful.

Mr. Alsdorf has been investigating zinc availability to crops from different soils. Emphasis has been placed on the role of soil organic matter since much of the available zinc is associated with organic compounds. Several researchers report that a significant amount (25% at least) of zinc applied to soil organic matter is not extractable and thus not available to plants. The mechanism of this reaction has not been fully elucidated. The moisture regime in soils is important, since researchers have shown that drying of soil significantly affects zinc extraction. Mr. Alsdorf has collected soils from Punjab, Himachal Pradesh and Madhya Pradesh states. These soils represent large differences in clay mineralogy, organic content, pH and salt content. He has imposed different moisture regimes and organic matter additions to the soils and is extracting zinc with different chemical solutions. Except for occasional difficulties with instrument operations, the work is progressing very well.

Mr. Thomas Stilwell is the second assistant at Ludhiana, and he is conducting research on potassium release and crop uptake from soils of the Punjab. He has a distinct advantage in his assignment, since he is quite familiar with Indian culture and speaks Hindi as a result of an earlier Peace Corps stay in Uttar Pradesh. His Indian advisor has been Dr. G. S. Sekhon, Associate Chairman of the Soils Department. He has initiated field-plot experiments with wheat on six different sites in Punjab state. The experimental variables are N, P and several rates of K applications. An appropriate experimental design has been used for the plot layout. The wheat has been harvested in all experiments and some plant samples are being returned to the USA for analyses that cannot be done conveniently in India. A preliminary analysis has shown a positive wheat yield response to potassium levels at all sites.

The impetus for Mr. Stilwell's work is that many crops do not respond to potassium applications in some Punjab soils, even though these soils show low levels of this element. X-ray diffraction studies have shown these soils to be high in micas, and potassium may be weathering out during the cropping period. Chemical and X-ray analyses of soil samples from the Punjab were previously started at the Ohio State University. In addition to various chemical analyses of the soils studied, he will obtain the uptake of some 17 essential elements by wheat plants.

The third assistant is Mr. George T. Kaiser, whose Indian advisor is Dr. N. G. Perur, Chairman of the Soils Department, Mysore University of Agricultural Sciences. Mr. Kaiser is evaluating phosphorus extraction procedures as an index for crop yields in an on-going, soil-test and plant-yield correlation study. His previous research has involved a comparison of the Mehta and the S.A.H.T. ignition methods for evaluating organic phosphorus levels. He has established several field plot experiments in India to evaluate different phosphorus levels on growth and yield of wheat. These plots have now

been harvested and pertinent growth and yield data recorded. Some supplemental data of the soils and plant materials will be obtained from samples that are being returned to Ohio. These data will include X-ray diffraction patterns of the soils and the concentration of essential elements in the plant materials.

2. As a direct consequence of the activities of our three research assistants in India, two of our residence faculty are significantly involved in research on soils from that country. Our soil mineralogist, Dr. L. P. Wilding, is currently determining the concentration of vermiculite, kaolinite, montmorillonite, and illite minerals in soils of this country. These soils were previously selected by Indian soil scientists and the 211 (d) professor to represent some major soil categories. They include sites from Punjab, Himachal Pradesh, Madhya Pradesh and Mysore states. This type of information is generally lacking in soils of the developing countries, and these data will be of particular value to Indian soil scientists. These findings will give much insight into proper fertilization and management of these soils, since research data on similar soils at different world locations can be utilized more effectively.

Our specialist in soil genesis, Dr. N. Holowaychuk, is studying various chemical and physical analyses of the same soil samples. He is currently making such determinations as particle (grain) size analysis, pH, sodium and total salt contents, organic matter and exchangeable ions. A primary use of these data is to properly classify the soils in accordance with known physical, chemical and mineralogical data. Again, a correct soil classification will permit use of data collected on similar soils throughout the world.

3. Publications. A master of science thesis was published on zinc relations in soil. The author is continuing this work while on assignment in India. This publication is as follows: D. Gary Alsdorf, M.S. 1971. Ohio State University. The Influence of Coordination Bond Geometry and Drying Temperatures on Zinc Retention by Soil.

C. Training of Graduate Students

[Covered under A and B]

D. Development of Competence for Consultation Service

1. The 211 (d) professor continues active participation in the College's International Affairs Advisory Committee. This committee works in concert with the University's Office of International Agricultural Affairs. During 1971 the committee worked out a procedure for more effective use of foreign scientists and educators who speak on campus. The committee is currently deliberating means for improving foreign academic study programs and group study tours. The 211 (d) professor is called upon frequently to contribute his knowledge in the international area and serves as a subcommittee chairman on group study tours in the crop and soil science areas.

2. The 211 (d) grant program sponsored a stopover of one of Ohio State's soils professors, Dr. George Hall, to study tropical soils in Hawaii. Dr. Hall teaches and does research in soil genesis and classification and is currently on a 2-year OSU/AID assignment in India. During his 5-day visit he made field identification tours; reviewed laboratory data of soil chemicals, physical and mineralogical properties and discussed classification schemes for tropical soils. Previous to this study visit, Dr. Hall had not had the opportunity to study tropical soils in their natural environments.

3. The 211 (d) grant program also sponsored the travel of one of OSU's agronomy professors, Dr. Donald Herr, to a symposium on Control of Water Hyacinth (Eichornia crassipes) in Florida. Dr. Herr teaches crop science to some 300 agricultural students each year and does research in weed control. He had a year's research experience on aquatic weed control in irrigation canals in India under OSU/AID program. Water hyacinth is causing tremendous problems in Southeastern United States and in many tropical areas of the world. The primary purposes for supporting travel to the symposium was to increase Dr. Herr's expertise and to continue his interest in this area of study.

4. The 211 (d) grant program sponsored travel of the 211 (d) professor to India for consultation with the three research assistants on one-year assignments in that country and with cooperating Indian scientists. Stopover visits were made at the University of Hawaii, the Agricultural Engineering and Soils Laboratory in Bangkok and the Land Development, Irrigation, Drainage and Reclamation Center at the Aristotelian University of Thessalonika. This faculty member teaches courses in soil physics and does research in land drainage. He had previously been on two short-term AID assignments in India, and this trip permitted him to become better informed on current developments and trends in Indian research in soils and crops. Dr. Taylor met with scientists at the Central Government Salinity Institute and was appraised of their current research on reclamation of saline and alkali soil. He also gave a seminar at the Mysore University of Agricultural Sciences on drainage research in the humid, temperate region.

The stopover visit in Thailand permitted the 211 (d) professor to study water management practices under monsoon conditions. He was ably assisted by Dr. Bunyut Vimokesant of the Pathumtani College of Agriculture in Bangkok. He observed drainage and irrigation practices in the Bangkok Plains, these practices being based on the extensive use of canals and dikes. Most of these structures are several hundred years old and were constructed almost entirely by hand tools and animal power. Until recently the only pumps used had low-lift capacity and were powered by man or wind. The system of canals and dikes are still operated essentially as they were a hundred years ago. In essence the canals and smaller ditches act not only as drains but also as storages of flood water for crop irrigation. The entire system operates in a location where adequate drainage during monsoon rains is economically impossible. A modification of this system may have useful application in other monsoon areas of nearly-level topography.

A two-day visit into the interior of Thailand also gave him an opportunity to study land development for agriculture in the jungle areas. These are areas of rolling topography and soils of excessive drainage. Much of the land is now in forest and clearing of the jungle vegetation requires heavy equipment. To obtain a better perspective of equipment facilities, he made two visits to the School for Machinery Operators, Department of Vocational Education. These

visits were particularly useful for gaining an insight into the internal organization for meeting both technical and manpower needs in a developing country.

A brief visit to the University of Hawaii gave an opportunity to visit with soil scientists and to discuss some recent fertility research on well-drained tropical soils. Dr. Goro Uehara, of that institution, gave a thorough briefing on soils of Thailand. A visit with Dr. George Terzides in Thessalonika gave good insight into land management research and teaching in the Mediterranean area. The rugged topography of Greece restricts much of the land to grazing for sheep. Intensive agriculture is limited to the plains, and these occupy only a small percentage of the land surface. Some irrigation of crops is done, and the development of water supplies is a major need.

E. Interactions with Other CUSURDI Institutions (Council of United States Universities for Rural Development in India)

1. One Ohio State University research assistant is doing his thesis research in Mysore State, India, where the University of Tennessee has an AID contract team. His study will provide information on phosphorus release from soil and uptake by wheat. The clay mineralogy of these soils is being identified, and quantitative estimates of the important clay minerals are being made. These data will be made available to the University of Tennessee 211 (d) professor and other CUSURDI institutions.

2. Another Ohio State University research assistant is doing zinc research on soils from the Punjab, Himachal Pradesh and Madhya Pradesh. The clay mineralogy is also being identified. Again, these data will be made available to the Illinois 211 (d) professor and to other CUSURDI institutions.

F. Involvement of Other University Resources

The funds provided by the 211 (d) grant are important but are not adequate to cover a complete program in International soil-plant-water relations. Many other parts of the Ohio State University provide either direct or indirect support to the program during the past year.

Administrative services and coordinator were provided by the Office of International Affairs of the College of Agriculture and Home Economics. This provided for logical tie-in and complementary relationships with other international agricultural programs. The University business offices handled all of the financial services for the program. The regular administrative structure of the Department of Agronomy, the College, and the University provided services, without reimbursement for their costs.

All of the facilities of the Ohio State University, including offices, classrooms, laboratories, greenhouses, and equipment were provided by the University.

Considerable extra financial support was provided directly for the field of International Soil-Plant-Water Relations through the Department of Agronomy by the College of Agriculture and Home Economics, and the Ohio Agricultural Research and Development Center, particularly for faculty salaries, visiting professors, graduate research assistants, research funds, secretarial help, teaching materials, office supplies, and equipment. This direct support to the program was estimated to amount to \$25,000 during the last year.

IV. INTERNATIONAL PROGRAMS OF THE OHIO STATE UNIVERSITY

The Ohio State University continues to develop the international dimension throughout the University. Generally, emphasis is given to area study programs, and study abroad, especially study tours. Encouragement is given to the various units in the University for faculty to engage in research and study abroad.

The College of Agriculture and Home Economics, through its Office of International Affairs, administers many international programs and works with all departments of Agriculture and Home Economics and Natural Resources in the development of international programs and the international competence of the faculty.

In the last year the College has continued programs supported by US/AID, mainly in Foreign Agricultural University development in India, Brazil and Uganda. On these programs about 30 OSU faculty were abroad and about 60 foreign faculty were programmed by OSU in the United States during the last year.

The Department of Agricultural Engineering continued a program in India supported by Ford Foundation. This consisted of sending a few OSU faculty abroad and bringing some to OSU from India for study.

The Department of Agricultural Economics and Rural Sociology has an AID-supported research project on Capital Formation in Agriculture, with the center of work being Brazil, and this has involved a number of OSU faculty.

The 211 (d) program in Soil-Plant-Water relations is in the Department of Agronomy. In the last year, it has involved at least four faculty members and 3 graduate students directly, but it benefits the entire department and the college.

The College has had a Peace Corps (ACTION) intern training program during the last year with emphasis on India and Tunisia.

A number of the OSU faculty in Agriculture have been consultants in foreign countries for various agencies or have participated in international meetings in foreign countries during the last year.

About 15 courses on International Agriculture and Rural Development have been developed in the College. The College offers a curriculum for undergraduates in International Agriculture. A number of graduate students

from the United States in the various professional areas have tailored programs of study preparing them for an international career.

The College has developed a program of graduate students studying abroad during the last few years. During the last academic year, two undergraduate students were studying in India and three in Brazil, and 3 graduate students were in India.

Last year the College programmed many foreign visitors from many countries in Agriculture in Ohio. Among them were 13 farmers from India for six weeks.

About 135 foreign graduate students were enrolled in the College of Agriculture and Home Economics during the last year.

The College has an International Advisory Committee of faculty with all departments, schools, and units of the teaching, research, and extension represented.

V. EXPENDITURES

The expenditures for each year of the grant through June 30, 1972, are shown in the table on the following page. Total expenditures as of June 30, 1972, were \$131,142.26. The expenditure for 1971-72 was \$43,142.36. Of this amount, approximately \$2,800.00 represents international travel for which the project has not yet been billed. Higher expenditures occurred in 1971-72 because of the international travel of one research assistant in India and because of per diem, travel and research supplies of this assistant while in India. In addition, the international travel cost of the 211 (d) professor's trips to India in 1969, 1970, and 1971, was not previously listed as an expenditure for those years.

The expenditures for 1971-72 are shown in detail in the Appendix, and these were as follows: Except for a \$200 honorarium, the salaries and retirement category represents the salary of the 211 (d) professor. The graduate students' expenditure of \$7550 is the stipend paid three research assistants. These stipends were lower in 1972-73 since the assistants were receiving per diem allowances while in India. Two of the assistants were receiving USAID rupee funds for per diem, travel and research expenses while in India. The third assistant was paid for these expenses from the 211 (d) grant. The total travel expenditure was \$14,966.63, of which \$2,800 represent international travel to India that has not yet been billed to the 211 (d) project. The latter amount is for travel of the 211 (d) professor during 1971 and 1972. Of the amount billed in 1971-72, approximately \$5,400 was for international travel to India for the 211 (d) professor in 1969 and 1970, and for one research assistant and his wife during 1971. Approximately, \$4,400 was for per diem expense of one research assistant while in India. The expenditure of \$729.17 was for travel within India for purposes of conducting field plot research at different locations in Mysore state. The per diem expenditure of \$728.75 was for the 211 (d) professor's visit to India and for stopovers in

EXPENDITURES

CONTRACT AID/csd - 1928 (OHIO)

Category	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75**
Salaries and Retirement	\$16,238.86	\$19,402.62	\$21,776.24	\$18,375.70	\$22,000.00	\$22,000.00	\$200.00
Graduate Students	--	11,700.00	12,600.00	7,550.00	10,500.00	4,500.00	4,500.00
Travel	1,159.02	1,394.28	2,366.52	12,166.63 2,800.00*	1,500.00	500.00	200.00
Equipment	--	--	812.51	861.56	500.00	500.00	200.00
Miscellaneous	<u>35.30</u>	<u>269.81</u>	<u>244.74</u>	<u>1,388.47</u>	<u>1,000.00</u>	<u>500.00</u>	<u>257.74</u>
Annual Totals	\$17,433.18	\$32,766.71	\$37,800.01	\$43,142.36	\$35,500.00	\$28,000.00	\$5,357.74
Cumulative Totals	\$17,433.18	\$50,199.89	\$87,999.90	\$131,142.26	\$166,642.26	\$194,642.26	\$200,000.00

*Cost for international travel not yet billed to this project (estimated).

**A two-year time extension will be requested for 1973-75.

Statement as of June 30, 1972

Hawaii, Thailand and Greece. The expenses for attending the CUSURDI annual meeting in Washington was \$448.65. Local travel expenses of \$30.50 were for a study tour for a visiting soil scientist from Malaysia. The expenditure of \$227.73 was for a study-visitation in Hawaii of Dr. George Hall, a faculty member in the Department of Agronomy. The expenditure of \$218.84 was for another faculty member of the Department of Agronomy to attend a symposium on aquatic weed control in Florida.

The equipment category expenditure was \$861.56, and all of the purchases were from U.S. sources. The soil monoliths will be used for teaching purposes in the course, "Tropical and Subtropical Soils." The part for the Briggs and Stratton engine and the soil probes were for use of the research assistants in India; while the amplifier circuit and nitrate electrode were purchased in order to complement the soils research facilities in the Department of Agronomy. The books and educational supplies were purchased for use in the Agronomy library. The largest expense in the miscellaneous category was for chemicals and other research supplies of one research assistant in India.

VI. WORK PLAN AND BUDGET FOR 1972-73

The 211 (d) professor will continue to teach courses on tropical soils and to coordinate work under the grant. Additional soil monoliths will be procured to assist in teaching the course, "Tropical and Subtropical Soils." A one-week international seminar is being planned for the coming year. This was scheduled for the previous year but had to be postponed. This seminar will attempt to bring two or three internationally well-known agriculturalists to the campus to extend the international interests of the Department and College. Some funds will be used to support these speakers. Costs for sponsoring this seminar are reflected in the miscellaneous and travel categories of the budget for next year.

The three research assistants will be completing their Indian research during the coming year. Two are expected to obtain Ph.D. degrees and terminate their work under the 211 (d) program. The third assistant will obtain an M.S. degree and continue his graduate studies under the 211 (d) program.

With a favorable indication for the continuation of the grant beyond 1973, plans could now be made for involving additional research assistants in the program. If indications are unfavorable, no new assistants will be appointed.

The projected budgetary requirements for the coming year are as follows:

Salaries and retirement	\$22,000
Graduate student stipend	10,500
Travel	1,500
Equipment	500
Miscellaneous	<u>1,000</u>
Total	\$35,500

This budget is projected on the basis that the project will not be renewed after June 30, 1972. Otherwise, the budget for graduate student stipend would be much larger.

Should a decision be made in the near future, to continue the 211 (d) program beyond its present date of termination, additional funding to the extent of \$200,000 has been requested in a separate proposal.

A request is now being made to extend the 211 (d) grant period for two years beyond June 30, 1973. No additional funding is requested for this extension.

APPENDIX I.

Expenditures for Year 1971-72

Salaries and Retirement

Salary and retirement for 211 (d) professor	\$18,175.70
Honorarium to Professor Hans Jenny	<u>200.00</u>
Total	\$18,375.70

Graduate Students

Stipends, Graduate Research Associates:	
D. Gary Alsdorf	2,400.00
George T. Kaiser	2,750.00
Thomas J. Stilwell	<u>2,400.00</u>
Total	\$7,550.00

Travel

1. India travel and stopover visits of 211 (d) professor	
Per diem and ground transportation	728.75
International travel	1,400.00 *
2. Annual meeting 211 (d) project - in Washington	
(4 persons)	448.65
Local travel (in state) of 211 (d) professor	30.50
3. Symposia on "Aquatic Weed Control"	
(Dr. Donald Herr, participant)	218.84
4. Stopover visit in Hawaii	
(Dr. George F. Hall, participant)	227.73
5. Research Assistant travel in India (Thesis research)	729.17
6. India per diem for Research Assistant in India	4,415.87
7. International travel of Research Assistant in India	
Per diem	347.45
International Travel (includes wife)	2,418.09
8. "Mission Payments" for International travel in India	
for 211 (d) professor (Years 1969 and 1970)	2,601.58

Appendix page 2

9. 1971 International travel of 211 (d) professor in India \$1400.00*

Travel Totals \$12,166.63
2,800.00*

GRAND TOTAL for Travel \$14,966.63

*Cost of International travel not yet billed to this project.

Equipment

3 Soil Monoliths 500.01
Part for Briggs and Stratton Engine 26.12
3 soil probes 7.00
Amplifier circuit (Bausch and Lomb) 35.00
Nitrate electrode (A.H. Thomas & Co.) 195.00
Books and educational supplied (Campus Bookstore) 69.83
Water Information Center Books 28.00

Total \$861.56

Miscellaneous

Passport, inoculation for 211 (d) professor 88.82

Research Assistants' expenses for chemicals and
supplies in India 1,126.81

Office supplies, long-distance telephone calls,
cablegrams 147.84

Registration fee for Symposia (Dr. D. Herr, Participant) 25.00

Total \$1,388.47

GRAND TOTAL for year 1971-72 \$43,142.36

Appendix 2. Supplementary Material Required by the "Guidelines."

VI. Other Resources for Grant-Related Activities

- a. One faculty member devotes essentially full time to courses on tropical crops and soils and on a course in world climates. This member is in addition to the 211 (d) professor. The value of this contribution to the teaching program is approximately \$20,000.
- b. Some ten faculty members in the Department of Agronomy advise foreign students on research and course curricula that are pertinent to tropical crops and soils. The value of faculty time devoted to these activities is estimated at \$10,000.
- c. The University sponsors many visiting scholars, who have spent considerable time in the developing countries. Library acquisitions of research periodicals from different world regions are also made available. Faculties from departments other than Agronomy advise foreign students on subjects pertinent to tropical crops (Horticulture Department), to mechanization in developing countries (Agricultural Engineering) and to marketing and credit in the lesser developed nations (Agricultural Economics). The approximate contribution is \$5,000.
- d. The University gives direct support to the 211 (d) program by providing at no expense the following: office space, telephone service, laboratories, secretarial help, teaching materials, office supplies and equipment. The University Business Office administers, without charge, all 211 (d) funds, processes requisitions, etc., and keeps all pertinent records. The estimated value of these services is \$25,000.

Table I

Distribution of 211(d) Grant Funds and Contributions From Other Sources of Funding*

Review Period July 1, 1971 to July 1, 1972

OHIO
AID csd-1928
1971-72

(List all grant related activities)	Period Under Review	211(d) Expenditures			Non 211(d) Funding Amount
		Cumulative Total	Projected Next Year	Projected to end of Grant	
e.g. Research	\$23,000	\$56,000	\$16,000	\$84,000	\$10,000
Teaching	12,000	50,000	15,500	78,000	20,000
Consultation and Public Services	4,000	17,000	2,000	26,000	5,000
Other					
Library					
Honorarium	1,500	8,000	2,000	12,000	25,000
Miscellaneous					
TOTAL	\$40,500	\$131,000	\$35,500	\$200,000	\$60,000

* These figures are our best estimates

ABSTRACT

Alsdorf, D. G., M.S. Thesis entitled "The Influence of Coordination Bond Geometry and Drying Temperature on Zinc Retention by Soil." (1971) OSU.

In this study it was possible to divide the zinc which had been added to the soil into three categories based on extracting solutions. Exchangeable zinc is thought to be mainly ionically bonded; chelated zinc is held by coordinate covalent bonds; and, non-displaceable zinc could be retained by any combination of physical or chemical interactions. It was found that as much as 90% of the zinc retained by a soil was in the non-displaceable fraction.

Comparisons were made in the magnitude of these three categories when the soil was dried (moist, air dry, 50° C and 100° C) before and after the zinc was added. Attempts were made to relate the differences to structural changes of organic matter.

Several different metals were also tested on their ability to remove zinc adsorbed by the soil. The results were explained on the basis of bonding hybridization in each metal as compared to zinc.

The results are summarized as follows:

- a. The quantities of zinc adsorbed exhibited the trend of 100°C < moist > air dry > 50°C.
- b. The quantities of exchangeable and chelated zinc were higher when the soil was dried before the zinc was added.
- c. $\text{DTPA} > \text{Cu}^{++} > \text{Li}^{+} > \text{NH}_4^{+}$ in displacing zinc which was added after drying the soil.
- d. $\text{DTPA} > \text{Hg}^{++} > \text{Cu}^{++} > \text{Cd}^{++} > \text{Ni}^{++}$ for displacing zinc which was added before drying.

OHIO
AID csd-1928
1971-1972

ABSTRACT

KAISER, G.T. M.S. Thesis, entitled "A Comparison of Soil Organic Phosphorus Levels in the AP Horizon of Twenty-three Ohio Soils Using Two Methods of Determination." 1970. OSU.

The soil organic P level of the twenty-three benchmark Ohio soils varies from 94 to 495 $\mu\text{gm P/gm air dry soil}$ and from 26 to 68 per cent of total P. Higher values of soil organic P were usually obtained with the ignition method rather than with the Mehta extraction method. Soil organic P (as $\mu\text{gm P/gm air dry soil}$) was positively and significantly related through single linear regression analysis to soil physical and chemical properties (clay content, % organic C, total N, % base saturation, and pH) and especially to clay content and percent organic carbon. Organic carbon best predicted soil organic P as determined by the ignition method, while clay content best predicted Mehta extraction soil organic P. Soil organic P tended to increase from the better drained soils to the more poorly-drained soils when comparing all twenty-three soils and catena related soils. This increase was especially large when the more poorly-drained soils were higher in organic carbon and clay content. The relationship of clay to soil organic P seems particularly significant.

THE PENNSYLVANIA STATE UNIVERSITY

COLLEGE OF AGRICULTURE

AGRONOMY DEPARTMENT

ANNUAL TECHNICAL REPORT OF 211(d) PROJECT

1971 - 1972

Title: Crop Production in India

Grantee: The Pennsylvania State University, University Park, Pa. 16802

Director: Agronomy Department (119 Tyson Building)
Dr. Richard H. Cole, Project Leader

A. Statistical Summary:

Grant Period June 1, 1968 to May 31, 1975 Grant Amount \$200,000.00
Expenditures for Report Year \$47,930.21 Accumulated \$116,738.19
Anticipated for Next Year \$44,000.00

B. Narrative Summary:

Program funds have been utilized to promote the international interests in the Agronomy Department at The Pennsylvania State University and enable it to become the most internationally involved department in the College of Agriculture. Encouraged by the agronomy faculty, cooperating Penn State faculty and administrators, international agronomy students, participants in our Indian programs, and our Indian counterparts, the project has developed to the point where the international agronomic aspects of our teaching and research programs are receiving major emphasis. While problems related to Indian agricultural development have received priority, problems of other developing nations have been given significant attention. International policies have been developed and future areas of specialization identified.

Staff involvement, both faculty and student, and attitude change have been the major keys. Long-term and short-term international work; cooperative, continuous programs; stimulating discussion and seminar sessions; timely student advisement assistance; improved teaching and curriculum; program expansion; proper selection and availability of competent staff; priority evaluation; good relationships with cooperators; and home campus support have all contributed. Success in the future will be dependent on follow-through of the present work, thorough re-evaluations, and timely published materials. Greater total University effort will strengthen our program.

A continuation of our Indian program and an expansion of our Argentina program in international agronomy is essential. Excellent faculty support is expected in future years. The drastic curtailment of the total program in India and the restriction on graduate student participation will make accomplishments more difficult to obtain this project year. Plans for work in countries other than India will be dependent on the cooperation in and results of the 1972-73 project year. Use of funds to establish international areas of excellence in Agronomy at The Pennsylvania State University to attack future crop production problems in India and other developing nations was apparently justified and should serve as an example of how to commit similar educational funds in the future.

I. GENERAL BACKGROUND AND PURPOSE OF THE GRANT

This project is one of six being conducted by the universities which are coordinating their efforts in India through CUSURDI (the Council of United States Universities for Rural Development in India). Each project was designed to encourage the employment of a full-time faculty member to conduct research, supervise graduate students, and carry out other activities to increase the university's competence in the international dimension of a chosen discipline. Inter-university and inter-disciplinary exchange of information and knowledge has been encouraged and joint reviews of work plans and progress has been conducted by CUSURDI.

Because of the crop production needs and interests in Central India and the competence in agronomy at The Pennsylvania State University, the area of specialization ultimately selected for this project was "Crop Production in India." This has proved to be an excellent area of specialization because it has been broad enough to gain wide faculty and student support while stimulating more specialized areas of international interest in agronomy at the University.

II. OBJECTIVES

The major objectives of the 211(d) project at The Pennsylvania State University are as follows:

1. To increase interest in and knowledge about the agricultural problems of India and improve the capabilities of The Pennsylvania State University to become associated with international programs in crop production;
2. To increase the pool of scientists interested in and capable of assisting in agricultural development outside the United States;
3. To provide an opportunity for graduate students to obtain research experience in crop production involving problems relevant to India;
4. To create an awareness and stimulate interest of plant and soil scientists in international assignments and careers; and
5. To encourage youth to seek training leading to careers in international agriculture.

For the past two years, emphasis has been placed upon objectives 1, 2 and 4. In regard to objective 3, graduate students with past international experience have been assigned applied problems that would be relevant in India or other developing nations. Their research, however, has usually not been conducted primarily in the host country. This has proved acceptable to potential employers. Youth have been encouraged to seek training leading to careers in international agriculture (objective 5) through counseling and expanding the use of international examples in our agronomy courses. A significantly greater percentage of students would be interested if adequate employment were available for B.S. and M.S. graduates.

The initial area of specialization of this project was food grain crop and seed production. Considering the competencies of our staff and the problems encountered in the rain-fed areas of Maharashtra where cooperative work was established, it appeared desirable not to limit our interest to food crops or to concentrate on seed problems that were already being studied by local agencies. Emphasis was placed on the crops presently or potentially important in the cooperative work area, including forage crops. The characterization of soil, a basic first step in improving production, was also given primary consideration.

III. ACCOMPLISHMENTS

- A. Increasing interest in and knowledge about the agricultural problems of India and improving the capabilities of P.S.U. to become associated with international programs in crop production.

Contact with international students, direct involvement of faculty members, and special seminars have all played an important role. The faculty have graciously served as chairmen of graduate student committees and committee members. An effort has been made to see that all faculty are properly placed on committees. Three faculty members have been directly involved with tours in India this past year. Others have been involved as a result of their contact with students. A special seminar on Argentina was conducted during the Spring term of 1972. Those in attendance were often the same ones that had shown an interest in our Indian Agriculture seminars. An estimated 30% of the year's expenditures have been used to meet this objective.

- B. Increasing the pool of scientists interested in and capable of assisting in agricultural development outside the U.S.

Both students and faculty have been encouraged in seminars, regular classes and counseling to study methods of development outside their home country. This area has shown steady improvement since the initiation of this project. One student has graduated and is now working in Mexico. Seventy-five percent of the faculty are available and would consider an international appointment. Approximately 20% of the year's expenditures have been used to meet this objective.

- C. Providing opportunity for graduate students to obtain research experience in crop production involving problems relevant to India.

While involving 25% of this year's expenditures, this objective has been receiving less prominence as the project has progressed. Six American students have been involved this past year. The future involvement of students will depend primarily on the increased involvement of the faculty. Long-term, continuous programs are needed. One student study tour was planned and the results of his experiences will be reported in the next annual report.

- D. Creating awareness and stimulating interest of plant and soil scientists in international assignments and careers.

This objective is difficult to separate from the first two objectives. Awareness and interest has been encouraged by expanding our programs in India and Argentina. While the faculty are primarily interested in Penn State programs, students are interested in career assignments. About 15% of this year's expenditures were used directly to accomplish this objective.

- E. Encouraging youth to seek training leading to careers in international agriculture.

Very few graduate students have considered international employment unless they were already interested when accepted as a student. They often find themselves too specialized when they consider the opportunities

available to them. Only one Ph.D. candidate, not committed when accepted as a candidate, has decided to work in international agriculture upon completing his degree requirements. This work was primarily accomplished by personal counseling and involved about 10% of the year's expenditures.

IV. IMPACT OF GRANT

A. Development of Teaching Competence

The international teaching competence of the faculty in the Agronomy Department continues to improve because of the increased involvement of the staff in international programs. Ten faculty members accepted international assignments in 1971-72, with seven involved partially or wholly in an assignment in India. Discussion of crops and soils problems, found in developing countries throughout the world, are common in many courses.

The revision of the agronomy curriculum has been completed with virtually 100% approval of the faculty. The 211(d) professor was privileged to be a member of the curriculum revision committee. Undergraduate students from this major will be better qualified to handle international assignments or study international agriculture at the post-graduate level than previous majors.

Because of the inclusion of several of the aspects of international agronomy into the existing courses, the present thinking of the faculty is not to organize new courses specifically for students with an international interest. A single course in international agronomy available to both upper-level undergraduates and graduate students has been suggested and is expected to be considered in 1972-73. The election of this course, as well as other international courses at the University, and involvement in the international seminar for students and faculty should be sufficient to expand the international interest of students that are considering international careers.

B. Development of Research Competence

An effort has been made to significantly expand the international competence in two agronomic subject matter areas of excellence at the University in 1971-72. The forage crop improvement and management area has been expanded by the involvement of Dr. J. B. Washko in a special assignment for our AUD team in Maharashtra State. His evaluations were particularly relevant since one of the Indian participants assigned to him as a student is scheduled to return to India in the spring of 1973. Dr. J. S. Shenk has studied forage quality problems in Central America and has established cooperative relationships with scientists in several countries. The 211(d) professor and one student have initiated preliminary forage evaluation and studied likely seed programs in India.

Dr. Roger Pennock is returning to his regularly assigned position in soil characterization in August of 1972 after a five-year assignment in India. His assistance in establishing a cooperative proposal with Mahatma Phule Agricultural University, the Maharashtra Department of Agriculture, and The Pennsylvania State University was extremely helpful

to Dr. R. L. Cunningham, one of the 211(d) student advisors. While an American student cannot be involved in this project at this time, it is hoped that this work can be continued with the cooperation of the Indian faculty and students, and our Penn State soil characterization faculty.

Interest continues to exist in several supporting areas. A residual phosphorus test continues to be conducted in India with the helpful advice of Dr. D. E. Baker, advisor of one of our 211(d) Ph.D. graduates. A continued interest in the seed programs has been maintained by the 211(d) professor after the resignation of the APP Seed Specialist in January of 1972. Seed production in Maharashtra has grown from an acreage of 8,000 in 1970-71, to 26,000 in 1971-72, to an indicated 43,000 in 1972-73. Maharashtra's interest in the maize germ plasm being developed at Penn State was substantiated by Dr. R. G. Creech's trip to India in November of 1971. Requests have been obtained for dent corn, sweet corn, pop corn, special purpose maize, and genetic marker materials. Cooperative soybean work is being coordinated by the 211(d) professor and students.

One 211(d) thesis was completed in 1971-72. Thesis advisor for the study was Dr. D. E. Baker, Professor of Soil Chemistry. The title of the thesis submitted by Dr. Michael L. Colegrove was as follows: Soil test to relate responses of grain sorghum to superphosphate treatments on a calcareous Indian soil, Ph.D. thesis, The Pennsylvania State University, December, 1971, 62 pages. An abstract is attached.

C. Training of Graduate Students

Six American graduate students committed to contribute their professional careers to international agronomy have been advised by the 211(d) professor in 1971-72. All except one of the students have worked at least three years in international assignments. Each has a co-advisor on the agronomy faculty primarily responsible for his research training.

Dr. Michael L. Colegrove worked as a consultant for a 6-month period following his December graduation with Sptan-Aero Ltd. in Ecuador. His duties involved the completion of a land use inventory of over one million acres in the Guayas River Basin. He is presently employed by the Rockefeller Foundation in Mexico.

Wayne L. Haag will complete a three-month work trip in India this September and expects to be employed by the Rockefeller Foundation by January 1, 1973.

Because of the present travel restrictions, Mr. A. David Wilson will not go to India this fall as planned. He has been assigned an alternate thesis problem in remote sensing. This is expected to help us expand the area of excellence in soil characterization. A fourth student totally supported by the 211(d) grant, J. Harold Stern, is studying water usage in international soils. He plans to complete the M.S. in March of 1973. Two other American students are continuing their work on other University funds. One of these students expects to be involved in a project in India for a 12- to 18-month period beginning about September, 1973.

The 211(d) professor also assisted with the advisement of 4 Indian participants in 1971-72. The Indian students and 4 other international students are being prepared to return to specific positions in their home nations.

D. Development of Competence for Consultation Services

Because of the international involvement of a large number of the faculty and graduate students and a few undergraduate students, the Agronomy Department continues to become better prepared to consider international assignments in many areas of interest. The forage crop improvement and management, and soil characterization areas continue to be the most likely for future significant international involvement.

Dr. C. S. Bryner, Extension Agronomist, has studied extension education in South Asia and the Near East during this last year. Two faculty members, Dr. D. P. Knievel and Dr. A. S. Hunter, are presently assigned to our education project in crop production in Argentina. Several short-term assignments have been filled for next year.

The international agronomy seminar has featured a study of the agriculture in Argentina, as well as having a full semester session on Indian agronomic problems.

The interests of our faculty were documented in a 1972 survey. About 75% of the agronomy faculty has indicated a definite interest in an international assignment in the future. This compares to an estimate of 10% in 1968. The greatest interest lies in future programs in Latin America. Spanish speaking countries are preferred. A majority wish to continue programs in India. The international agronomy family seminar has helped families become interested in our programs. A team effort by the Penn State faculty is preferred over individual contracts. While interest is at a high level, present programs must be continued until productive results are obtained when possible.

E. Relationships with other CUSURDI Universities

Because each 211(d) project is in different project areas and the uniqueness of the dry-farming area of Maharashtra, interaction among universities has been somewhat minimized.

Soybeans for project use in India were obtained from the University of Illinois at Urbana and Jabalpur. Project reports from the Illinois team in India have proved helpful. Cooperating Indian pathologists have communicated among states. This has involved an associate of Dr. Sinclair's, the 211(d) professor from Illinois. Dr. Poehlman's (Missouri) mungbean report has been called to the attention of Indian cooperators in Maharashtra. Several useful abstracts have been received from Dr. Brown (Tennessee). One agricultural statistical report was extensively used by the agronomy faculty. Several unofficial meetings were arranged with Dr. Arscott's students at Ohio. Dr. Lineback's cooperative grain quality work is well-known in Maharashtra.

Penn State will be in a position to make a major contribution within a two-year period. The soil test - phosphorus work will be completed this karif season. The contribution of the maize germ plasm to the

Indian project is still unknown. The forage crop and soil characterization projects have just been initiated.

While not supported by 211(d) funds, Dr. Roger Pennock's APP work in soil salinity and soil moisture have contributed significantly to other projects in India. Several scientists and 211(d) students have visited the laboratories in Maharashtra. Contributions from projects of this nature are difficult to evaluate, but may become extremely significant in the future.

V. INTERNATIONAL PROGRAMS OF THE UNIVERSITY

The international work at The Pennsylvania State University is being coordinated by a newly reorganized University Committee on International Programs. This committee plans to encourage and develop programs among colleges. Members of the committee are optimistic that the programs presently being considered will be funded at an early date.

Programs in International Agriculture are presently being conducted in India, Spain and Argentina. The program in India has involved faculty from most of the departments in the College of Agriculture. In Spain, the project is in agricultural marketing involving scientists from the Agricultural Economics Department. A program in Uruguay in fruit and vegetable production is being planned with the support of the Horticulture Department. The College is cooperating with Argentina with educational programs in agricultural extension and crop production.

The Agronomy Department has taken primary responsibility in the operations of the AID supported 211(d) program in India and the Argentina programs in the crop production areas. Several faculty members have also worked in the USAID contract programs in India. Faculty and student interest in this involvement has been gratifying. An effort will be made to keep participation at a high level in future years.

VI. UNIVERSITY RESOURCES IN THE 211(d) PROGRAM

The Pennsylvania State University has provided the office, laboratory, greenhouse and field facilities as well as the supervisory, clerical and accounting services required by the project. It has also encouraged faculty not assigned to the project to contribute time freely to all aspects of the program. As the project has expanded, so has the assistance from the University increased substantially. The objectives of the project have been mutually compatible with the needs and objectives of the Agronomy Department.

The magnitude of the support from departmental funds can be seen in the estimates provided in Table 1. While 211(d) funds have been utilized to organize programs and promote international research, other funds have contributed substantially to all areas. Outside funds provided major contributions in the international teaching and consulting areas.

It should be pointed out that there has also been a substantial contribution by cooperating universities in the state of Maharashtra. Faculties of these universities have worked without questions with the four professors directly involved in 211(d) work in Maharashtra. Research facilities have been made available whenever they have been requested.

All this has been possible by the American and Indian faculty and students' sincere interest in mutually studying the crop production problems in the rain-fed areas of Maharashtra. It is anticipated that this interest will be easily maintained and the contributions continued throughout the granting period.

Table 1. Distribution of 211(d) funds and estimated contributions from other sources of funding for the period June 1, 1972 through May 31, 1972.

<u>Activities</u>	<u>211(d) Funds</u>	<u>Non 211(d) Funding</u>
International Teaching	\$ 3,834.42	\$ 5,000.00
Student Advising	7,189.53	3,000.00
International Research	11,982.55	1,250.00
International Service	7,189.53	3,750.00
International Consulting	3,355.11	5,000.00
Program Organization	11,982.55	3,000.00
Other	2,396.52	4,000.00
	<hr/>	<hr/>
Total	\$47,930.21	\$25,000.00

VII. EXPENDITURES

The budget and expenditures for the project are reported in Table 2. Total project expenditures to date are approximately 58% of the total budget to be spent over the seven granting years. As can be seen, about 24% of this total budget was committed during the 1971-72 fiscal year.

Salaries and wages expended in 1971-72 include the full salary of the 211(d) professor (Dr. Richard H. Cole) and the salaries of five 211(d) graduate assistants. Dr. Michael L. Colegrove has graduated and Mr. James D. Bergman is continuing his work without financial assistance from the University. Assistantships are still provided for Mr. Wayne L. Haag and Mr. A. David Wilson. One new student with 5 1/2 years international experience, Mr. J. Harold Stern, was assigned to the program in January of 1972. Wages were also paid undergraduate students for part-time direct assistance of the 211(d) professor and students.

Travel and transportation costs have been much greater than predicted in the original budget. Three trips were made to India by the Penn State faculty during 1971-72 and one 211(d) student's trip was approved during this period. Dr. Richard H. Cole was in Maharashtra in May and June of 1972 at a project cost of \$1,413.56 above travel expenses. His major contributions involved establishing research with alfalfa, soybeans, maize and sorghum, and making final arrangements for future 211(d) students. Dr. Robert L. Cunningham studied the level of soil characterization technology in Maharashtra and prepared a proposal for study of a 211(d) student in Mahatma Phule Agricultural University. He also stopped for a two-day visit at the International Soil Characterization Laboratory in Bangkok. Total cost of this September 7 through October 10 trip excluding travel was \$518.15. Dr. Roy G. Creech visited the plant breeders and seed industry in Maharashtra in the month of November to determine their interest in developing special purpose maizes for nutritional and industrial uses. Germ plasm has been forwarded from Penn State's corn programs. Cost excluding travel was \$519.59.

Equipment purchased in 1970-71 costing in excess of \$100.00 included a soybean-sorghum thresher manufactured by the Swanson Machine Company of Champlain, Illinois. Total cost was \$2,443.50. This was required to thresh the crop production test materials being grown by the 211(d) graduate assistants. The remaining equipment and supply funds were required to support the research programs of the 211(d) staff.

Major items in the other direct cost category were graduate assistantship fees and computer usage costs.

Table 2. Budget and Expenditures for the 211(d) International Agronomy Project at The Pennsylvania State University.

<u>Category</u>	<u>Original Five-Year Budget</u>	<u>Revised Seven-Year Budget</u>	<u>Total Project Expenditures To Date</u>	<u>Expenditures 6/1/71-5/31/72</u>
Salary & Wages	\$146,000.00	\$136,500.00	\$ 80,479.63	\$32,638.23
Travel & Transportation	21,000.00	44,500.00	13,815.69	2,803.90
Travel Not Charged to Date (estimated)			11,500.00	5,500.00
Equipment & Supplies	22,000.00	13,000.00	8,226.09	5,005.31
Other Direct Costs	11,000.00	6,000.00	2,716.78	1,982.77
Totals	\$200,000.00	\$200,000.00	\$116,738.19	\$47,930.21

VIII. WORK PLAN & BUDGET FOR 1972-73

The proposed budget for the next fiscal year is as follows:

<u>Category</u>	<u>1972-73 Budget</u>
Salaries & Wages	\$29,000.00
Travel & Transportation	11,000.00
Equipment & Supplies	2,500.00
Other Direct Costs	<u>1,500.00</u>
	\$44,000.00

Under the present unsettled conditions between the United States and India it is difficult to provide a firm budget for the 1972-73 fiscal year. Since none of the 211(d) students will be permanently assigned in India during this period, and one student is expected to complete his degree by mid-year, the total budget is expected to be below last year's expenditures.

Short-term travel to India will be requested for several professors in the Department. The 211(d) professor, Dr. R. H. Cole, is expected to be in Maharashtra during January and February of 1973 to meet previous commitments and promote future work. Dr. D. E. Baker, advisor of a past 211(d) student, will present the results of this phosphorus work in India and the soil and plant analysis results obtained in the states on his visit in February. If facilities are completed, the proposed soil characterization laboratory adequately staffed, and maps of the Rahuri area made available, Dr. G. W. Petersen will go to Maharashtra in January or February to help implement a joint proposal that has been developed among Penn State, MPKV and the Maharashtra Department of Agriculture.

Other travel that will be requested in future years includes a return tour by Dr. R. L. Cunningham to assist with the characterization - land use phase of the proposed cooperative work. Dr. R. R. Hill, alfalfa breeding specialist, has consented to come to Maharashtra as soon as the forage breeding post is staffed, an official request for assistance has been obtained, and the work has progressed to a point where his efforts can be utilized. Co-workers in India have also requested that we consider returning Dr. R. Pennock, a five-year team member in Poona, to assist MPKV in establishing their soil moisture research laboratory when it is completed. Dr. J. S. Shenk has indicated an interest in cooperating with the Indian scientists involved in crop quality research. Faculty from all the Agricultural Universities in Maharashtra have indicated a desire to consider proposals of cooperative work.

The 211(d) professor will continue to cooperate with his Indian counterparts in an effort to improve production in soybeans, maize, and forage crops (primarily alfalfa), and continue to encourage the rapid development of quality seed in the State. A 211(d) graduate assistant will be assigned in the fall of 1973 if permitted.

Since Indian participants will no longer be coming to the United States under our AID contract, departmental funds will be utilized to admit one student each year from Maharashtra. A similar agreement to the one presently in effect will be established so the student knows he will be given acceptable employment on his return to India. Transportation and some other assistance will be furnished by a Rupee fund developed by the professors in the agronomic area (Agronomy, Soil Science and Plant Breeding). Acceptance will be dependent upon approval of the participating departments and the university involved. An effort will be made to send those students that can be expected to expand new areas of speciality in Maharashtra.

Seminars, courses, and international program participation will be encouraged as in the past. Because of our recent involvement in Argentina, an effort will be made to study the agriculture of southern South America and learn to speak Spanish. Publication of papers and reports of international interest will be encouraged. A substantial proportion of Dr. Roger Pennock's time will be available for him to produce technical reports of his work in India.

One graduate assistant will complete his Ph.D. prior to January 1, 1973, after his return from India in September. Two others will be continuing their work throughout the 1972-73 fiscal year. Both continuing students have considerable international experience and will not be adversely affected by the present restraints on program participants. A fourth student, scheduled to be involved in the fall of 1973, would require long-term study in India. Final judgment on his involvement will be determined in the future.

IX. PLAN FOR THE SUBSEQUENT TWO YEARS

While the plan for 1972-73 is somewhat definite because of previous commitments, alternate plans are being made for subsequent years. If Penn State continues to have a major interest and has an opportunity to work in India, the 211(d) staff can be expected to cooperate with Indian scientists in the dry-farming areas of Maharashtra. This is an excellent location because the needs in the State correspond favorably with our areas of specialization in (a) forage crop improvement and management, and (b) soil characterization and land use. There are several scientists in both countries that have established an excellent mutual working relationship. Because this area of India has many of the problems common to the developing world, it is also an excellent location for students and faculty to become involved.

If Penn State will not be involved in future programs in India, an alternate Latin American country will be selected. The selection will be based on the likelihood of obtaining future cooperative agreements in that country and a considering of our areas of international specialization.

Greater emphasis will be placed on cooperative publication of results than in previous years. Faculty and students from the Agronomy Department who have worked in India can be expected to report significant results and pertinent observations. This effort will undoubtedly be reduced if a country change becomes necessary in the project.

The objectives of this project appear to be as sound today as they were when the proposal was accepted in 1968. Because of the late start at The Pennsylvania State University, the initial funds are apparently enough for a full program through the first six years of the granting period. In the seventh year, the final student funded by the project should be returning from India and a major effort will be made to evaluate the effects of the program on the faculty, students and administrative units involved. It can be expected that the Department will continue to be involved in international programs and the international professors of agronomy will be responsible to promote participation.

February, 1972

Department of Agronomy
College of Agriculture
The Pennsylvania State University
119 Tyson Building
University Park
Pennsylvania 16802

Summary of the thesis by Michael L. Colegrove

"Soil tests to relate responses of grain sorghum
to superphosphate treatments on a calcareous Indian soil"

This investigation was undertaken to study the response of sorghum to phosphorus (P) applications, and fixation and availability of P on a calcareous soil in India. Alternate soil analysis procedures were compared with the standard techniques utilized in India.

The Olson method, now in use in India, appeared to be a satisfactory technique for determining the availability of P in the Indian soil studied. Sorghum yield increases of about 70% were common with broadcast P application of 90 Kg./Ha. When extremely high rates were applied, yield increases were greater than 100%. Fixation in soils was rapid, however, indicating the need for seasonal applications. Future tests would likely be most productive when P is supplied in a band treatment adjacent to sorghum rows.

This work was supported by USAID in a grant to The Pennsylvania State University. The information and conclusions in the thesis do not necessarily reflect the position of AID or the U.S. Government. Advisors for this study were Dr. D. E. Baker, Professor of Soil Chemistry, and Dr. R. H. Cole, Associate Professor of International Agronomy.

UNIVERSITY OF TENNESSEE

COLLEGE OF AGRICULTURE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

ANNUAL TECHNICAL REPORT OF 211(d) PROJECT

1971 - 1972

211(d) Annual Report, AID/csd 1927
July 1, 1971 - June 30, 1972

Title: AGRICULTURAL ECONOMIC ISSUES IN INDIA

Grantee: The University of Tennessee, Institute of Agriculture

Director: David W. Brown, International Professor of Agricultural Economics

Administered through Department of Agricultural Economics and
Rural Sociology, T. J. Whatley, Head, and Director of International
Agricultural Programs, Lewis H. Dickson

A. Statistical Summary

Period of Grant: July 1968 through June 1973 Amount of Grant: \$200,000

Expenditures for FY 1972: \$51,053 Accumulated: \$160,535

Anticipated for FY 1973: \$39,465

B. Narrative Summary

Grant work this year shifted more strongly into research and educational contributions related directly to AID concerns in both India and broader LDC contexts.

Besides teaching and working with several graduate students, the 211(d) Professor drafted some teaching materials on "grassroots" agricultural program planning and implementation, with India-like situations especially in mind. Part of this was in association with the ADC/RTN/Agricultural Administration group. He was involved also in the USDA/AID agricultural policy shortcourse for LDC leaders, an AID/TA/Methodology conference, and Peace Corps efforts to establish stronger professional ties with agricultural colleges. Efforts continued on campus to strengthen library collections, cross-disciplinary interaction, and interest in and understanding of international development.

Two of the five 211(d) Fellows completed their study programs. The research of one, based on early 1971 field work in Mysore State, dealt with irrigated land/water use. The second dealt conceptually with agricultural program feedback. April 1972, another 211(d) Fellow went to Bangalore for three months to study farmer credit repayment problems. The 211(d) Fellows, along with other returned Peace Corps Volunteers and LDC nationals in the department, continued to be a valuable source of campus insight and stimulation for international activities.

Grant work during FY 1973 will center around completion of two remaining 211(d) student studies, publication of 211(d)-related research, and further evolution and testing of the training materials related to program decision-making and administration. Professional contacts in India will be sustained to the extent possible. New international linkages for interested faculty and students will be sought in a manner compatible with both Institute of Agriculture and AID interests.

**FOURTH ANNUAL TECHNICAL REPORT
July 1, 1971 - June 30, 1972**

**AID/Section 211(d) Institutional Grant, csd-1927
University of Tennessee
AGRICULTURAL ECONOMIC ISSUES IN INDIA**

I. GENERAL BACKGROUND

This grant stemmed from the belief that AID/CUSURDI agricultural assistance could be enhanced by closer links between (a) agricultural economists at Tennessee and (b) professional colleagues, former students, and team members in India. It came also from the desire to strengthen curricula and counseling for "international" students on campus; to relate their research more closely to analytical needs in India and other developing countries; to increase faculty acquaintance with LDC problems; and to tap more fully previous experience in agricultural economics and related fields that bears on development, both in Tennessee and abroad.

Grant funds were seen as a vehicle to enable the Department of Agricultural Economics and Rural Sociology and the Institute of Agriculture, to make progress in these directions that would not otherwise be possible...to help catalyze and set the stage for a modest, but self-sustaining international dimension that would be complementary to both campus educational endeavors and AID-related concerns abroad. Though India was to be given special attention, contributions to other developing countries and AID planning were anticipated too. It was envisioned also that involvement of faculty and students in developing countries might be a source of fresh insight in tackling Tennessee's own agricultural modernization and rural development problems.

Unique 211(d) contributions were seen to pivot around and spread from (1) an added faculty member who could give full-time attention to the international dimension, as well as augment relevant specialties; (2) opportunities for some American graduate students to launch their international career base and at the same time enhance LDC-related insights and inquiry; and (3) travel for a limited number of faculty and students to help build up communicative and research linkages with agricultural economists in India and elsewhere.

II. GRANT OBJECTIVES

Specific objectives of this grant, as stated in the original instrument, are:

To develop within the University of Tennessee specialized competency to deal with agricultural economics issues of India, and to establish this area of specialization as a legitimate and continuing function of the University. In furtherance of the basic objective, and through the assistance of the proposed grant, the University of Tennessee proposes to engage in research and graduate instruction so as:

1. To increase the capability of the University of Tennessee to render assistance to India (and other developing nations) in the general area of agricultural economics.
2. To increase the pool of scientific manpower trained in agricultural economics interested in and capable of assisting India (and other developing nations).
3. To create a professional awareness of the international dimensions of agricultural economics.
4. To stimulate interest of agricultural economists in international service careers as employees of private or public entities.
5. To encourage college students to seek training leading to careers in agricultural economics under private or public auspices.
6. To provide an opportunity for graduate students to obtain research experience on problems of particular relevance to the developing countries (to the maximum extent feasible, by assisting with research activities carried out wholly or partially in India).
7. To increase interest in and knowledge about the agricultural problems of India by drawing upon all relevant special competencies of staff members of the Department of Agricultural Economics and Rural Sociology and other departments of the University.

All of these objectives have received attention since the grant's initiation in 1968. Relative to some of the other 211(d)/India grants, less attention has been given to research accomplishment as an end in itself and more to campus build-up of curricula, professional interaction, teaching materials and faculty/student involvement.

It soon became clear that to try to develop expertise for all aspects of agricultural economic problems for all of India would be much too ambitious, diffuse, and pretentious. So special geographic focus was placed on Mysore State, where much of Tennessee's involvement has been. And, to help fill in the apparent gap between policy-level analysis, at the one extreme, and farm-level analysis, at the other, emphasis was given to operational program design related to farm modernization, marketing, credit, and companion change-agency concerns.

Especially after Fall 1971, when prospects for continuing links with South Indian agricultural universities and development programs became uncertain, grant-related endeavors have taken on a broader-than-India tone. Program execution problems encountered in Mysore State are still strongly in mind, but more attention is now being given to training and research implications for, and linkages with, other LDC situations.

III. MAJOR ACCOMPLISHMENTS, 1971-72

Whereas emphasis during the first three years was on establishing Indian contacts, strengthening curricula and ancillary campus activities, and attracting more "international" students, the focus this fourth grant year shifted to analytical and educational substance itself. Persons most directly concerned were the 211(d) professor (D. W. Brown), another professor with LDC experience (M. B. Badenhop), and five 211(d) graduate fellows. The work included not only faculty-student research related to agricultural program design, but also educational materials that would have application in countries besides India. Much of this was done in cooperation with other AID-related activities, and there were interfaces with such fields as rural sociology and development administration. Efforts to improve campus reinforcement and public understanding of international development work continued. Specific highlights are:

A. Teaching

Courses in the department that carried a strong international flavor because of the inherent subjectmatter and/or student composition this year included:

Ag. Econ. 4240, World Agriculture and Trade (Badenhop)
Fall 1971, 13 students

Ag. Econ. 4250, Agricultural and Rural Program Planning (Brown)
Summer 1971, 13 students
Spring 1972, 5 students

Ag. Econ. 4330, Land Economics (Martin)
Winter 1972, 25 students

Ag. Econ. 5410, Agricultural Marketing Analysis (Snell)
Fall 1971, 22 students

Ag. Econ. 5440, The Economics of Agricultural Development (Badenhop)
Winter 1972, 8 students

Ag. Econ. 6210, Agricultural and Rural Transformation Problems (Brown)
Summer 1971, 8 students

Rur. Soc. 4450, Diffusion of Agricultural Technology (Leuthold)
Spring 1972, 8 students

Four or five additional graduate students from other departments took special problems courses with Dr. Badenhop or Brown on topics related to international development.

The 211(d) Professor and fellows continued to be active in organizing special seminars related to international development and world affairs. Those in which they had an especially strong hand were:

- 1971 June 30 George Smith, 211(d) Fellow, Agricultural Development in Bolivia (UT/Ag. World Food and Fiber Series Seminar).
- July 21 Kok Kian Poh, East-West Center graduate student and Malaysian Federal Land Development Authority staff member, Land Settlement in Malaysia (UT/Ag. World Food and Fiber Series Seminar).
- Aug. 2 Parker Cashdollar, 211(d) Fellow, Land Use Possibilities in the Tungabhadra Irrigation Project of Mysore State, India (departmental graduate research seminar).
- Aug. 12 Wayne A. Schutjer, Agricultural Development Council, The A/D/C Research and Training Network Program, and Emerging Opportunities for U. S. University Service to International Agriculture (informal seminar, UT Committee on International Agriculture).
- Aug. 20 Ag. Econ. 6210 class, Diagnosing the Problems of Disadvantaged Farmers (special briefing session for interested faculty and students on the results of the class' group term exercise).
- Oct. 7 D. W. Brown and others, The 211(d) Program and Future Plans (informal briefing and idea exchange with interested faculty and students).
- Oct. 26 Noel Rebello, AID Participant from Mysore State, India, Agricultural Program Planning to Reflect Farmer Capabilities in Mysore State, India (departmental graduate research seminar).

- Nov. 29 Thomas H. Silcock, World Bank Economist-Editor, World Bank Criteria for the Evaluation of Country Prospects and Plans (UT public lecture). Also two informal seminars on public administration, international relations, economic and agricultural aspects of IBRD work.
- 1972 Jan. 20 Charles B. Seckinger, AID/Washington, Rap session with 211(d) fellows and other interested persons on development research plans and needs.
- Feb. 21 Kusum Nair, Michigan State University, Feast or Famine: Some Issues in Agricultural Development (UT public lecture). Also various sessions with faculty and students, Feb. 21-23. (Her visit catalyzed by Thomas Vollrath, 211-d Fellow, in association with Walter C. Neale, Professor of Economics. Financing provided by the Dean of Business Administration and the Division of International Education.)
- Mar. 14 Glenn Ames, 211(d) Fellow, Production Credit Problems of Small Farmers in Mysore State (departmental graduate research seminar).

Robert Thurston, 211(d) Fellow, was instrumental in initiating a cross-campus "International Issues" panel series that involved faculty and students from various departments:

- Oct. 12 U. S. Universities and International Professionals Training and Developmental Needs
- Jan. 13 U. S. Foreign Aid -- Questions, Issues, Possibilities
- Jan. 27 Implications of U. S. Economic Policy in the Third World
- Feb. 17 Roles of U. S. Professionals Abroad

There were several lectures and seminars sponsored by the UT Division of International Education which people in the 211(d) circuit helped to publicize and took part in. Among others, these included speakers on foreign policy and international assistance made available by the State Department and AID. One AID visitor of special relevance to the substance of this grant was James Bleidner, who discussed land reform and other developments in Chile.

On the agricultural campus, two additional seminars that received cross-departmental participation were:

- Sep. 22 W. L. Parks, Professor of Soil Science, Soil, Water and Plant Nutrition Problems in India (USDA Club talk).
- Apr. 6 Webster Pendergrass, Vice President for Agriculture, Recent Developments in Indian Agriculture and the UT/AID Program (Experiment Station seminar).

The 211(d) Professor continued to serve as a source of help for agricultural students who wanted to look into international service opportunities with such groups as the Peace Corps, as well as for colleagues seeking facts about international agriculture and development.

Starting July 1972, the Department's international teaching and service capacity is being augmented by a new faculty member, Brady Deaton, who recently completed his Ph.D. at Wisconsin and who was previously a Peace Corps Volunteer in Thailand. He will be teaching agricultural policy and advanced land economics. While his initial research will focus on Tennessee rural poverty and resource development, he has strong interest in international involvements.

B. Research and Training Materials.

Six "international" M.S. theses and Ph.D. dissertations were completed or initiated during the 1971-72 period. Some deal directly with India; others take advantage of students' backgrounds elsewhere, but embody analytical elements of relevance to Indian problems and programs. These include:

Sang Gee Kim, AID/Korea Participant, M.S.: The Impact of PL 480 Shipments on Prices and Domestic Production of Foodgrain in Korea, Under J. G. Snell.

Parker D. Cashdollar, 211(d) Fellow, Ph.D.: An Economic Analysis of Crops and Land Use Localizations in the Tungabhadra Irrigation Project of Mysore State, India, Dec. 1971, under M. B. Badenhop. Based on field work in India, Nov. 1970 - Mar. 1971, in cooperation with Mysore University of Agricultural Sciences. Extra copies available. An article based on this study has been prepared by Badenhop and Cashdollar, and is under current review.

Noel S. P. Rebello, AID/India Participant, Ph.D.: Agricultural Program Planning to Reflect Potentials of Small Farms, with Applications to Mysore State, India, Mar. 1972. Under D. W. Brown. Based in part on Cashdollar's farm survey and production input-output data.

Robert V. Thurston, 211(d) Fellow, M.S.: Informational Feedback in Agricultural Development Programs, completed July 1972. Under D. W. Brown. Applies constructs from economic, communications, and development administration theory. Relates especially to Venezuelan local-action programs, but provides frame for dealing with similar problems elsewhere.

Thomas L. Vollrath, 211(d) Fellow, M.S.: A Framework for Diagnosing Cultural/Institutional Obstacles to Agricultural Modernization in Upper Volta (tentative title), to be completed Fall 1972. Under M. B. Badenhop. Should carry analytical implications for other countries as well.

Glenn C. W. Ames, 211(d) Fellow, Ph.D.: Production Credit Repayment Problems of Small Farmers in Mysore State, and Possible Solutions, expected to be completed by Winter 1973. Under D. W. Brown. To be based on field work in India, April-July 1972, in cooperation with Mysore University of Agricultural Science and various Mysore State agencies.

M. B. Badenhop, in association with Nelson Rodriguez (Ph.D. student), C. L. Cleland (Professor of Rural Sociology), and Nelson Robinson (UT Director of International Education), analyzed further details of the 1968 survey of landholders in the Dominican Republic that had been done under a small USAID contract. This subsequent work was contributed by the University of Tennessee. Pending AID concurrence, the 84-page report, Land Tenure in the Dominican Republic (May 1972), is available for distribution in limited quantities.

Relevant to the focus of this grant is the Ph.D. dissertation completed by Gene Ellis in June 1972 under Professor Walter C. Neale in the Economics Department -- Man or Machine; Beast or Burden: A Case Study of the Economics of Agricultural Mechanization in Ada District, Ethiopia. Financial support for this study was provided by AID.

Reflecting (1) the increasing uncertainty of future institutional linkages with India and (2) the feeling that a number of other agricultural economists in AID and U. S. university circuits have more to offer regarding India's broad scene, the 211(d) Professor's own efforts have gone into the build-up of diagnostic constructs and teaching materials related to the planning and implementation of agricultural programs at operational levels. "Grassroots" program execution difficulties observed in India have been key points of departure, but this line of inquiry and writing is being evolved with other developing countries in mind as well. This is being done in communication with other groups with similar concerns, especially the Agricultural Development Council Research and Training Network and AID/TA/Development Administration.

More specifically toward this end, Dr. Brown during the past year...

- ...Prepared a preliminary set of notes, exercises, and readings on decision-making aspects of agricultural and rural program planning. (Evolved in connection with his 4250 course, Summer 1971. Some improvements suggested by students, colleagues, and AID reviewers subsequently incorporated.)
- ...Took part in the (AID-financed) ADC/RTN/Agricultural Administration workshop endeavor, aimed at developing training materials and a "model" training course for LDC middle-level program managers. This included preparation for and participation in three workshop sessions (New York, Sep. 17; Tucson, December 11-12; Honolulu, Apr. 4-8), and drafting of four "chapters" on:
 - Allocation of time
 - Determining the work program
 - Interagency working relationships
 - Evaluation
- ...Guided three graduate students (Rebello, Thurston, Ames) in research studies that focus on change-agencies as decisionmakers.

The constructs and teaching materials stemming from this line of work may be of use not only to change agencies in developing countries, but also to agricultural and rural agencies in the U. S.

The 211(d) Professor was also chairman or member of the advisory committees of several other graduate students concerned with U. S. or LDC development, and spent considerable time helping to refine theses and other research manuscripts.

C. Graduate Students

Of the approximately 50 graduate students in agricultural economics during the 1971-72 period, 19 were LDC-oriented in terms of background, program emphases, and/or future plans. Of these, five were 211(d) Fellows, five were returned Peace Corps Volunteers under non-211(d) auspices, and nine were from developing countries. Only one student was from India, but three of the Americans had their Peace Corps experience there. All of the 211(d) Fellows had begun their M.S. or Ph.D. work in previous years; two of the five completed their study program by July 1972. During the year five new "international" students joined the Department, and six left for jobs or further graduate study elsewhere. More details about these students are shown in Attachment 1.

Three additional M.S. students, though majoring in other fields, had close associations with 211(d) activities. James Rugh in agricultural engineering (Peace Corps, Senegal and India) was very active in local educational work related to international development and relief, and in April 1972 was named to the OXFAM/America national board of directors. Anthony Griffin (Peace Corps, Colombia) completed his M.S. in agricultural extension (with two of his special problems in agricultural economics and rural sociology), and continues as UT's Associate Director for International Student Affairs. William Seiders (Peace Corps, Colombia) completed his M.S. degree in agricultural extension, Spring 1972, and has started Ph.D. work in international extension at Louisiana State University.

As a group, the "international" graduate students have performed well academically, have added much to faculty-student perspectives, and have been a source of fresh inspiration for dealing with both U. S. and LDC development problems. Five of the six agricultural economics graduate students elected to Gamma Sigma Delta this year were "international" students. The majority of departmental faculty seem interested in having more returned Peace Corps Volunteers and sponsored students from other countries.

The number of such students will probably be down next year. Funding constraints have prevented additional 211(d) fellowships from being awarded. As evidenced by Attachment 1, the Department Head has sought and obtained Experiment Station appointments for several, but this means their working on U.S.-oriented research rather than on LDC problems. Assistantship stipends in the Institute of Agriculture this past year have been very uncompetitive (hopefully to be improved soon). This, combined with shortage of funding for research directly related to international development, was a factor in several strong American applicants deciding to go elsewhere for graduate study. Also,

the phase-down of the AID contract work in India has resulted in fewer Indian participants taking courses in agricultural economics and rural sociology. Whether there will be sufficient interest to warrant continuation of all the international courses and special activities evolved these past four years in the Institute of Agriculture is in some doubt.

The 211(d) Fellows and other "international" students in the Department have continued to exert a stimulating influence elsewhere on campus and in the Knoxville community. Besides organizing the special seminars reported earlier, they were among the key leaders in International House activities, orientation programs for new foreign students, the second Knoxville Walk for Development, the annual UT "World on Parade" night, and refugee relief efforts. Several gave talks related to international development -- in International House forums; at local UN Association, school, church, and civic group meetings; and on TV. More subtle, but equally important, has been the "snowball" effect of the 211(d) Fellows and returned Peace Corps Volunteers in catalyzing and reinforcing campus attention to international concerns. Here again, the reduced number of such students anticipated next year places this generative spirit in jeopardy.

D. Consultive and Public Service

Beside the A/D/C RTN workshops mentioned earlier, the 211(d) Professor participated this year in several off-campus activities related to international development:

Co-chairman (with M. B. Badenhop), contributed papers section, international agriculture session, American Agricultural Economics Association meetings, August 1971. (Review and selection of papers.)

Resource person, USDA/AID Agricultural Policy Seminar for LDC leaders, Washington, D. C., August 9-10 and 23-26, 1971. (Also helped with the planning of this seminar course, and prepared three teaching pieces on agricultural modernization, helps for disadvantaged farm people, and opportunities for policy innovations.)

Gave a talk at the Peace Corps/SREB-sponsored International Agricultural Forum on the 211(d) idea and opportunities for agricultural colleges to strengthen their international dimension, Atlanta, August 27-23, 1971. (Also, with UT's L. N. Skold, helped Peace Corps officials plan this forum, aimed at reaching professors and deans in the Southeast. Others attending from UT were Dean Glen Hall and Dr. D. M. Thorpe.)

At the request of Erven Long and CUSURDI, spent three days in Washington and several days at UT assembling information and preparing a working paper on implications of international aid for U. S. agriculture, November 1971. (Used as a basis for subsequent materials on this subject developed and circulated by Drs. Long and Scoville.)

In response to a request from Erven Long, prepared a summary of previous UT research related to rural population adjustments to changing conditions, February 1972.

Participant, invitational consultative seminar on technical assistance methodology, sponsored by AID/TA/Methodology Division, Atlanta, March 24-26, 1972.

Continued as Peace Corps Career Consultant for agricultural economics (correspondence with returning Volunteers about graduate study and career opportunities).

Served (with L. N. Skold) as an informal sounding board about some ideas for university linkages being developed by Peace Corps/Washington-- e.g., its proposed "Future Agricultural Research Manpower" (FARM) program.

Gave talks on international development and assistance to the Knoxville Torch Club, UN Association, and League of Women Voters.

Helped arrange programs for several international visitors to TVA and UT, and discussed various program aspects with them. (Others in the Department and Institute of Agriculture occasionally involved.)

E. Linkages with India and Other Programs

A major contribution of 211(d) to Tennessee's work in India has been the intensified attention on campus to the needs of AID Participants from there -- more opportunities in courses, seminars, and informal settings to relate their specialities to Indian development needs...to become acquainted with innovative ideas in other countries...to think about things they could do something about upon their return to India. Several of the Indian Participants at UT during the 211(d) period have taken advantage of such opportunities. However, with the flow of new Participants from India having ceased (only two remaining as of July 1972), this element of 211(d) contribution has been greatly curtailed.

Communication with persons in South India during 1971-72 was mainly with UT team members; Agricultural Department personnel; and Dr. R. Ramanna, Dr. Donald Taylor, and other agricultural economists at Mysore University of Agricultural Sciences. This was chiefly concerned with followthrough to Cashdollar's Tungabhadra study, Rebello's SFDA study, and arrangements for Ames' credit repayment study. Cashdollar's data and linear programming results were made available to MUAS and other Mysore agencies, and agricultural economists were encouraged to make use of these in further analyses and writing. (No concrete knowledge of such thus far.) The Development Commissioner and other Mysore State officials have taken considerable interest in Ames' farm credit study progress and in seeing the findings when completed.

Possibilities of having a 211(d) Fellow collaborate in research with Tamil Nadu Agricultural University were explored this year. They seemed personally interested, but strains in U.S.-India relations apparently made them feel it best not to consider such for the present.

Rebello's study of local-level agricultural program planning led to communication with, and help from, Mysore State officials concerned with the Small Farmers Development Agencies. His intentions following return to Bangalore were to follow up with more concrete analysis and informational feedouts related specifically to SFDA, a program of current interest in India.

A. N. K. Murthy, former AID/Tennessee Participant who in Spring 1971 completed a dissertation on regulated markets in Mysore, has endeavored to pursue this further in research and educational work. His insight in this area was recently sought by a World Bank mission to India.

Plans had been for one or two department faculty to go to South India during CY 1972 to become better acquainted with Indian problems and programs, to backstop 211(d) student research, and to make informal contributions to collaborating institutions there. However, the freeze on 211(d) involvements in India ruled this out.

The 211(d) Professor's participation in the RTN/Agricultural Administration workshop at the East West Center in April opened up doors for at least informal communication with a couple of new Indian contacts. D. K. Desai of the Indian Institute of Management and Kuldeep Mathur of the H. C. Mathur State Institute of Public Administration in Jaipur were at the workshop. They expressed interest in keeping in touch with the work of the RTN group and Dr. Brown, as well as in student/faculty research cooperation if and when future conditions permit. There has already been some exchange of materials between Dr. Brown and these two persons.

Linkages with other U. S. universities in the AID 211(d) grant/research contract orbit this year were especially with Ohio State, Cornell, Michigan State, and Wisconsin. The Tennessee Party Chief in Bangalore helped arrange for the graduate students (one from Cornell and the other from Ohio State) to do research in Mysore. Cornell's John Mellor and Dr. Brown have kept in touch through correspondence about one another's activities. Contacts with Gar Wood, Nick Luykx, and Donald Green through the RTN workshops provided a feel of the work at Michigan State and the East-West Food Institute related to agricultural program management, as a help to Dr. Brown in deciding how his own efforts along this line might be most complementary.

Glenn Ames, the UT 211(d) Fellow now conducting the credit repayment study, sought and received very helpful suggestions from Dale Adams at Ohio State while this project was in the formulative stage. This led to Ames spending several days at Ohio State with Dr. Adams and others in the AID/finance project to review background materials and to seek their ideas about how his project could be made most complementary to their own efforts. Ames also spent a few days at the Wisconsin Land Tenure Center, and received similar help. Hopefully the result will be a research contribution that not only sheds further light on farm loan repayment in India specifically, but also augments the broader buildup of insight in this problem area.

During the year several people in AID/Washington were very helpful in reinforcing the substance of Tennessee's 211(d) work. John Young, as well as Dr. Myren, called attention to, and where possible provided copies of, recent reports related to the concerns of this grant. When further 211(d) research in India seemed ruled out, Dr. Blume explored possible linkages with AID activities in other NESAC countries. He also sought and obtained ideas from USAID/Afghanistan about dissertation topics that our Participant from there might usefully tackle while at Tennessee. Dr. McDermott took the initiative in circulating the teaching materials drafted by Dr. Brown among several AID/W persons and obtaining their suggestions for improvement. The 211(d) professor had several contacts during the year with the TA/Development Administration and TA/Agricultural Economics groups, who were sources of stimulation and insight. Charles Seckinger during this visit to Knoxville was a very helpful sounding board about proposed research and training materials. He also encouraged and paved the way for one of the 211(d) fellows, Robert Thurston, to visit AID/Washington to get in touch with persons and materials of relevance to his study on program feedback. Following the Atlanta conference, the TA/Methodology group has contacted the 211(d) professor about things that he might do to augment their efforts to develop educational materials related to technical assistance methods. All this has not yet added up to much in terms of concrete results from AID's viewpoint, but it does represent a pattern and spirit of interaction at professional levels that could yield more productive university contributions in the future.

F. Involvement of Other University Resources

The University has continued to reinforce work of the 211(d) faculty and students in ways that it can -- office space, supplies, computer and duplication facilities, secretarial help beyond that covered by the grant, and time by the department head and the Office of International Agricultural Programs in administrative backstopping.

The Department Head, T. J. Whatley, has taken much interest in helping to work out ways for capable students with international interests to start or continue graduate study. During 1971-72 financial support was provided under Experiment Station and NSF auspices for four returned Peace Corps Volunteers and two foreign nationals. Arrangements were made for an additional student whose IIE/Fulbright scholarship had been cut off by funding cutbacks to continue during 1972-73 under departmental auspices. This usually has meant doing research on U. S. problems, but has enabled such students to take graduate work consistent with their international career aims.

One professor -- Dr. M. B. Badenhop -- has been linked particularly closely to the 211(d) effort. Over half his time this past year has been devoted to teaching "international" courses, guiding research and writing reports related to LDC problems, meeting with visitors, serving as a sounding board for proposed 211(d) activities, etc.

Involvement of other professors in the Department has been primarily through special attention to international agriculture in certain courses and membership on graduate advisory committees.

One professor outside agricultural economics -- L. N. Skold in Plant and Soil Sciences, a former India team member -- has had more than the usual associations with 211(d) circuits. He has continued to serve as chairman of the Committee for International Agriculture, provide counsel to students with international interests, give talks related to Indian international development, help handle international visitors, and reinforce various international activities on campus.

Three professors outside the department made significant contributions of time this year as members of thesis and dissertation committees related to 211(d) work -- Nelson Robinson, Political Science; Frank Bell, Plant and Soil Sciences; and Robert Dotson, Agricultural Extension Education. D. M. Thorpe, former Party Chief, was also a helpful source of technical counsel.

The University's Divisions of International Education and International Student Affairs continued to reinforce 211(d) endeavors in several ways-- helping to expedite and publicize visiting speakers; office assistance related to the Walk for Development, International House seminars, and other special activities that 211(d) students spearheaded; helping to explore available (this year more often not available) avenues of financial aid for "international" students; and communication about other campus activities of relevance. As noted earlier, the Dean of Business Administration, who has had previous interest in University international activities, provided a substantial part of the funding for Kusum Nair's visit.

Despite funding cutbacks, the Agricultural Library made new acquisitions of materials on India and international development at a somewhat accelerated pace -- several hundred items this year. The 211(d) professor was helped in making selections by three former India team members -- M. B. Badenhop, L. N. Skold, and D. M. Thorpe.

No University funds were specifically assigned to 211(d) work, but the value of time and support that related closely to 211(d) aims during FY 1972 might be estimated at \$34,900, not counting administrative time and office facilities:

Faculty time, other than the 211(d) Professor, devoted to international and development courses, "international" student advising, visitors, etc. (1 man-year equivalent)	\$ 20,000
Financial help (assistantships, workships, fellowships, tuition) to five non-211(d) students with international career interests, excluding time on U. S. oriented research	\$ 12,000
New agricultural library acquisitions related to India and international agriculture	\$ 2,000
Honoraria and expenses for off-campus speakers	\$ 600
Office supplies and reproduction of materials	\$ 200
Donated computer use	\$ 100

In terms of functional contributions, something like 47% (\$16,500) of this University support related to teaching and student professional development, 38% (\$13,200) to research reinforcement, and 15% (\$5,200) to consultative and public educational service.

IV. INTERNATIONAL PROGRAMS OF THE UNIVERSITY OF TENNESSEE

The major overseas undertaking of the Institute of Agriculture has been the AID contracts in South India. So with the phase-out of this program in September 1972, there will no longer be an institutional channel for overseas faculty service, foreign student enrollment on the agricultural campus will be down, and there will no longer be a full-time Director of International Agricultural Programs.

The implications for the 211(d) work will not be quite so severe, as these past two years the 211(d) Professor has moved into a functional focus on agricultural program planning and implementation that transcends India. However, it does leave him and others in the Department without a specific LDC setting to relate to firsthand, other than personal links to former associates and students abroad.

Not counting executive visitors, those who have retired, and those who are now at other institutions, there are 21 University of Tennessee staff members who have had long or short term assignments in India -- three in agricultural economics, three in agricultural engineering, two in agricultural information, four in extension administration and methods, one in library administration, and eight in plant and soil sciences. A number of these have expressed interest in other international involvements from time to time, as well as in sustaining contacts in India, should there be future opportunities. A few others in agriculture who have had overseas experience elsewhere or who have been close to 211(d) circuits have indicated similar interests.

Nearing completion is a history of Tennessee/AID agricultural programs in India that Dr. D. M. Thorpe has been preparing.

Elsewhere on the Knoxville campus, international activities continued this year at a modest but healthy pace. Foreign student enrollment, Fall 1971, was 455--up 14 percent from the previous year. Unlike some universities, budget squeezes did not bring cuts in foreign student services or international studies offerings; in fact, at least one or two additional international studies positions were opened up, and the area studies committees provided for the first time with some "seed money" to reinforce their activities. There were no major institutional involvements abroad, but individual faculty and students did undertake overseas learning, service, and research activities in a variety of contexts. Of particular relevance to the focus of this grant was the establishment in the Political Science Department of a graduate course series in comparative and developmental administration.

One intriguing line of inquiry was an exploratory study of cross-cultural communication problems initiated by the Division of International Student Affairs and the Department of Psychology. Innovative approaches involving TV taping of pairs and groups of students were employed. Funding to continue this is being sought.

V. EXPENDITURES

Grant expenses during FY 1972 were approximately \$51,053. This was below the \$55,000 figure projected in last year's report, mainly because only one graduate student and no faculty members went to India. Total Tennessee grant expenditures to date -- July 1968 through June 1972 -- were about \$160,535. This leaves some \$39,465 for the final grant year, plus \$1,775 credited to the 211(d) account as reimbursement for Dr. Brown's contributions to the USDA/AID agricultural policy shortcourse. See Attachment 2 for more line item detail, and Attachment 3 for estimated functional (teaching, research, consultive service) allocations.

Major expense items during the July 1971-June 1972 period were: the 211(d) professor's salary, stipends and tuition for the five 211(d) Fellows, half-time services of one secretary, and international air fare and initial expenses for Glenn Ames' research in India. Lesser items included travel to the 1971 211(d) review meetings; research-related travel by Ames and Thurston to Columbus, Madison, and Washington; computer and publication costs of the Cashdollar study; and some special postage, cable, and long-distance telephone expenses.

As in previous years, no equipment items were purchased under the grant. No expenses were incurred for the visiting international speakers; they were provided by other university sources or by their own sponsoring agencies. All of Dr. Brown's travel costs, except for the annual review meeting, were covered by the cooperating group concerned, and -- in accord with UT Institute of Agriculture policy -- any additional reimbursement received was credited to the 211(d) account. Air transportation and India-based expenses for Ames' study in Mysore were handled so as to utilize U. S. Rupee accounts.

Estimated expenses for Ames' India research, April-July 1972, beyond his normal fellowship stipend are:

International air travel and accompanied baggage	\$1,850
Passport, visa, shots	\$ 50
Maintenance while abroad	\$1,450
Student survey help, field travel, materials and other India research costs	\$ <u>300</u>
	\$3,650

VI. WORK PLAN & BUDGET FOR 1972-73

Grant work during FY 1973 will center around (1) completion of research previously initiated under 211(d) and digestion of results for more widespread dissemination, and (2) further development of training materials related to agricultural program planning and administration.

During the first half of the year, two 211(d) Fellows will be completing their research under Drs. Badenhop and Brown. Thomas Vollrath's M.S. thesis on cultural-institutional considerations in subsistence farmer modernization should be done by early Fall. Glenn Ames will be back on campus from India by early August, and expects to have his analysis and writing related to Mysore production credit repayment problems finished by Winter or early Spring 1973. The third remaining fellow, George Smith, will shift from 211(d) to Experiment Station auspices by September and will do his Ph.D. research on resource conservation considerations in Tennessee river basin development. In part this reflects the freeze on 211(d) research in India and the difficulties of doing substantive LDC-oriented research off-site, and in part personal family considerations of the student. Disappointing as this is, the stimulation and insight provided by Smith these past two years, and the future contributions he is likely to make, have still justified the 211(d) investment in him.

Drs. Brown and Badenhop will endeavor to generate informational feedouts from the Vollrath and Ames studies, as well as from the Cashdollar, Thurston, and Rebello studies completed during FY 1972.

Dr. Brown plans also to devote considerable attention to further evolution of concepts and teaching materials related to "grassroots" agricultural program implementation, in cooperation with the ADC/RTN workshop group, the East-West Food Institute, and the AID/TA/Development Administration group. He hopes to refine the 4250 course notes into a monograph that stresses decisionmaking at operational program levels. If the RTN activity continues as planned, there will be involvement in the further development of "model" course outlines and materials for teaching middle-level program managers. As one spin-off of this, the East-West Food Institute is proposing to try out a course of this nature, probably in Taiwan in late CY 1972, and has invited Dr. Brown to serve as a resource person in its planning and conduct. Also, AID/TA/DA has expressed interest in having him take part in some activities this coming year related to public and private sector agricultural management improvement efforts.

One of Dr. Brown's M.S. students, Robert Mabele from Tanzania, is planning to do a thesis study on informational and communicative components of marketing systems for smallholders in his home country.

The Department will endeavor to keep in touch with former students and other contacts in India, at least through correspondence, exchange of materials, and encouragement of further analysis and information dissemination stemming from previous research. Also, an effort will be made through library acquisitions and other means to keep up with agricultural development in India, Mysore State particularly...a need that perhaps becomes more important, now that AID and CUSURDI members have fewer direct associations there.

A May 1972 survey of Departmental faculty, initiated by the 211(d) Professor and the Department Head, disclosed that four or five professors have interest in short-term overseas assignments, and one or two long-term assignments, if leave arrangements could be worked out. Approaches have been made by international agencies to certain individuals, and possibly one will take such an assignment during the coming year.

More compatible for some with on-going campus commitments or at certain family stages is the idea of a few weeks abroad to backstop student research, follow through with former students, contribute to special training activities, etc. In terms of grant objectives of strengthening the departmental base for international teaching and research, it would be desirable for additional faculty to "get their feet wet" abroad in such manner, as well as for the professors most directly concerned with international teaching (Badenhop and Brown) to have direct LDC contacts from time to time. Remaining Tennessee grant funds seem sufficient to cover two, possibly three, such faculty involvements abroad. Since doing this in India does not appear possible in the near future, an eye will be kept peeled for outlets in other developing countries where interested faculty could both learn and make useful contributions.

Several possibilities are in mind. The 211(d) Professor could productively observe program difficulties and innovations to help improve the training materials that he is developing, and has contacts, in Latin America and Southeast Asia especially, that could afford this. Mr. Fuchs-Carsch, the Ph.D. candidate now working with agricultural planning in Ethiopia under AID auspices, plans to do a dissertation study related to this and would benefit by having a faculty member interact with him at an early point. At the same time this would also provide a handhold for the professor involved to become better acquainted with problems and programs in a developing country related to his particular specialty. Various professors in the Department have contacts in Africa, Asia, and Latin America with whom mutually beneficial linkages might be fostered. AID people have mentioned some possible research, consultive, or training needs where a professor or student could both help and learn. Firmer plans about how best to broaden faculty LDC experience with the remaining grant funds will be jelled early in FY 1973 in consultation with relevant AID personnel.

As shown in Attachment 2, unexpended grant funds going into FY 1973 are about \$39,465. It is proposed to use these mainly to cover the 211(d) Professor's salary; stipends, tuition, and research costs for the remaining 211(d) Fellows; part-time support of one secretary; and one or two faculty overseas learning/service activities, if appropriate opportunities in keeping with AID's and UT's concerns come along. In this last connection, if productive LDC linkages do not jell during the year or if other expenses are less than anticipated, AID concurrence may be sought for carrying over remaining funds into FY 1974 to help expedite such faculty involvements. Such carry-over would probably not be more than five or ten thousand dollars.

Looking ahead to July 1973, the 211(d) Professor will be shifting to conventional College of Agriculture/Experiment Station auspices unless new avenues of salary support for international development work become available. Teaching of development oriented courses, advising of international students, and occasional LDC involvements would still be possible, but he could no longer devote the bulk of his attention to such endeavors.

Finally, of possible interest to readers of this report are some administrative changes in the Institute of Agriculture, effective Summer 1972. The present head of agricultural economics and rural sociology, T. J. Whatley, is becoming Assistant Dean of the Agricultural Experiment Station. His replacement as Department Head will be J. A. Martin, whose previous work has been primarily in land resource economics at UT. Gist Welling, recent Tennessee/India Party Chief, is heading the newly expanded extension resource development group. W. D. Bishop, who was an India team consultant in 1970, has been named Dean of the Tennessee Agricultural Extension Service. There have also been recent realignments of departments related to the plant, soil, and animal sciences.

ATTACHMENT 1.

"INTERNATIONAL" AGRICULTURAL ECONOMICS STUDENTS ON BOARD DURING 1971-72

211(d) Fellows

- Glenn Ames.....Peace Corps, Venezuela. Completed Ph.D. prelims, Spring 1972. Field research in South India, Apr.-July 1972. Expects to complete dissertation by Winter 1973.
- Parker Cashdollar...Completed Ph.D. dissertation based on his field work in South India, Dec. 1971. Since Sep. 1971, Assistant Professor of Economics at U. of Tenn. Martin campus, teaching principles and development economics.
- George Smith.....Peace Corps, Ecuador and Bolivia. Completed Ph.D. prelims, Spring 1972. Starting Fall 1972, will shift to Experiment Station assistantship for dissertation research on river-basin development. Should complete by 1973.
- Robert Thurston.....Peace Corps, Venezuela. Completed M.S. thesis, June 1972. Starting Summer 1972, will be Peace Corps Associate Director, British Honduras.
- Thomas Vollrath.....Peace Corps, Upper Volta. Expects to complete M.S. thesis by Fall 1972.

Other Americans with International Interests

- John Anania.....Peace Corps, Mysore State, India. Completed M.S. thesis under Experiment Station auspices, Oct. 1971. Since Nov. 1971 has been extension economist with U. of West Virginia pilot Allegheny Highlands Project at Elkins, W. Va.
- Michael Fuchs-Carsch.Pease Corps, Kenya. Completed Ph.D. prelims Spring 1971. July 1971-April 1972, was economist with the Bureau of Census International Demography Center in Suitland, Md. Since then has been agricultural planning economist in Ethiopia under AID/Transcendury auspices. Hopes to develop Ph.D. dissertation related to this work.
- Ellen Gouin.....Peace Corps, Upper Volta. Expects to complete M.S. thesis under NSF fellowship, Summer 1972.
- Thomas Lederer.....Peace Corps, Mysore State, India. Completed M.S. thesis under Experiment Station auspices, Spring 1972. Will begin Ph.D. work in rural development at Pennsylvania State, Fall 1972.
- Merle Menegay.....Peace Corps, Mysore State, India. Began M.S. work, Fall 1971, under Experiment Station assistantship. Has been awarded an NSF traineeship, starting Fall 1972.

ATTACHMENT 1. (Continued)

Students from Other Countries

- Khairulah Dawlaty.....AID/Afghanistan Participant. Began Ph.D. studies, Sept. 1971. Hopes to develop dissertation related to Afghanistan foreign trade prospects.
- Leonardo Gonzales.....Philippines. Began Ph.D. studies, Sept. 1971, under IIE/Fulbright scholarship with UT tuition waiver. An Experiment Station workshop, starting July 1972, is enabling him to continue toward degree completion.
- Rene Gouin.....French citizen reared in Morocco. Agricultural technical assistance experience in Gabon, Senegal, and Upper Volta. Received UT/McClure Fellowship award, June 1971. Expects to complete M.S. thesis under Experiment Station auspices, Summer 1972.
- Sang Gee Kim.....AID/Korea Participant. Completed M.S. thesis, Summer 1971. Returned to agricultural economics research position in the Korean Ministry of Agriculture.
- Ying-Nan Lin.....Taiwan. Completed Ph.D. prelims, Spring 1972. Starting dissertation research under Experiment Station auspices.
- Robert Mabele.....Tanzania. Began M.S. studies, Sep. 1971, under AFGRAD scholarship. Plans to do thesis study related to farmer marketing programs of Tanzania.
- Noel Rebello.....AID/India Participant. Completed Ph.D. dissertation, Dec. 1971. Returned to faculty position in agricultural economics, Mysore University of Agricultural Sciences.
- Nelson Rodriguez.....Venezuela. Participated in the UT/Dominican Republic land tenure study and subsequent tabulations. Since Fall 1970 has been economist with the Inter-American Development Bank in Washington. Completed Ph.D. prelims, Summer 1972. Hopes to develop dissertation related to his IADB project evaluation work.
- Christian Saade.....Lebanon. Began M.S. studies, Sep. 1971. May do thesis related to livestock marketing in Lebanon.

ATTACHMENT 2.

ACTUAL AND PROJECTED 211(d)/TENNESSEE GRANT EXPENDITURES

	To Date			Projected	
	FY 1969-71	FY 1972	Cumulative FY 1969-72	FY 1973 ^c	5 Yr. Total
Personnel: ^a					
Salaries	\$ 63,927	\$23,100	\$ 87,027	\$24,000	\$111,027
Fringe benefits	4,759	1,823	6,582	1,920	8,502
Graduate Fellows: (No. on board)	(1-5)	(5-4)		(3-0)	
Stipends	26,030	16,366	42,396	5,433	47,829
Tuition	5,842	5,137	10,979	2,316	13,295
Travel, U. S. and abroad	7,393	3,663	11,056	3,200 ^d	14,256
Other ^b	<u>1,531</u>	<u>964</u>	<u>2,495</u>	<u>2,596</u>	<u>5,091</u>
Total	\$ 109,482	\$51,053	\$160,535	\$39,465	\$200,000 ^e

^aIncludes the 211(d) professor and partial support of one secretary.

^bMainly overseas research costs, computer use, reproduction of materials, postage, communications.

^cAuthorization may be sought to extend use of some funds into FY 1974 for faculty-LDC linkage and information dissemination purposes.

^dAllows for one or two faculty learning/service assignments abroad.

^eIn addition, \$1,775 has been placed in the 211(d)/Tennessee account as reimbursement for special help provided for the 1971 USDA/AID policy shortcourse.

ATTACHMENT 3.

ESTIMATED FUNCTIONAL DISTRIBUTION
OF 211(d)/TENNESSEE GRANT EXPENDITURES

	To Date		Projected	
	FY 1969-71	FY 1972	FY 1973*	5-Yr.Total
<u>Teaching</u> --courses, counseling, graduate study support, curricula building, special campus learning and LDC-feedback activities	\$ 55,300 (51%)	\$18,300 (36%)	\$ 7,500 (19%)	\$ 81,100 (41%)
<u>Research</u> --thesis studies on campus and in India, acquisition of research materials, establishment of links with India and elsewhere, preparation of materials based on research and LDC experiences	\$ 35,100 (32%)	\$17,900 (35%)	\$17,200 (44%)	\$ 70,200 (35%)
<u>Consultive and public service</u> --information to professionals in India and other LDC's, helps to other AID-related activities, international visitors, talks to Tennessee groups	\$ 19,100 (17%)	\$14,900 (29%)	\$14,700 (37%)	\$ 48,700 (24%)
TOTAL	\$109,500	\$51,100	\$39,400	\$200,000

* Authorization may be sought to extend use of some funds into FY 1974 to help reinforce faculty-LDC links if productive opportunities are not found in early FY 1973.