Project No. 386-0470

# P R O J E C T  P A P E R

## AGRICULTURAL RESEARCH



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# AGRICULTURAL RESEARCH PROJECT PAPER

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# AGRICULTURAL RESEARCH PROJECT
(386-0470)

## I. PROJECT RECOMMENDATION

Approval of a grant for a project to enhance the capability of the Indian agricultural research system to conduct research on selected priority problems requiring key scientific and technological development is recommended.

A. Grantee: The President of India

B. Implementing Agency: The Indian Council of Agricultural Research (ICAR)

C. Financing:
1. AID Contribution: Grant of $20 million
2. Grantee Contribution: $8 million equivalent
3. Total Cost: $28 million
4. Project Assistance Completion Date (PACD): September 30, 1989

D. Life of Project: Seven Years

## II. PROJECT RATIONALE AND DESCRIPTION

### A. Summary Project Description

The project will contribute to increased agricultural productivity, production, employment and income through creating new agricultural technologies designed to eliminate specific constraints to food production, preservation and consumption. It will enhance the capability of the Indian Agricultural Research system to deal with scientific problems related to the production and processing of relevant commodities in functional scientific areas. It will accomplish this through collaborative research between Indian and U.S. agricultural research scientists with cooperation and support of their respective institutions.

The project will deal with the scientific areas identified by the Indo-U.S. Agricultural Subcommission as high priority for U.S. collaborative assistance. The aim of the Project is to enable India to benefit from available technology in the U.S. The initial project design has focused on two research subprojects: soybean

processing and utilization, and post-harvest technology for fruits and vegetables. A procedure for adding and financing additional subprojects or for modifying existing subprojects is also included.

AID will provide $20 million in grant funds and the Government of India will contribute $8 million in local currency. The life of the project will be up to seven years with individual research projects to be completed, generally, in five years.

Funds provided by AID will support the following project elements: advanced training for Indian scientists in the U.S. and specialized facilities which are necessary to the success of the research endeavors; spare parts and some supplies; and additional research staff assigned to work on the subprojects. USAID/India, with non-project funds, will handle all logistics and management from the U.S. side. USAID will make all arrangements, for expatriate scientific consultations and training of Indian scientists at U.S. institutions with the concurrence of ICAR. USAID will also be responsible for arranging procurement of commodities to be imported into India under the project as per specifications agreed to by ICAR.

B. Objectives of the Project

1. Goal, Purpose and Outputs

The goal of this project is to increase agricultural productivity, production, employment and income.

The purpose of the project is to strengthen the capability of the Indian Agricultural research system to conduct research on priority problems in certain key functional scientific areas. Such strengthening will lead to increased agricultural production, improved technology for preservation and utilization of food crop commodities and increased efficiency and effectivness in select areas of scientific investigation. U.S. scientific collaboration can be particularly beneficial in these areas because of the technological advances made by the U.S. Land Grant universities, the U.S. Department of Agriculture, or other organizations.

The outputs of the project that will contribute to strengthening Indian agricultural research capability will be new knowledge of agricultural technologies developed during project research. The new technologies will be developed to tackle two priority problem areas initially: processing and

utilization of perishable fruits and vegetables; and processing and utilization of soybeans, a protein and oil bearing crop with great potential for improving income and nutrition in rural areas. These two subprojects are further described in this Project Paper.

India and the U.S. will also consider collaboration on additional subprojects such as: (1) integrated plant nutrient management systems with emphasis on biological nitrogen fixation; (2) energy research in agriculture, including use of solar energy for the use of wind power; (3) agro-forestry research and development of silvi-pastoral systems for food, fodder, and fuel systems; and (4) on-farm water management research. Other areas will be identified through the mutual agreement of the GOI and USAID.

In addition to specific subprojects, the Project can finance specific activities at the initiative of ICAR which are research related and consistent with the objectives of this project. This could include training, scientific exchanges between Indian and U.S. scientists, seminars, and workshops.

Through this project, the following inputs will be provided by AID and the GOI: scientific collaboration for the design and implementation of research subprojects; advanced training in the U.S. of Indian scientists, equipment and facilities required for research staff; and recurring costs.

2. End of Project

At the end of this project period, the Indian Agricultural Research institutions participating in the project would be expected to have acquired the capability to generate the scientific and technological advances required for a sustained growth in selected areas. The participating institutions of the Indian Council of Agricultural Research (ICAR) such as the Indian Agricultural Research Institute (IARI), the Indian Institute of Horticultural Research (IIHR), Bangalore, the Regional Research Center of IIHR, Lucknow, and the Central Institute for Agricultural Engineering (CIAE), will implement the initial two subprojects. As a result, they will have enhanced scientific capabilities in the identified problem areas. They will also have staff in place who are trained in the most appropriate innovative techniques in their areas. Hence, India's capability to respond creatively to specific constraints to food production, preservation and consumption will be improved.

## C. Rationale and Strategy

### 1. Overall AID Strategy for Food Production and Rural Employment

Given its importance in India's economy, the agricultural sector must provide not only for an improvement in per capita food supplies, but also a major impetus to overall employment generation and income growth. Thus, the GOI has set ambitious but feasible production growth rates for 1980-85 of 3.9 percent per annum for foodgrains overall, including 4.3 percent and 4.2 percent for diary products. Achievement of the Plan's agricultural production targets will support employment growth estimated at 3.5 percent per year in agricultural sector (including forestry and fisheries) to accommodate 15 million of the projected 34 million additional person years of employment needed to be generated during the Sixth Five Year Plan period.

The GOI's strategy for food production and rural employment combines efforts to consolidate and spread the agricultural production gains of the "green revolution" with targeted rural development programs aimed at raising household incomes above the poverty line. The first set of programs emphasizes expansion of agricultural infrastructure and input supplies, especially irrigation, high yielding varities (HYV) of seeds and other agricultural technology and fertilizer. The second set consists primarily of the National Rural Employment Program (rural works, including food-for-work) and the Integrated Rural Development Program (which includes special programs for small and marginal farmers, diarying and rural enterprise development). The GOI's agricultural policies are sound and provide an appropriate framework for both accelerated production growth and for expansion of employment and incomes for the rural poor.1/ Given the conducive environment for broad-based agricultural growth and population problems, agriculture is a suitable sector for substantial bilateral assistance to India.

USAID has reviewed the major GOI agricultural and rural development programs to determine those areas where U.S. technical expertise and financial assistance are likely to have the greatest impact. In some areas, institutions are relatively well developed and relatively little technology

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1/ See John R. Westley and M.C. Gupta, "Agricultural Growth in India. Policies, Performance, Impact", USAID/India, May, 1982.

transfer is appropriate. In some areas, other donors are already providing adequate support. This is true particularly of the state extension systems being strengthened under a series of World Bank projects.

One of the areas where AID can make an important contribution, particularly to the GOI's agricultural production strategy, is agricultural research and education. U.S. agricultural universities, with support from AID and the Ford and Rockefeller Foundations, have already made a major contribution in this area when they were involved in the development of India's agricultural universities and research institutions in the 1950's and 1960's.2/

Some of these research institutions are now well established and have a broad based capability to undertake agricultural research on a variety of crops. Indian research institutions also possess highly qualified staff and certain key technical equipment and resources. The institutional development that has occurred since the early 1960's is clearly evident. Nonetheless, there remain significant opportunities for futher strengthening the Indian research systems and for collaboration between U.S. and Indian scientists and agricultural research institutions.

AID also supports India's food production and rural employment goals through the Title II Food for Cooperatives and Food-for-Work program. The CLUSA/NDDB 3/ Oilseed Growers Cooperative Project is included in the Sixth Five Year Plan, and could make a significant contribution to soybean production. This would in turn assist India to reduce vegetable oil imports, which have been running at about 1 million metric tons or $600 - $800 million per year recently. Agricultural research financed under this project will contribute significantly to increased productivity leading to greater production and utilization of soybeans.

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2/ Over 300 staff members from six universities accepted assignments in India and over 1,000 Indian faculty members and graduate students studied in the U.S. The six universities were Kansas State University; University of Missouri; Onio State University; University of Illinois; Pennsylvania State University and University of Tennessee.

3/ Cooperative League of the U.S.A./National Dairy Development Board.

## 2. Agricultural Research and Education

The key to the transition from traditional to science based agriculture is the establishment of indigenous capabilities for search and innovation. India has made good progress since Independence (1947) in building up this capability. Agricultural research is conducted at 35 ICAR research institutes and 23 state agricultural universities under the coordination of ICAR.4/

The basis for a modern agricultural extension system was created in 1952 with the launching of the Community Development Program. Agricultural extension is now being strengthened with the adoption at the state level of the training and visit (T&V) system developed by the World Bank. A good foundation and demand for location-specific research results has been created. India's research and extension system played a crucial role in adapting the original wheat and rice HYV's to local conditions and using basic genetic materials imported from Mexico and the Philippines with high yield potential for development of new varities with short stature lodging resistance, fertilizer responsiveness and associated production technologies. The production increases which were achieved through the effective adoption of these HYV's in India illustrate that the nation has capable agricultural scientists and has been able to make substantial progress in many fields. Analyses of the productivity of agricultural research indicate that rates of return to research are on the order of 40-50 percent in India.5/

In order to reap the full potential of new agricultural technologies, India's agricultural research efforts must be strengthened for crops other than wheat and rice and for problems other than the development and adaptation of HYV's. Furthermore, technology which is applicable under one ecological situation may have to be modified substantially before it is useful in another very different environment. This is important in a country as large and as ecologically diverse as India. There is an urgent need to develop advanced capability in additional crops and scientific areas and to adapt them to India's varied environments.

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4/ See Annex C for a detailed discussion of the Indian Agricultural Research System.

5/ See Economic Analysis Section and Robert E. Evenson and Yoav Kislev, Agricultural Research and Productivity, New Haven: Yale University Press, 1975.

USAID and ICAR have been working to identify high-priority areas for collaboration which fulfill the need for the development of new and improved agricultural technologies. The Indo-US Agricultural Subcommission endorsed a preliminary list of research priorities at its initial meeting in September 1980.6/ The Agricultural subcommission met again in June, 1982 in Washington, D.C. At this second meeting, the previous list of research priorities was reaffirmed and additional topics were discussed.7/

This project will primarily finance subprojects from that list and other scientific areas consistent with the GOI Sixth Plan and AID's assistance strategy for India.

D. Project Elements

1. Nature and Scope of Activities to be Financed

The following elements will be required to implement effectively this Agricultural Research Project and will be financed by AID grant contributions to the Project: (1) additional staff; (2) staff training; (3) scientific consultation from the U.S.; and (4) laboratory and field equipment and supplies needed for the subprojects. Equally essential elements to be financed by GOI contributions to the Project are: (1) existing staff and part of the additional staff working in the selected areas; (2) physical facilities such as laboratories and other buildings; and (3) recurring project costs.

The GOI/ICAR will be prepared to take over full financing of assisted research subprojects upon termination of AID assistance to those subprojects. The AID contribution will finance 100 percent of all dollar costs as well as all local costs of training and equipment purchases in India; it will also finance costs of new staff on a declining scale over the life of the subprojects.

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6/ See Annex A Appendix 1 for the Minutes of First Meeting, September 1980.

7/ See Annex A Appendix 2 for the Minutes of Second Meeting June, 1982.

Indepth evaluations during year five of the project will consider the necessity for extension and funding of selected ongoing research activities after the fifth year.

A followup project may also be considered by the GOI and AID to undertake additional agricultural research and education activities if it appears to be feasible and useful.

2. Summary of the Elements to be Financed

a. Staffing

The Indian research system is composed of professional personnel (both scientific and administrative), technical staff and field hands. All additional staff required for ICAR and the subprojects will be financed under this project. Local cost financing of additional staff essential to strengthen the implementing ICAR institutions and to achieve subproject objectives in the proposed time frame will be financed on a declining scale by AID and an increasing scale by ICAR. Existing staff will be fully financed by ICAR.

b. Training

A key project element is the training of staff members of the ICAR implementing institutions in the latest technological advances in U.S. agricultural research. The project will emphasize, but not be limited to postdoctoral short-term training in specific problem areas in the U.S. at collaborating universities or elsewhere as appropriate. International travel for these participants will be financed by the project according to established AID procedures. Training in India will also be financed and will include work at ICRISAT (Internaticnal Crop Research Institute for Semi-Arid Tropics) or at the Indian universities.

c. Scientific Consultation

U.S. scientific consultation with ICAR and participating institutes will be supported under this project. The problem areas to be researched will be identified by ICAR where the U.S. has a particular expertise of value to Indian agricultural development. To enable the necessary technology transfer and development of necessary innovations to occur in these areas, U.S. consultants will

visit India on a short term basis to assist in the design and implementation of planned and future subprojects.

d. Equipment and Supplies

Necessary non-expendable equipment such as laboratory items and specialized research instruments will be financed by ICAR and AID and may, depending on the specific item, be purchased in the U.S. or India.

e. Facilities

The GOI will provide the land and buildings required to carryout the research program. To implement the subprojects and ensure that the necessary support is in place for experimentation, AID may finance some specialized equipment and physical facilities, such as warehouses and plant growth facilities.

3. Implementation Arrangements

In the U.S., a large number of individual actions in implementing training and scientific collaboration will be required. It is essential that the best available resources be provided to the project in a timely and efficient manner. This will require the investment of a considerable amount of staff work in identifying experts and making arrangements for this participation and organizing logistics. Responsible staff must have a solid understanding of the program and be experienced in working overseas. The services of qualified U.S. universities or consortia thereof or other agricultural research entities may be contracted by USAID to provide the short-term specialized services for counterpart Indian institutions in undertaking research, handle procurement of specified equipment, arrange for training of Indian technicians and scientists, as well as for consultants when needed to assist with the design of new subprojects as requested by ICAR and USAID.

E. Other Donors in Agricultural Research 9/

The Indian agricultural system is receiving useful assistance from the donor community. The format of much of the assistance is similar to the assistance mode proposed in the AID agricultural research project. This includes the

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9/ See Annex K for details.

funding of scientific consultation, training, equipment and facilities and staff support in selected research areas. This project will complement the work of the other donors as they undertake strengthening efforts for different institutions in the ICAR system.

## III SUMMARY PROJECT ANALYSES

### A. Technical Project Summaries

In September 1980, the Working Group on Research and Education of the Indo-U.S. Subcommission on Agriculture identified a number of priority areas in which U.S. collaboration would be helpful.10/ These areas are consistent with India's priorities for agricultural research outlined in the Sixth Five Year Plan and to be included in the Seventh Five Year Plan of the GOI. They are also recognized as problem areas for which the U.S. has an established capability and scientific expertise. Given the existing agricultural research system in India and the excellent quality of India's scientists, collaboration on the development of solutions for these and other such problem areas provides an opportunity for mutually beneficial Indo-U.S. interchange. This collaboration provides an initial basis for the selection of subprojects to be undertaken through the proposed agricultural research project.

Two research subprojects - soybean processing and utilization and post-harvest technology for fruits and vegetables - are being initially designed under this project. Summaries are provided herein and detailed descriptions are included in Volume II.

The set of second priority subprojects which have not yet been designed, but which are likely to be included in this project are: Biological Nitrogen Fixation; Energy Research in Agriculture; Agro-forestry; On-farm Water Management Research and Management of Agricultural Research and Education Systems. Other topics in agricultural research may also be considered for financing under the project.

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10/ See Annex A - Indo-U.S. Subcommission meetings.

## SUBPROJECT 1. SOYBEAN PROCESSING AND UTILIZATION

### Background

The per capita availability of food for the Indian population has increased only slightly during the past thirty years. Furthermore, the nutritional quality of the common Indian diet is not adequate to meet necessary protein consumption requirements. The production and utilization of soybeans has great potential for augmenting human nutrition in India. Soybean production currently covers 743,000 hectares and is targeted for 1,800,000 hectares by 1985-86.

The nutritional potential of soybeans in this context is considerable. They contain about 40 percent protein and 20 percent oil, almost all of the essential amino acids, and a large amount of unsaturated essential fatty acids. Supplementation of cereals with soy protein provides an amino acid complementation which results in increased protein quality and quantity approaching that of animal protein. This improved food quality is important because of its acceptability to India's population which is largely vegetarian. In addition to its high food value, soybeans are one of the least expensive sources of protein. Therefore, it would be advantageous to develop processing and utilization techniques that would make soybeans more widely available.

### Purpose and Description

The basic objective of this project is to maximize the use of soybeans as a food source through improving its processing and utilization with particular attention to the low income segment of the society. Research activities, therefore, are geared to the development of simple and adaptable soybean processes and equipment and subsequent technology transfer to the rural population at the home, village and small industry level.

The Central Institute of Agricultural Engineering (CIAE), an ICAR institution located at Bhopal, Madhya Pradesh, will be responsible for conducting the research activities in soybean processing and utilization. Some of the scientific staff, technical staff, laboratories and equipment are available. The project will complement the work of the "All India Coordinated Research Project on Soybeans" which is developing soybean varieties suitable for differing regions. It will also complement the breeding program for developing high-yielding varieties with high resistance to diseases and pests at G.B. Pant University, J.N. Krishi Vishwa Vidyalaya and the Indian Agricultural Research Institute (IARI).

The specific components of the subproject are:*/

1. The development of processes and equipment for full-fat soybean flour applicable to the home, village and small industry level;

2. The development of processes and equipment to obtain dal (splits) from soybeans applicable to the home, village and small industry level;

3. The development of low-cost extrusion cooking processes and equipment for soybean flour and other soy products applicable to the small industry level;

4. The development of processes and equipment for preparing low-fat soybean flour applicable to the village and small industry level;

5. The development of processes and equipment for soy flour supplemented baked products applicable to the small industry level;

6. The development of processes and equipment for fermented and coagulated soy-based products applicable to the home, village and small industry level;

7 The establishment of appropriate systems technologies for handling, storage and packaging of whole soybeans and soy products; and

8. Supportive training program in oilseed processing and utilization.

*/ additional components may be added at a later time according to established procedures.

The project will finance the following inputs to accomplish these components:

1) supplemental staff at CIAE at the scientist, technical and labourer level; 2) training for Indian scientists; 3) U.S. scientific consultation and 4) some laboratory equipment. 15 scientists will be supported by the subproject. 58 months of direct subproject related training and 50 months of support in academic and other training will be provided. 25 months of scientific consultation are planned.

# ILLUSTRATIVE BUDGET FOR SOYBEAN PROCESSING AND UTILIZATION

## (GOI AND AID)

## ALL FIGURES DENOMINATED IN U.S. DOLLARS

## ($000)

| ITEM | | AID | | | GOI | TOTAL |
|---|---|---|---|---|---|---|
| | | FY | LC | TOTAL | LC | |
| A. | Training, Workshops | 552 | 24 | 576 | - | 576 |
| B. | Consulting Services | 375 | - | 375 | - | 375 |
| C. | Commodities & Equipment | 527 | 356 | 883 | - | 883 |
| D. | Facilities | - | - | - | 174 | 174 |
| E. | Office Equipment/Supplies | - | - | - | - | 80 |
| F. | Operational Research | - | 142 | 142 | - | 142 |
| G. | Vehicles | - | - | - | 28 | 28 |
| H. | Maintenance | 196 | - | 196 | 459 | 658 |
| I. | Staff: Present | - | - | - | 109 | 109 |
| | New | - | 152 | 152 | 163 | 315 |
| | TOTAL | 1650 | 674 | 2324 | 1013 | 3337 |

Note: Figures shown above are estimates and are subject to change.

SUBPROJECT 2 POST HARVEST TECHNOLOGY OF FRUITS & VEGETABLES

The proposed subproject in postharvest technology of fruits and vegetables focuses on improving the postharvest system for seven perishable commodities; namely, mangoes, citrus, guava, banana, onions, potatoes and tomatoes. Investigations are to be conducted at four locations involved in the "All Indian Coordinated Program on Postharvest Technology of Horticultural Crops", Indian Council of Agricultural Research (ICAR). Research is to be conducted based on the entire marketing system starting with preharvest and harvest problems and continuing to either the terminal market and/or the processing facility. The limitations of the present infrastructure, such as inadequate containers, insufficient cooling and poor transport, are outlined with proposed research alternatives including the use of evaporative cooling, improved handling and harvest methods and variety selection. Economic losses and impact of new methods will be determined.

New and modified postharvest technology systems for fruits and vegetables focus on minimizing postharvest losses. The overall objective is to increase the food supply and improve the nutritional status of the Indian people by reducing postharvest losses and improving quality of the selected crops.

Research on reducing postharvest losses of the selected crops will be assigned to three existing research institutes: Indian Agricultural Research Institute at Delhi (IARI); Regional Research Center of IIHR, Lucknow; RRC, Lucknow; Indian Institute of Horticultural Research (IIHR), Bangalore. In addition, the creation of a new research center at Nagpur by ICAR is contemplated. IIHR, Banglore, IIHR, Lucknow and the Nagpur Research Center were identified on the basis of their strategic location in regions of excess crop production, which requires transport to other regions while IARI is located in Delhi which receives substantial quantities of produce from other regions. Each of the existing institutes have scientists and facilities capable of supporting limited research programs on reducing postharvest food losses, however, additional scientists will be rquired to support the proposed research program.

The subproject will finance scientific equipment, training of Indian scientists and consultation of U.S. scientists for each of the proposed four locations.

SUBPROJECT 3 BIOLOGICAL NITROGEN FIXATION

The biological nitrogen fixation (BNF) process supplies most of the nitrogen requirements of leguminous crops. The pulses like Bengalgram, peas, pigeonpea, greengram, blackgram, lentil, soybean and groundnut are important food crop legumes in India. The importance of these crops is illustrated by the fact that the GOI has targeted oilseed production at 13.5 million tons and pulse production at 14.8 million tons for 1982-83.

Currently, pulse yields in India are less than half the yields of cereal crops. Cereal yields are generally higher because of the availability of HYV's and the use of nitrogen fertilizer. Fertilizer nitrogen is essentially dependent of fossil fuels and therefore, increasingly expensive. Moreover, since food crop legumes are capable of biologically fixing nitrogen from the atmosphere, it is prudent and critical that ways be found to utilize this process more effectively for meeting crop nitrogen requirements in the future.

A number of species of bacteria and algae have the ability to utilize (fix) gaseous nitrogen from the air. Some of these micro-organisms work symbiotically in nodules on the roots of plants and require an energy source from the host plant. These bacteria (Rhizobia) thus far are the most important in terms of agricultural legumes crops and have been shown to fix up to 400 kg/ha/yr of nitrogen under ideal conditions.

A major limitation to development and promotion of appropriate cultures for leguminous crops is the lack of viable effective inoculants for many of the legumes. The kind of legume and soil conditions vary between different locations. Rhizobium strains need to be selected for particular legumes and soil and climatic conditions. However, rhizobium inoculants are highly perishable and often lose viability bfore reaching their destination.

Priority components of the subproject will be to: (1) survey and screen different BNF systems under agro-climatic conditions in India and to develop a National Culture Collection of both Rhizobium and Azospirillum; (2) to ascertain whether significant yield increase can be obtained using available legume inoculation technology; and develop a procedure to ensure quality of legume inoculants available to farmers.

This project will benefit greatly from Indo-U.S. collaboration. The technology in the U.S. is highly advanced and there are more centers of BNF research in the U.S. than in any other country.

## SUBPROJECT 4 NATIONAL CENTER FOR ENERGY IN AGRICULTURE

The rural agriculture sector of India makes extensive use of non-conventional energy sources. Firewood, plant and animal residues, human and animal power and direct and indirect solar energy are presently used in the rural household and village setting for a variety of tasks related to agriculture. Because of the constraints on resources and necessary capital needed for development of large scale commercial sources of energy, the agricultural sector in India must develop and rely on conventional alternative sources of energy. This requires careful analyses of the new technologies especially in terms of their potential suitability to the rural setting as well as the cost and management requirements for their adoption. Nevertheless, the finite supply and escalating prices of the world's oil dictate that new and enhanced use of renewable energy technologies must occur on a broad scale throughout India even though the present cost of many of these technologies is beyond the reach of many of the rural population at present.

A broad range of alternative energy sources and technologies can be developed. None of these will alone offer a complete solution to the energy requirements. Thus, considerable effort is needed to identify, develop and disseminate these resources.

The agricultural sector in India has a critical need to develop new energy technologies, both for production agriculture and the post harvest technology. The lack of suitable transportation, packaging, storage facilities and other processing industries account for high food losses in India and low returns to the growers in the event of the good crop. During the last ten years the GOI has initiated a number of projects aimed at solving these problems. Progress has been made in certain areas such as biogas production and limited use of solar energy. However, the GOI recognizes that more effort is needed, particularly in the research and development of new technologies.

Recently, the ICAR has created a "professor of eminence" position at Punjab Agricultural University with focus on intensive energy research in India. Currently, studies are begin undertaken to quantify energy balance and technology substitution in agriculture and related agro-industry, characterize potential bio-mass types, analyze the thermodynamics and chemistry of bioconversion processes and develop economic gasifiers and biomass processes. Since 1971 there is an all India coordinated ICAR Scheme on Energy Requirememts in the Agricultural Sector, monitoring energy needed, energy available and identifying critical gaps. The ICAR has launched an All India Coordinated Project on Renewable Energy Sources in Agricultural and Agro-based Industries. The Central Institute of Agricultural Engineering in Bhopal has created a strong research team on Agriculture Energy and Power.

The subproject to be designed and implemented under the Agricultural Research Project will have the objective of assisting the ICAR in strengthening an advanced center to undertake appropriate energy research and development studies aimed at finding suitable technologies for the agriculture sector in India. Priorities will be to analyze information related to the energy requirements in various agriculture production and postharvest systems; identify and research promising sources of solar, wind, biogas and other bioconversion technologies appropriate to India; and develop and evaluate on an adaptive or pilot level the new technologies, including the management and cost effectiveness of adoption.

This subproject would complement the solar energy activities being supported under the Technologies for the Rural Poor Project (386-0465) and the bioconversion activities supported under the Alternative Energy Resources Development Project (386-0470).

The U.S. has developed a number of outstanding research centers in the field of energy research in agriculture where collaboration with this subproject will be beneficial.

SUBPROJECT 5

## ON-FARM WATER MANAGEMENT

There is enormous scope throughout India for improving rainfed agriculture through better utilization of rainfall in relation to regionally specific land use capabilities. Although existing and planned irrigation schemes are critical to agricultural production, irrigation facilities alone will not be available to maximize productivity for a major portion of India's rainfed agroclimatic zones.

Increased population has placed high demand on soil, timber and water resources throughout the country. The needs of food, fodder and fuel have resulted in uncontrolled exploitation of forest and soil resources. Deforestation, besides reducing timber resources, has resulted in severe soil erosion, reduced ground water recharge, higher incidence of flooding and sedimentation problems. The nature of monsoon rainfall in India aggravates these conditions especially under improper management. On the average nearly 6.7 million hectares of agricultural land are flooded annually while at the same time more than 50 districts are declared drought stricken.

Soil conservation has been practiced in India since the First Plan period. Nearly 23 million hectares constituting 13% of the total cultivated area has received some sort of conservation program. However, there is now a need to rethink concepts regarding soil conservation programs because of the changing agricultural production technology and increased population pressure on land resources. Moreover, the availability of new technologies for computing hydrologic data, quantifying climatic, soil and groundwater parameters offers a new approach for evaluating land use productivity while maintaining effective conservation measures at the same time.

Conservation efforts must now be conceived in view of the needs for food, fuel and fodder. Thus, development of an effective means to manage resources and maximize productivity requires scientific analysis of an integrated ecosystem. This involves integrating conservation technology with production technology so that farmers benefit and the natural resource base of the nation is protected. Conceptually, a number of scientific disciplines must be interrelated in order to develop land and water management systems.

The objective of this subproject is to develop an effective scientific basis for managing irrigation on farms under different agroclimatic zones in India. The U.S. has four to five decades of intensive experience with agricultural irrigation and on-farm water management research in the USDA as well as the land grant universities. Techniques for efficiently obtaining field data and for its interpretation have been well developed. U.S. universities and USDA research centers will collaborate in the project.

SUBPROJECT 6 AGRO FORESTRY RESEARCH AND EDUCATION

India has approximately 75 million hectares of forested land of which only 30 million hectares are considered productive forest and these are, for the most part, relatively inaccessible. Most of the remaining 45 million hectares designated as forest are presently unproductive as a result of indiscriminate timber and fuel wood harvest.

Because of population pressure, the demand for both fuel wood and timber products has increased significantly in recent years. At the same time, food production requirements are increasing and this makes it imperative to conceptualize new approaches to reforestation programs which take into account the food, fodder and conservation needs of the country. Presently, social forestry programs have been designed and funded in most major states of India and these attempt to focus on developing a process of integrated rural development where local fuel wood and other needs can be met. Although considerable progress has been made over the last few years in social forestry, it is recognized by the GOI that the lack of basic and applied research is limiting social forestry development.

The National Agricultural Commission has drawn attention to developing a strategy of "Production Forestry", "Social Forestry" and "Forestry Research and Education". Both production forestry and social forestry must rely on forestry research and education in order to develop strong cohesive programs. The USAID Forestry Sector Review (1982) concluded that agro forestry research and education was paramount to developing an effective national strategy. Urgent attention must be given to basic and applied research that integrate forest and agricultural production systems.

This subproject will be implemented through the ICAR and will establish and strengthen a National Agroforestry Research Center. Coordination with other Indian centers, universities and institutions involved in forestry and related resource management problems in improvement of tree crop systems will be developed. The objectives of the project will be to conduct necessary supporting research on tree crop genetics, soils, ecology, physiology, biochemistry, tissue culture and other fields to support the tree improvement effort for social and production forestry in agriculture systems. Specific priority activities will include, but not be limited to, (1) special studies aimed at defining forest-food crop production systems under different agroclimatic conditions, (2) selecting superior tree species and genetic improvement, (3) establishing seed orchards and (4) field testing plant communities for efficiency of biomass production. Special emphasis will also be given to training of forest scientists.

Strong and active collaboration with U.S. institutions with advanced experience in forest research and resource management will be brought into the subproject.

This activity will complement the biomass research and development activities supported under the Alternative Energy Resources Development project (386-0474) as well as the activities planned under the proposed FY 1984 Forestry Research, Training and Extension Project (386-0488).

## OTHER SUBPROJECTS

Other areas of agricultural research already identified by the Indo-U.S. Subcommission can be considered for inclusion in this project. The list of topics selected for research cover important problems; such as, livestock breeding technology with emphasis on efficiency of production and animal utility, pest management including the use of insect pheromones and control of nematodes, and research on bioregulant and plant hormone utilization, management of agricultural education and research systems.

## B. Administrative Analysis 11/

### 1. Organization and Administration of ICAR

The Minister for Agriculture and Irrigation in the Government of India is the President of the Indian Council for Agricultural Research (ICAR). The Minister of State in the Ministry is the Vice President of ICAR. The Director General of the Council is the principal executive of the Council. He is concurrently Secretary to the Department of Agricultural Research and Education of the Government of India. He also functions as the principal advisor to the GOI on all matters connected with agriculture, animal husbandry and fisheries research and education.

At the headquarters of the ICAR, the Director General is, on the technical side, assisted by four Deputy Directors General for (a) Crop Sciences, (b) Soils, Agronomy and Agricultural Engineering (c) Agricultural Education and (d) Animal Sciences. The Deputy Directors General are assisted by Assistant Directors General and other technical officers. On the administrative side, the Director General is assisted by the Secretary of the Council who is also the Joint Secretary in the Department of Agricultural Research and Education. The secretary is assisted by a Director of Personnel, a Director of Finance and a number of Additional Secretaries, Under Secretaries and other administrative staff.

The activities of the ICAR are financed by the Government of India by: (a) outright grants-in-aid and (b) receipts of the Agricultural Produce Cess Fund. In order to impart the desired degree of operational flexibility and speed in project implementation, the GOI has agreed to give a lump sum grant to the Council every year. This will be composed of two parts; viz., (1) Plan and (2) Non-Plan. The Council can economize on certain items and reappropriate funds for other purposes within its charter. As regards Plan outlays, the Council is able to reappropriate from one approved scheme to another provided the total outlay of all schemes for a five year period does not exceed the approved outlay in the Five Year Plan. The Additional Secretary to the Ministry of Finance is associated with the ICAR as a member of the Governing Body and advises the ICAR on all matters relating to its budget and expenditure.

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11/ See Annex C for more extensive review.

As the agency is responsible for the central government's contribution to both agricultural research and education, the ICAR ensures linkages between central and state governments and facilitates cooperation with international agricultural research institutions and other international organizations. India has established effective working relationships with many of the international research centers and has made a substantial contribution to these centers and the international community. It has a budget of $378 million for the Sixth Five Year Plan.

2. Functions of ICAR

The ICAR provides financial, technical and management support for the following institutions and projects:

- The twenty-three State Agricultural Unversities.
- Thirty-five centrally-controlled agricultural research institutes and centers and four project directorates;
- More than sixty-five nationally coordinated research schemes on commodities on problems of widespread concern;
- Operational research projects in selected areas and on applied subprojects in various parts of the country;
- A limited number of ad hoc reserch projects conducted by individual institutions; and
- Implementation of the Lab-to-Land program through all ICAR research projects; this program aims to transfer technology from the laboratories to the marginal and small farmers.

These activities are discussed in further detail below:

a. The State Agricultural Universities

The ICAR is responsible for the coordination and promotion of higher agricultural education in India. One of its most important functions is to improve the standards of education and train qualified personnel to provide a sound technological and scientific base for Indian agriculture. To accomplish these functions, the ICAR provides assistance to the agricultural universities for: (1) their development programs; (2) the improvement of staff pay scales and (3)

scholarships, fellowships and teacher training programs. The ICAR handles this support through its educational division under the Deputy Director General for Agricultural Education.12/

The present system of twenty-three agricultural universities in seventeen states was developed over the last twenty years to provide scientific education which would serve the needs of the farming community. The universities were designed to be involved in both teaching and applied research and their students were expected to learn a practical orientation to agricultural problems. See Annex B, Appendix A for a list of State Agricultural Universities (SAU).

b. Research Institutes

The ICAR provides management and financial support to thirty-five centrally controlled research institutes and project directorates which have been established to ensure in-depth research on a wide range of commodities and scientific problem areas.

The Indian Agricultural Research Institute (IARI) in Delhi is a major center of research and training in India. It was established in Pusa (Bihar) in 1905 and later transferred to Delhi in 1935. The major functions of the Institute include: basic and applied research into selected aspects of crop sciences, teaching at the post-graduate level, and conducting extension advisory services in the villages in the Union Territory of Delhi.

IARI is renowned for its contributions to the advancement of knowledge in agricultural sciences in India. Although it is a research institution, it has acquired the status of a deemed university by the 1956 Act of University Grants Commission. It has now been training students for Masters of Science and Ph.D degrees in as many as fifteen disciplines, and its functions are spread over as many as seventeen divisions.13/

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12/ ICAR, History and Growth: Indian Council of Agricultural Research, New Delhi, December 1976, pp. 127-128.

13/ Genetics and Plant Breeding, Seed Technology, Plant Pathology, Microbiology, Agronomy, Soil Science and Agricultural Chemistry, Agricultural Physics, Bio-Chemistry, Agricultural Chemicals, Entomology, Mycology and Plant Pathology, Horticulture, Vegetable Crops and Floriculture, Agricultural Engineering, Agricultural Economics and Agricultural Extension.

The other research institutes for specific scientific research are located throughout India. When the network of these institutes was merged with the work at the Center through the ICAR, it enabled the problems of agriculture to be viewed comprehensively.14/ ICAR incorporates a wide variety of research endeavors countrywide and provides a significant mechanism for the development and transfer of applied agricultural technology.

c. All India Coordinated Research Projects

ICAR also organizes and finances more than sixty-five national coordinated research schemes on commodities or problems of widespread interest.15/ These projects operate through ICAR institutes as well as through agricultural universities and therefore, provide a link between Center and State level institutions. While the ICAR institutes and agricultural universities organize research on fundamental and applied aspects of production, preservation and utilization of crops, animals and fish, the coordinated projects undertake applied research on specific commodities. The coordinated projects complement the work which is carried out at the State agricultural universities and research institutes of ICAR.

The National Coordinated Maize Improvement Scheme, instituted by ICAR in cooperation with the States in 1957, laid the foundation for more effective national planning of research on a commodity or problem basis. It provided a model for the development of other national coordinated schemes. The basic format of the program included a national coordinator, based at IARI, four highly productive maize hybrids were developed, tested and prepared for release with wide adaptability in the Gangetic Plain, the Terai and the Deccan. The scheme resulted in the development of plans for the National Seeds Corporation which would arrange for production and distribution of foundation and certified seeds of these hybrids and improved varieties and hybrids of other crops for use by farmers throughout the nation. This model of research proved to be an effective means to tackle particular commodity-specific problems.

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14/ The ICAR Institutes are listed in Annex B, Appendix B.

15/ The All India Coordinated Research Projects are listed in Annex B, Appendix C.

Major advances have been achieved through this coordinated research model for the production of several crops, most notably wheat and rice. Indian scientists further developed basic genetic materials from abroad to incorporate, among other things, desired grain quality, broad-based resistance to pathogens and better adaptation to the country's differing ecological zones.

Several of the All India Coordinated projects will relate to the research to be financed under the project. They are soybeans, oilseeds (groundnut), post-harvest technology of fruits, vegetables, citrus and potatoes.

d. Other Research Projects

The ICAR also conducts operational research projects in specific areas of the country to gain an insight into the socio-economic constraints affecting the adoption of research results.16/ The soybean processing and utilization subproject will finance an operational research component for testing and demonstrating the subprojects research results. ICAR also supports a number of ad hoc research projects conducted by individual institutions.

e. The Lab-to-Land Program

In 1979, the ICAR instituted an experimental program which aims to transfer the latest proven and viable agricultural technology to 125,000 farm families of small and marginal farmers, landless laborers and other communities in rural settings representing the poorer socio-economic groups. The Lab-to-Land program is being implemented by the Council through the existing research centers of the ICAR institutes, agricultural universities, affiliated agricultural colleges and voluntary organizations. Scientists in over 300 research locations of the ICAR are participating in this program.

The Lab-to-Land program is operating in eight agroclimatic zones in India and involves the selection of target farm families who receive assistance, emphasizing families having one to two hectares of land and are willing to adopt new agricultural technology. ICAR scientists are developing and implementing individual farm plans for the selected families. In addition, training of farm youth and farm women is also being undertaken to accelerate the adoption of new agricultural technology.

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16/ These projects are listed in Annex C, Appendix D.

The program has provided a farm level interaction for research scientists that will permit the design of highly relevant research activities to cope with farmer's problems. Based on the success of the program, the ICAR has decided to extend it until May 1985. About 75,000 new farm families are expected to be involved in the program's second phase.

3. Staffing Policies

The ICAR has constituted various selection committees interview boards for the selection of personnel for scientific and technical posts at the ICAR headquarters and at the institutes.

Boards have also been set up for the selection of Directors in various grades at the institutes. Boards include the Chairman of the Agricultural Scientist's Recruitment Board, the Director General or his representative and two to three advisors. The President, the Vice-President, the Director General, the Directors of the institutes and the Secretary also have specific appointing authorities for specific salary levels.

The recruitment board is responsible for the recruitment to posts in the Agricultural Research Service (ARS) and other such posts and services as may be specified by the President.

ICAR has a comprehensive personnel policy and procedures to recruit qualified staff, provide career development opportunities at all staff levels and offer a good promotion potential. Through this system, including the ARS, the ICAR has been able to attract numerous qualified Indian scientists and technicians, employing over 13,000 people.

C. Socio-Economic Analysis

It is possible in principle to assess the economic gains likely to accrue from agricultural research programs or from particular agricultural research activities such as the subprojects proposed for funding under this project. Since the late 1960's a large number of ex post benefit-cost analyses of agricultural research have been carried out and a good deal of effort has been devoted to the development of ex ante models for agricultural research resource allocation. These include benefit-cost as well as more comprehensive economic models.17/ Unfortunately, these ex ante methods are

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17/ Vernon W. Ruttan, Agricultural Research Policy, Minneapolis: University of Minnesota Press, 1982; see Chapter 10, "The Economic Benefits from Agricultural Research", and Chapter 11, "Research Resource Allocation".

generally relatively expensive to apply and require an extensive base of high-quality data. Also, ex ante estimates of long-term research benefits necessarily remain highly speculative and subjective, and there is a wide range of plausible outcomes.18/ Consequently, neither the ICAR nor USAID has attempted to carry out ex ante benefit-cost analyses of the initial subprojects. However, a University of Minnesota consultant provided under AID's Asia Agricultural Research Review Project assessed the overall productivity and distributional impact of agricultural research in India as well as the prospects for each of the subprojects. His report is included as Annex B. This section summarizes the consultant's conclusions on benefits and benefit incidence and adds some observations on socio-cultural feasibility participation, replicability and on the role of women. Additional subprojects considered for funding under the project will include an economic analysis as a part of the subproject proposal.

1. The Economics of Agricultural Research in India: Overview

A number of studies in past investment in Indian agricultural research have indicated that the rates of return from research have been high. The estimates on internal rates of return are summarized in Annex B Table 1. It should be noted that most of the returns to research in the earliest study (Evenson) are due to research before the "Green Revolution" wheat and rice varieties were introduced. Thus, it was Indian research, not research in Mexico or the Philippines, which produced these results. The new agricultural technology of the mid-sixties did lift the productivity of the research system and this probably accounts for the difference between the two time periods in the later study by Bal and Kahlon. The higher rates of return to agricultural research may also reflect increasingly favorable pricing and other policies for foodgrains after the mid-1960's.19/

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18/ ibid., Chapter 11, and C. Richard Shumway, "Models and Methods Used to Allocate Resources in Agricultural Research: A Critical Review", in Thomas M. Arndt, Dana G. Dalrymale and Vernon W. Ruttan, Resource Allocation and Productivity in National and International Agricultural Research, Minneapolis: University of Minnesota Press, 1977.

19/ USAID/India, "Agricultural Growth in India: Policies, Performance and Impact", May 1982, Section I.

The high-yielding cereal varieties (HYV's) introduced in the mid-1960's were highly responsive to fertilizer and performed best under irrigated conditions. Consequently, they had the greatest impact in those areas already well endowed with institutional and physical infrastructure and have probably served to widen regional income disparties (see Annex A, Table 2). With respect to the incidence of benefits between producers and consumers, between large and small farmers and between farmers and landless laborers, however, the recent evidence suggests that the overall distributional impact has been favorable. Real foodgrain prices have declined since the mid-1960's (see Annex A, Table 1); the poor have benefitted most from this decline, since they spend 50-60% of their income on foodgrains, whereas the rich spend a much smaller percentage of their income on basic food items. Small farmers have been quick to adopt HYV's (despite a tendency to lag behind large farmers initially), and the HYV's themselves have increased employment.20/ Overall, the foodgrain production increases associated with HYV's may have resulted in an improvement in rural income distribution.21/ In Punjab and Haryana, the states with the most rapid foodgrain production growth in the 1960's and 1970's, the percentage of the rural population below the poverty line declined to 12% and 23% respectively by 1977-78, as compared with the Indian average of 51%.22/

Returning to the issue of impact on productivity, the fact that rates of return to research investment have been high in the past does not necessarily mean that returns to all new research projects will be high or even positive. There has been and will continue to be considerable variation in the rates of return on individual projects. The results of this proposed project, whose component sub-projects are not homogenous, may also show substantial variation. However, the high pay-offs from the sub-projects that are successful is likely to be sufficient to make up for those that are not.

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20/ ibid., Section III and M. Prahladachar, "Income Distribution Effects of Green Revolution in India: A Review of Empirical Evidences, "University of Minnesota, Economic Development Center, April 1982, Section I.A and 2.

21/ USAID/India, op. cit., Section III.A.

22/ ibid., Section IV.A.

## 2. Soybean Processing and Utilization

Soybean cultivation in India was introduced during 1971-72 and has increased to about 600,000 hectares in 1980-81. The major expansion of soybean cultivation has taken place in Madhya Pradesh where this proposed subproject will be implemented (Bhopal). The projected land area for soybean cultivation is targeted for 1.8 million hectares during the Sixth Five Year Plan. In as much as soybeans do well in the dry farming areas and under diverse soil/climatic conditions, soybean hectarage and production should continue to expand rapidly. From the nutritional standpoint, soybeans contain about 40 percent protein and 20 percent oil, characteristic of a product having high protein/energy ratio. Supplementation of the traditional cereal based mixed diet with soy products can provide protein quality and quantity approaching that of animal protein. In addition to its high food value, soybeans are one of the least expensive sources of protein.

Although soybeans were introduced in India primarily as an additional protein source, this main objective is currently not being met. Past research emphasis in India has been primarily on the utilization of soybeans to augment oil production. Laboratory studies at Indian universities (G.B. Pant University of Agriculture and Technology, Pantnagar, J.N.K.V.V., Jabalpur and the University of Agricultural Sciences, Bangalore) and elsewhere have established that soybeans can be used in various Indian food preparations. However, these studies have not addressed the wider usage of soybeans by attempting to develop equipment and processes appropriate to village soybean processing industries.

This subproject emphasizes the development and establishment of village level operation units for those soy processing technologies which hold particular promise for adoption. The production of various soy products constitute a capability for rural industry to increase income and employment for the rural sector. Such pilot level operational studies hold a key for adoption by private enterprise and the local industry sector.

Large scale utilization of soybean food products in the rural areas depends on an awareness of the nutritional benefits of such products and on the development of appropriate products. This concern will continuously be at the forefront of specific research priorities of this subproject. This will be done by maintaining close linkages with the All India Coordinated Project on Soybeans as well as the all India Coordinated Scheme on Post Harvest Technology.

The implementation of village level operational processing units will be evaluated in terms of economic feasibility and acceptability of the products produced. Techno-economic studies including household and village-level testing for product marketability will be carried out during years 3-5 of the project with the assistance of the subprojects' economist and management systems specialist.

3. Post-Harvest Technologies for Fruits and Vegetables

Research in fruits and vegetables had a late start in India. The All India Coordinated Horticultural Crops Improvement Project was initiated only during the Fifth Plan period, 1974-79, while the All India Coordinated Research Program on Post Harvest Technology of Horticultural Crops was sanctioned only in 1978. Under this program four centers were selected to conduct research on post-harvest problems; it took three years to complete the staffing of these centers. This subproject is directly focussed on post harvest problems relating to selected fruits and vegetables at these research centers. Its most immediate objective is to strengthen and upgrade the research capabilities of centers. The selected fruits and vegetables are mangoes, citrus, guava, bananas, potatoes, onions and tomatoes.

The aim of research in post harvest technology is to increase supply of these fruits and vegetables by minimizing losses incurred at various stages of handling and marketing. Firm estimates of the quantum of loss are not available. Official and scientific circles place it between 20 and 35 percent of a total production of 50 million tons (fruits and vegetables combined).23/ At current prices the values of this loss to society is estimated at between $520 million and $1 billion (Rs.5 and 10 billion). The total production of the crops included in this subproject was about 32 million tons in 1980-81; in value terms, the loss of these six fruits and vegetables would thus be between $337 and $674 million (Rs.3.2 and Rs.6.4 billion). These are only tentative estimates, but in the absence of studies dealing with post harvest losses, these are the only estimates to go by. Nevertheless, the subproject itself will lead to the generation of firmer estimates of post harvest losses and where they occur.

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23/ Estimates based on opinions of scientists in the field. No systematic analysis is available which provides more reliable data.

Minimization of post harvest losses is equivalent to an upward shift in the supply function of fruits and vegetables with consequent reduction in consumer prices. More low income consumers both in rural and urban areas would benefit from the increased quantity of these perishable but nutritive items. Available data indicate that the demand for fruits and vegetables is price elastic. Consequently, the total income of the growers, who are mostly operators of small orchards and farms, would rise.

Part of the focus of research would be on the development of a package of practices at the orchard or the farm level where a substantial part of the loss occurs owing to traditional methods of picking, digging and harvesting. Even if the subproject succeeds only in developing a package of new practices to minimize losses at this level, the gains to producers would likely be substantial enough to induce them to increase production. This is important, because the income elasticity of demand for fruits and vegetables being high, greater output is needed to satisfy demand at higher levels of income.

As Table 6 in Annex A shows, about 70 percent of the area under vegetables and about 53 percent of the area under fruits are represented by operators of small holdings. Part of the benefits from loss minimizaton, is likely to accrue to them in the form of attractive and perhaps stable prices. This should encourage more small farmers to pursue fruit and vegetable farming. The literature suggests that one way of improving income of small farmers is to diversify their cropping pattern to cultivate selected high value crops, such as fruits and vegetables.24/ Though data on comparative costs and returns relating to all the fruits and vegetables included in this subproject are not available, the likely benefits can be illustrated with some location-specific data. For example, according to a study recently concluded by the Indian Institute of Foreign Trade, the yield per acre of citrus fruits in Jammu and Kashmir is about 32 quintals (3,200 kilograms), while the cost of production per acre is about Rs.1,700. Assuming an average harvest price of $0.32 (Rs.3) per kilogram (kg) of citrus fruits, the net return per acre works out to $832 (Rs.7,900). Another study, which divided

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24/ See particularly John W. Mellor, The New Economics of Growth, Ithaca, Cornell University Press, 1977.

the orange orchards in Nagpur in several size groups found the optimum size of orchards to be between one and two acres; for this size group, the net present value of the investment in orchards at a 12 percent rate of discount was estimated at Rs.7,910 per acre, and the internal rate of return at 45.9 percent.25/ A comparative study of different crops in Bihar estimated returns from onion cultivation at Rs.7,400 per hectare. It appears from these studies that returns from fruits and vegetables are generally high and surely higher than those obtained from grain cultivation. To the extent the small growers are encouraged to take to these high value crops, their income would rise. It appears reasonable to assume that the returns to growers would be still larger if the post harvest problems of losses and high risks, that combine to depress producer prices, could be reduced.

4. Social Soundness

a. Beneficiaries

The direct beneficiaries of project activities will be the scientists whose research capabilities are upgraded by the increased availability of modern equipment, the expanded opportunities for training and the increased exposure to procedures, processes and technologies not yet introduced or widely accepted in India. The upgraded research capabilities will result in the development of technologies that will increase food crop yields at the farm level and decrease food crop losses at the post harvest stage during processing and marketing. Thus farmers and individuals involved with processing and marketing agricultural commodities will benefit financially as the quantity and quality of the products they can pass on to consumers increases. The population in general will benefit from an increased availability of nutritious foodstuff and from the expanded employment opportunities generated by the growth in the agricultural subsectors affected by the project. In addition valuable foreign exchange which would have been used to import certain foodstuff; e.g., edible oils, will be freed to serve other purposes.

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25/ G.S. Gupta and P.S. George, "Profitability of Nagpur Santra (Orange) Cultivation Indian Journal of Agricultural Economics, July-September 1974.

b. Socio-Cultural Feasibility

In order for the benefits of project activities to reach beyond the research scientists, technologies developed must not only be effective they must be accepted by the intended users. In many cases, intended users are unwilling to apply new technologies because of their attachment to traditional practices or unable to apply new technologies because of the associated financial risks. In addition, technologies are sometimes not responsive to what the users perceive their needs to be.

The intended users of the technologies developed under this project shall include farmers of selected food crops as well as individuals involved with the processing and marketing of certain agricultural commodities. The rapid dissemination of the Green Revolution technologies has dispelled the notion that small farmers in India are unwilling to adopt new technologies that are demonstrably superior to old technologies. Similarly, processing and marketing enterprises are known to be open to change that will increase efficiency and thus profitability.

To ensure the suitability of technologies being developed under the project, regular field testing will take place in cooperation with the extension service. In addition, an on-going assessment of the constraints to the adoption of particular technologies will be built into each subproject.

c. Spread Effects

Widespread dissemination of research results depends, to a large extent, on the presence of an adequate extension system. The Agricultural Extension network, with agents at the village level, extension specialists at the development block level and extension officers at the district level, is one of the most comprehensive in the world. Currently, the extension system is being strengthened throughout India by adoption of the training and visitation system. In addition, ICAR has developed a "Lab-to-Land" program to make new technologies known and available to target groups through demonstrations, field trials and supply of inputs. New technologies are also spread through informal channels as successful adoption of the technologies take place and become known.

d. Role of Women

Of the three activities to be supported under the project initially, the post harvest technologies for fruits and vegetables and the soybean processing and utilization subprojects offer particularly significant opportunities for women. Kitchen gardening is dominated in India by women as is food processing on a cottage scale. To the extent that improved post harvest technologies are developed, income earning opportunities for women in vegetable production and village level food processing should expand. Similarly, the development of household and village level technologies for soybean processing should increase employment opportunities for women.

D. Environmental Analysis

The project's research activities will not have any adverse effects on the physical and natural environment. The individual research subprojects involve carefully designed experiments normally carried out within the limits of research stations. Controlled experimentation will be conducted in a manner consistent with accepted methodology and utilized exclusively for research purposes. Any field evaluations that are carried out will be confined to small areas and will be carefully monitored. Therefore, the Agricultural Research Project is categorically excluded from any environmental action as per AID's environmental procedures set forth in 22 CFR 216.2(c)(1)(ii) and 216.2(c)(2)(ii).

## IV. COST ESTIMATES, FINANCIAL PLAN, DISBURSEMENT PROCEDURES

A. Cost Estimates

Total project costs are estimated at $28 million with the GOI/ICAR contributing $8 million equivalent in Rupees and AID $20 million in grant funds. Estimates of total project costs were based on preliminary and detailed budgets developed for the soybean and post harvest technologies subprojects. Cost information presented for these activities provided a broad indication of future subproject costs (See Section III.A. for above cost breakouts for these activities). Given the average cost of these subprojects, a total of six subprojects are expected to be financed. No constraints to developing future subprojects are anticipated, as several topics have been identified for development.
Foreign exchange costs (consultants, training and equipment) were based on standard unit costs in effect at the time of project preparation. Inflation at 10% has been built in to these items and

a contingency at 5% factored in for equipment. Estimates for local costs were based on standardized figures for locally available equipment and vehicles as well as for local salaries. Below are presented the summary cost estimates and financial plan along with an expenditure schedule in Tables 1 and 2 respectively.

TABLE 1

SUMMARY COST ESTIMATE AND FINANCIAL PLAN
($ Million; $1.00 = Rs.9.50)

| PROJECT ELEMENT | AID | | | GOI/ ICAR | PROJECT TOTAL |
|---|---|---|---|---|---|
| | FX | LC | TOTAL | | |
| Training | 6.0 | - | 6.0 | - | 6.0 |
| Consultants | 3.0 | - | 3.0 | - | 3.0 |
| Equipment | 4.5 | 1.5 | 6.0 | - | 6.0 |
| Maintenance | 1.5 | - | 1.5 | 3.0 | 4.5 |
| Building & Facilities | - | - | - | 1.5 | 1.5 |
| ICAR Staff | - | 2.5 | 2.5 | 3.5 | 6.0 |
| Project Development & Contingency | 1.0 | - | 1.0 | - | 1.0 |
| T O T A L | 16 | 4 | 20 | 8 | 28 |

Note: These figures are approximations and may vary when future subprojects are more well defined and developed.

TABLE 2

PRELIMINARY PROJECT EXPENDITURES BY FISCAL YEAR
(Million $)

| FISCAL YEAR | AID | GOI | PROJECT TOTAL |
|---|---|---|---|
| 1983 | 2.0 | 1.5 | 3.5 |
| 1984 | 4.0 | 2.0 | 6.0 |
| 1985 | 4.0 | 2.0 | 6.0 |
| 1986 | 3.5 | 1.0 | 4.5 |
| 1987 | 3.0 | .5 | 3.5 |
| 1988 | 2.0 | .5 | 2.5 |
| 1989 | 1.5 | .5 | 2.0 |
| T O T A L | 20 | 8 | 28.0 |

Note: These figures are approximations and may vary when future subprojects are more well defined and developed.

AID foreign exchange will be used to defray the costs of obtaining U.S. technical services, short-term training (up to one accademic year) and laboratory equipment (including spare parts) from the U.S. A small amount of local cost financing of AID's contribution is also proposed to finance the purchase of locally available scientific equipment, workshops and conferences, and on a declining scale the costs for additional staff needed to do research work successfully.26/ A limited amount of funds have also been set aside for paying the costs of operational research recommended for certain subprojects such as soybeans. GOI/ICAR financing will contribute to recurring maintenance costs of vehicles and locally procured equipment as well as for staff salaries. The overall project also contains dollar funds for obtaining U.S. and local technical services anticipated for the design and finalization of future subprojects. Out of this line item, mid-term and final impact evaluations (at the end of the project) will also be financed.

C. Disbursement Procedures

Disbursement for foreign exchange expenditures will be made according to standard procedures using AID implementation documents such as Project Implementation Orders for obtaining technical services (PIO/Ts), ordering commodities (PIO/C) and for arranging for participant training (PIO/Ps). Disbursements for local costs will be made for eligible expenditures incurred by ICAR. USAID and the Department of Economics Affairs (DEA) of the Ministry of Finance have established standard procedures for the disbursements of local costs for ongoing projects. These procedures, including required documentation, the frequency of their submission and reporting, will be specified in Project Implementation Letters.

## V. IMPLEMENTATION PLAN

### A. Administrative and Operational Project Arrangements 27/

The Indian Council of Agricultural Research (ICAR) will be responsible for the overall organization and supervision of the project. The ICAR is linked to the GOI through the Department of Agricultural Research and Education (DARE). The ICAR is the agency responsible for the central governments' contribution to both agricultural research and education and serves as the national coordinating and supporting agency for much of the agricultural research carried out through state agencies.

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26/ In percentage terms 90, 70, 50, 30, 10 of the first through the fifth year of an average subproject.

27/ See Chart on page ..

The following implementation structure, or an alternative structure mutually agreeable to AID and ICAR, will be created by ICAR.

1. Project Approval and Monitoring

A Project Approval and Monitoring Committee (PAMC) will be constituted by the ICAR as the executive project authority for subproject approval and execution. It will be under the chairmanship of the Director General of ICAR and will consist of representatives of the GOI Planning Commission, the Department of Economic Affairs, the Department of Agriculture and three representatives from the state agriculture universities. At least two Deputy Director Generals (DDG's) (soil and crops) would be represented. One of the Assistant Directors General in the ICAR would be the member secretary of the PAMC. The functions of the PAMC would be to:

a. Approve the eligibility of participating Indian Institutions which could include the ICAR agricultural research institutes, state agricultural universities or other research institutions having agricultural faculties;

b. Receive, review and approve proposed research subprojects to be funded under this project, taking into consideration the recommendations of the design team and the Technical Advisory Group and USAID analysis and comments on the proposed subproject;

c. Review periodically the progress of the subproject;

d. Meet at least twice a year to execute approval and implementation responsibilities.

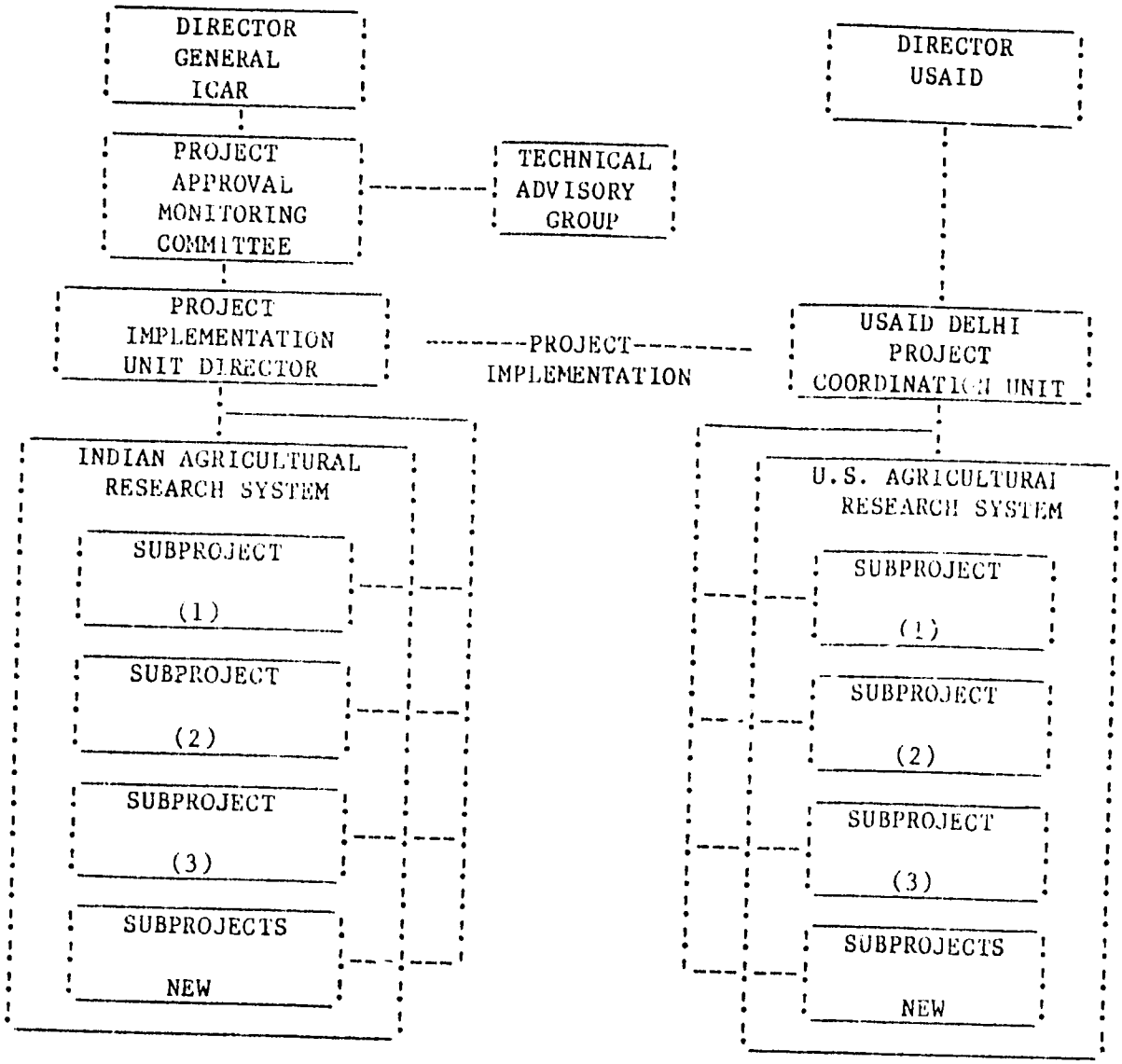
2. Technical Advisory Group (TAG)

The ICAR will constitute a Technical Advisory Group (TAG), which will function as the technical arm of the PAMC, primarily to provide technical review and recommendations regarding appraisal team reports for new subprojects. The same Assistant Director General (ADG) will serve as Member Secretary of the TAG. The TAG will consist of representatives in the major disciplines such as plant breeding, agronomy, entomology pathology, soil science, agricultural engineering and economics, with the provision to coopt specialists as and when required. Specialists from the U.S. side will, at the invitation of ICAR, participate in the technical and economic review of subprojects.

3. Project Implementation Unit

The ICAR would set up a Project Implementation Unit (PIU) to ensure satisfactory implementation of the various stages of the Project including project preparation, design, annual project reviews and monitoring. This unit will be staffed by professionals who are qualified to provide support services for the subproject research areas. Members will include designated DDGs, ADGs, Deputy Project Coordinators and appropriate technical and administrative support staff.

## PROJECT ORGANIZATION AND MANAGEMENT




(1) Institutions for Soybean Processing & Utilization

(2) Institution for Postharvest Technologies of Fruits and Vegetables

4. Project Administration

Subject to the overall guidelines approved by the PAMC, subprojects will be implemented by the participating institutions in accordance with their rules and regulations with regard to appointment of staff, purchase of equipment and construction of buildings and laboratories. However, the approval of the ICAR would be required for appointment of the head of a research subproject, local and foreign consultants and also for international training assignments.

The PIU will assist and monitor subproject implementation through:

(a) Participating in annual reviews with participating institutions and USAID to document the project's progress and to finalize the next year's work plans;

(b) Reviewing periodic reports on scientific achievements and completion reports of the subproject.

(c) Preparing annual reports based on the annual reviews of the subprojects and other materials;

(d) Reviewing statements of expenditure to ensure authenticity and eligibility, keeping accounts, preparing claims for reimbursements from AID, processing budget requests and in sum, handling all GOI financial reporting and accounting for the project;

(e) Assisting participating institutions in identifying and processing personnel to be trained under the project and arranging for training which will take place in India;

(f) Participation in evaluations;

(g) Provide support services such as travel and clerical assistance to the PAMC and the TAG.

5. USAID Project Coordination Unit

The GOI and the ICAR will deal directly with USAID in carrying out the project. On behalf of ICAR, USAID will arrange for all U.S. inputs required by the project. The USAID Project Coordination Unit will interact with the PIU in all operational aspects of the Project. Its responsibilities will include:

(a) Locating and recruiting U.S. scientists for subproject appraisal and design;

(b) Locating, recruiting and arranging with U.S. institutions or individual scientists as required to participate in the implementation of subprojects;

(c) Arranging directly or through contracts for U.S. training of participants;

(d) Arranging directly or through contracts for procurement, shipment and delivery of project supplies and equipment imported from the U.S.;

(e) Arranging for the logistic support (travel, housing, etc.) of expatriate personnel working in India under the Project;

(f) Monitoring Project operations;

(g) Participating in Project evaluations;

(h) Participating in annual reviews with the PIU and ICAR implementing institution.

6. Subproject Preparation and Approval Process

Future subproject topics will be identified by ICAR. For each new subproject, Indian scientists at their respective institutions with the help of the PIU will prepare a preliminary brief project identification document which defines the overall purpose, outlines the technical objectives and conceptual implementation and financial framework. This preliminary proposal will serve as the basis for ICAR to select a design team who will elaborate and further develop the proposal into a project document including details required by the PIU and USAID for approval and implementation. The design team will consist of highly qualified technical specialists in the concerned relevant subject matter.

Subproject documents will be reviewed and approved by the TAG prior to submission to USAID for comments and technical concurrence. USAID concurrence will require that each subproject clearly establish:

(a) the required Indian and U.S. inputs (training, technical assistance, scientific equipment, maintenance, building facilities, ICAR staff and other elements as appropriate) including their estimated costs and project scheduling over the life of the subproject;

(b) technical soundness;

(c) economic viability;

(d) importance to Indian agricultural development;

(e) the relevant policies that are conducive to adoption and use of research results by farmers;

(f) the institutional channels that are available for extending the research results to farmers.

The subproject preparation and approval process will include a series of steps in which the organizational units described above would have key roles. The sequence of events will be as follows:

(a) Subproject Design

The ICAR eligible institutions will prepare a proposal, with the assistance of the PIU, which is acceptable to the ICAR for financing under this project.

The PIU will then arrange for a design team of experts/ subject matter specialists to be nominated by ICAR, in consultation with USAID, to analyze and develop the subproject proposal into a mutually acceptable detailed project document for the final review and approval process prior to implementation.

(b) TAG Review and Approval

The subproject document will be reviewed and approved by the TAG and then will be submitted to USAID for comments and technical concurrence.

(c) PAMC Review and Approval

In the final step of the process, the subproject document, the TAG recommendations and USAID's comments will be provided to the PAMC. The PAMC will review and approve the project.

(d) After approval by the PAMC, ICAR will work with USAID as set forth in the approved subproject document and subsequently specified in project implementation letters.

B. AID Implementation Arrangements

1. AID Administrative Arrangements

USAID/India has designated a Project Officer who will be responsible for maintaining close liaison with ICAR to assure smooth execution of the Project. USAID is recruiting two U.S. university scientists to work with the USAID staff in project implementation. They will facilitate USAID linkages with the U.S. Land Grant University system and other organizations. USAID expects that an Indian professional will be added to the USAID staff to work full time on the project. The Project Officer, two university scientists and an Indian professional will comprise USAID's project coordination unit. A USAID Project Committee will monitor and support this unit and the project.

Following signature of the Project Agreement by the GOI and AID, USAID/India will arrange for the initial training programs for Indian scientists and for technical consultation required for all subprojects already approved. These actions by USAID will permit initial activities to be started early in the life of these subprojects.

2. Contractor Selection

A cost-reimbursement AID direct contract is considered best suited to provide services from the U.S. research community for implementation of subprojects. Formal AID contracting with U.S. institutions requires that each subproject be described in the BIFAD 28/ Briefs with a request for submission of "documentation of interest" to the BIFAD staff. Subsequently, the AID Contract Officer, following the educational institutions selection procedures set forth in AID procurement regulations will send a request for Technical Proposals (RFTP) to all qualified institutions recommended by the BIFAD staff, ICAR and/or USAID. After proposals are received, a technical evaluation will be conducted with ICAR participation and with ICAR concurrence, AID will select a contractor with whom to negotiate. A cost proposal will then be obtained, negotiations conducted by AID and with concurrence of ICAR a contract awarded.

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28/ BIFAD - Board for International Food and Agricultural Development, AID/Washington

C. Preliminary Calendar of Project Events

| | |
|---|---|
| 1982 | |
| November: | GOI and USAID sign Project Agreement |
| January/February: | PIO/T's and PIO/P's issued by USAID for initial consultation and training |
| 1983 | |
| September/October: | First annual review |
| 1984 | |
| August: | Second annual review |
| 1985 | |
| June/July: | Mid-term assessment (indepth evaluation) |
| August: | Third annual review |
| 1986 | |
| August: | Fourth annual review |
| 1987 | |
| August: | Second indepth Project evaluation |
| 1989 | Final evaluation |

## VI. MONITORING AND EVALUATION

### A. Monitoring

#### 1. Annual Review

ICAR and the USAID Project Unit will jointly undertake an annual review of progress of each subproject accordingto a mutually agreed schedule. U.S. scientists can be invited by ICAR to participate in these reviews as needed.The past year's progress will be reviewed, the following year's plan of work finalized and the work plan for the remaining years of subproject life discussed and agreed in more general terms. This cycle will be repeated each year. The annual review will be the focal point for ICAR and USAID guidance and direction of subproject research activities, including required training, consultation and equipment procurement actions to be taken.

#### 2. AID Monitoring and Staffing Implications

The monitoring by the USAID Project Unit calls for proposed field visits totaling approximately 50 weeks/year for the overall project, assuming a full portfolio of six subprojects. Present staffing plans include the addition of two agricultural specialists to be made available through the University Joint Career Corps (JCC) dual path program and the employment of an Indian professional to provide further support to USAID's management unit for this project. It is expected that these three individuals and USAID's project officer will be able to handle the day-to-day managerial, administrative and technical issues as they arise. Monitoring visits will focus primarily on the status of subproject progress and assistance in removing potential constraints to meeting subproject objectives. The type of problems which may arise include delays in recruiting sufficient staff to conduct required research, and the absence of timely supply of equipment, on specific technical problems for which specialized expertise would be warranted. In addition to field visits, periodic reports (the frequency and content of which will be mutually determined) from the participating Indian institutions or subproject progress will form a component of project monitoring activities.

B. Project Evaluation

Annual reviews and field visits are intended to provide information on the degree to which project inputs (technical services, equipment and training) are being provided to implement each research subproject. A mid-term evaluation that examines project impact, actual or potential, will also be conducted. Information generated from the annual reviews and monitoring visits will form a part of the mid-term project assessment. A final impact evaluation is also scheduled upon termination of the project. Both mid-term and final evaluations will also examine such issues relating to linkages to mechanisms for diffusing research results, the potential clients of research results and the degree to which lower income groups can obtain access to the research and extension system. It is anticipated that an independent evaluation team will conduct the mid-term and final evaluations. The team may consist of AID/Washington and host country representatives and if deemed necessary, specialized expertise from U.S. or Indian sources. Approximately $180,000 have been budgeted to pay for outside assistance if warranted. This figure assumes the costs of an individual consultant for each subproject's mid-term and final evaluation for a duration of approximately one month of service. These figures are estimates and may vary depending on each subproject's requirements (to be more precisely determined during its implementation) for outside consultant inputs.

EVALUATION COSTS
($ 000)

| SUBPROJECT | MID-TERM (MM) | COST 28/ | FINAL (MM) | COST | TOTAL COST |
|---|---|---|---|---|---|
| Soybeans | 1 | 15 | 1 | 15 | 30 |
| Post Harvest | 1 | 15 | 1 | 15 | 30 |
| New Subprojects(4) | 4 | 60 | 4 | 60 | 120 |
| TOTAL | 6 | 90 | 6 | 90 | 180 |

28/ At a unit cost of $15,000 per man month.

## VII. CONDITIONS AND COVENANTS

In addition to the standard conditions and covenants, the following conditions and covenants will be included in the Grant Agreement.

### A. Conditions

(1) Prior to first disbursement under the Grant, the Grantee will provide an implementation plan which sets forth the administrative and operational structure and procedures for the Indian Council of Agricultural Research (ICAR) or other authority designated to obtain approval of subprojects within the overall objectives and budgetary limits of the project. Said plan shall indicate the structure and responsibilities for: (a) subproject approval, monitoring and evaluation, (b) any technical advisory panels, (c) subproject implementation responsibility and procedures including subproject preparation, appraisal, approval and administration, (d) tentative life of project budgetary allocation of project resources by year and (e) documentation required for disbursement for any activities not included within formally defined subprojects. The functions, responsiblities and role of USAID in subproject design, appraisal, approval and support for implementation will be outlined in the implementation plan. This plan shall be reviewed and revised as necessary in writing by mutual agreement.

(2) Prior to any disbursement under the Grant for a specific subproject or other actvity specified in the mutually aproved implementation plan in compliance with (a) above or to the issuance by AID of documentation pursuant to which disbursements will be made the responsible Grantee representative will, except as the parties may otherwise agree in writing, furnish to AID, in form and substance satisfactory to AID, a detailed operational and financial plan for each subproject or other activity. Disbursements of the Grant will be authorized within the framework of mutually agreed upon and discrete subprojects and activities.

(3) Prior to any disbursements under to Grant for long-term or short-term training within any of the approved subprojects or other activities under this Project or to the issuance by AID of documentation pursuant to which such disbursements will be made, the Grantee will, except as the Parties may otherwise agree in writing furnish to AID, in form and substance satisfactory to AID, a detailed description of the procedural mechanism to be established and utilized by the Grantee for the selection of individuals for and implementation of training abroad.

B. Covenants

(1) Evaluations An evaluation program satisfactory to A.I.D. will be established as part of the Project. The evaluation program will consist of annual reviews of subprojects and in-depth impact evaluation to be conducted at the Project's mid-point and an impact evalution at the end of the Project. The program will include:

(a) reviews of progress toward attainment of subproject objectives and in turn the overall Project's objectives;

(b) the identification of problem areas or constraints which may inhibit such attainment;

(c) evaluation of the overall impact of the Project in technology tansfer and development;

(d) an assessment of the institutional strengthening efforts at designated research institutes with reference to AID financed activities.

(2) Training Except as the Parties may otherwise agree to writing, the Grantee agrees to make all reasonable efforts to assure that professional staff receiving training under this project are retained, following completion of training, in service with the Grantee on applicable subproject activities for the period of time provided for by the Government of India in its standard bonding requirement for such persons receiving training.

Annex A

SOCIO ECONOMIC ANALYSIS

# ECONOMIC ANALYSIS OF THE PROPOSED ICAR/AID AGRICULTURAL RESEARCH PROJECT

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Dr. Pray provided services for the work contained herein through the University of Minnesota/AID contract on the "Asia Regional Project on Agricultural Research Reviews".

# ECONOMIC ANALYSIS OF THE PROPOSED ICAR/AID AGRICULTURAL RESEARCH PROJECT

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# ECONOMIC ANALYSIS OF THE PROPOSED ICAR/AID AGRICULTURAL RESEARCH PROJECT

## I. PAST RETURNS TO AGRICULTURAL RESEARCH IN INDIA: WHO BENEFITTED?

There have been a large number of studies which have reviewed economic and social benefits from past investments in agricultural research. The studies make it clear that research has generally been a productive investment with internal rates of return well above 20%. Rates of return of this level are usual, both for less developed and developed countries. No other area of public sector investment in LDC agriculture has given such consistently high returns. Irrigation and extension which have had much greater investment in research are spread throughout all classes of society. The new food grain technology of the "Green Revolution" is used by farmers of all sizes, whether they are land owners or tenants. The new varieties required more labor and thus improved the income of the laborers. The new technology held down prices so that poor consumers in the cities and countryside, who spend most of their income on food, could buy more food. The critics are correct in saying that land owners benefitted more than other groups and that income distribution became somewhat worse during the "Green Revolution" period. However, the real income of the poor in most countries of Asia except Bangladesh (which did not experience a Green Revolution) has improved. Furthermore, no clear link between agricultural research and income distribution problems per se has been established.

The generalizations of the first paragraph also hold for India. A number of studies have concluded that the rates of return from Indian research have been high. These studies are summarized in Table 1:

TABLE 1:

RETURNS TO INVESTMENT IN INDIAN AGRICULTURE

| STUDY | ACTIVITY | PERIOD | RETURNS TO RS 1000 INVESTMENT | TIME LAG* (YEARS) | INTERNAL RATE OF RETURN |
|---|---|---|---|---|---|
| Evenson | Research | 1953-71 | 7960 | 61/2 | 40 |
| | Extension | 1953-75 | 175 | 1 | 17.5 |
| | IADP | | | | 15 |
| Kahlen et al | Research | 1960-73 | 1161 | 5 | 63.3 |
| Bal & Kahlon | Research | 1960-65 | 191 | 5 | 14.0 |
| | Research | 1967-73 | 1491 | 5 | 71.7 |

*Time between when the money was invested and the results started to have some impact.

Source: H. K. Bal and A. S. Kahlon "Returns from Investment on Agricultural Research," Indian Journal of Agricultural Economics. Vol. XXXII No.3

These also indicate that extension programs have had considerably lower rates of return than research. It should also be noted that most of the returns to research in the Evenson study are due to research before the "Green Revolution" wheat and rice varieties arrived. Thus, it was Indian research, not research in Mexico or the Philippines, which produced these results. The Green Revolution varieties clearly did lift the productivity of the research system and this probably accounts for the difference between the two time periods in the Bal and Kahlon study. However, the Indian research system clearly has been successful in generating its own new technology.

The benefits from agricultural research in India have not spread evenly throughout Indian society. There are differences between areas, commodities, consumers, and producers. Table 2 shows the growth of productivity for the main States between 1953 and 1971. The relative changes in productivity are most marked during the last period which corresponds to the "Green Revolution". The agricultural productivity made phenomenal jumps upward in Punjab, Haryana and Rajasthan. Gujarat and Assam also had growth rates which were well above the national average. The pattern of the last period in Table 2 seems to have continued through the 1970's. However, Karnataka, Himachal Pradesh and perhaps Maharashtra have joined Punjab and Haryana as rapidly growing States.

TABLE 2: STATEWISE GROWTH IN AGRICULTURAL PRODUCTIVITY

| | 1953-56 to 1956-61 | 1958-61 to 1963-65 | 1963-65 to 1969-72 |
|---|---|---|---|
| Andhra Pradesh | .85 | .11 | -1.05 |
| Assam | -2.27 | - .18 | 3.98 |
| Bihar | 1.40 | .32 | - .82 |
| Gujarat | .74 | 2.81 | 4.78 |
| Haryana | 2.41 | - .70 | 16.10 |
| Kerala | 1.97 | -1.25 | - .67 |
| Madhya Pradesh | 2.01 | .05 | -1.52 |
| Maharashtra | 2.11 | - .93 | -2.13 |
| Mysore | 1.03 | .69 | .27 |
| Orissa | -1.34 | 1.93 | 1.30 |
| Punjab | 2.41 | .52 | 13.40 |
| Rajasthan | .09 | - .99 | 12.7 |
| Tamil Nadu | 1.49 | 1.43 | .61 |
| Uttar Pradesh | .43 | .66 | 1.93 |
| West Bengal | -2.12 | 2.67 | - .36 |

Source: Robert Evenson and Dayanath Jha "The Contribution of Agricultural Research System to Agricultural Production in India". Indian Journal of Agricultural Economics, Vol.XXVIII No. 4.

The impact of new technology in the different crops is reflected in yield per acre. Table 3 shows that since 1964/65, the most rapid growth of crop yields was in wheat, followed by jowar (sorghum), cotton and tea. In contrast, the yields of the pulses have a very low growth rate since 1964/65 and for the whole period their growth rate was slightly negative. Groundnut yields grew at 1.6% rate from 1964 to 1980.

TABLE: 3

GROWTH RATES IN AREA, PRODUCTION AND YEILD OF SELECTED CROPS FROM 1949/50 to 1979/80a/ (% per annum)

| | Weight in the production Index | AREA | | | PRODUCTION | | | YIELD | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1949/50 to 1964/65 | 1964/65 to 1979/80 | 1949/50 to 1979/80 | 1949/50 to 1964/65 | 1964/65 to 1979/80 | 1949/50 to 1979/80 | 1949/50 to 1964/65 | 1964/65 to 1979/80 | 1949/50 to 1979/80 |
| Foodgrains | 64.12 | 1.4 | 0.6 | 0.8 | 3.0 | 2.9 | 2.5 | 1.4 | 1.9 | 1.4 |
| a. Cereals of which: | 60.05 | 1.2 | 0.7 | 0.9 | 3.2 | 3.3 | 2.9 | 2.0 | 1.9 | 1.6 |
| Rice | 33.98 | 1.3 | 0.8 | 1.0 | 3.5 | 2.5 | 2.4 | 2.3 | 1.7 | 1.4 |
| Wheat | 12.16 | 2.3 | 3.8 | 2.8 | 4.8 | 7.5 | 5.8 | 2.4 | 3.6 | 2.9 |
| Jowar | 4.46 | 1.1 | -1.0 | -0.1 | 3.2 | 1.7 | 1.3 | 2.1 | 2.7 | 1.4 |
| b. Pulses of which: | 8.07 | 1.3 | 0.1 | 0.4 | 1.4 | 0.1 | 0.1 | -0.5 | 0.1 | -0.1 |
| Gram | 3.58 | 1.7 | -0.6 | -0.5 | 2.7 | -0.1 | 0.1 | 3.5 | 0.5 | 0.5 |
| Tur | 1.35 | 0.8 | 0.1 | 0.4 | -1.3 | 0.9 | -0.1 | -1.9 | 0.8 | -0.6 |
| Non-Foodgrains | 31.88 | 2.5 | 0.6 | 1.3 | 3.5 | 2.4 | 2.6 | 1.0 | 1.1 | 0.9 |
| a. Oilseeds of which: | 10.96 | 2.7 | 0.1 | 1.2 | 3.2 | 1.5 | 2.0 | 2.3 | 1.2 | 0.5 |
| Groundnuts | 4.82 | 4.6 | -0.3 | 1.7 | 4.2 | 1.5 | 2.2 | -0.1 | 1.6 | 0.4 |
| Rapeseed & mustard | 1.73 | 2.9 | 1.3 | 1.8 | 3.5 | 1.7 | 2.9 | 3.1 | 0.4 | 1.1 |
| b. Fibres of which: | 4.03 | 2.6 | -0.3 | 0.6 | 4.5 | 2.0 | 2.3 | 1.7 | 2.2 | 1.5 |
| Cotton (lint) | 3.01 | 2.5 | -0.3 | 0.6 | 4.6 | 2.4 | 2.6 | 2.8 | 2.7 | 2.0 |
| Jute | 0.81 | 3.0 | 0.1 | 0.8 | 3.5 | 0.9 | 1.3 | 0.6 | 0.6 | 0.4 |

| Non-Foodgrains (contd.) | Weight in the production Index | AREA 1949/50 to 1964/65 | AREA 1964/65 to 1979/80 | AREA 1949/50 to 1979/80 | PRODUCTION 1949/50 to 1964/65 | PRODUCTION 1964/65 to 1979/80 | PRODUCTION 1949/50 to 1979/80 | YIELD 1949/50 to 1964/65 | YIELD 1964/65 to 1979/80 | YIELD 1949/50 to 1979/80 |
|---|---|---|---|---|---|---|---|---|---|---|
| c. Plantation Crops of which: | 2.28 | 2.4 | 2.1 | 2.3 | 2.6 | 3.9 | 3.2 | 0.2 | 2.5 | 1.8 |
| Tea | 1.85 | 0.5 | 0.7[b] | 0.8[c] | 2.0 | 3.3[b] | 2.5[c] | 2.2 | 2.6[b] | 1.7[c] |
| Coffee | 0.24 | 2.5 | 3.3[b] | 2.5[c] | 7.0 | 4.9 | 5.1 | 4.4 | 1.6 | 2.4 |
| Rubber | 0.19 | 8.9 | 4.9 | 6.8 | 6.7 | 8.4 | 8.8 | -2.0 | 3.5 | 2.0 |
| d. Condiments & Spices | 2.31 | 1.7 | 1.7 | 1.7 | 1.9 | 1.7 | 1.6 | 0.2 | -0.0 | 0.1 |
| e. Fruits & Vegetables | 3.97 | 4.1 | 2.4 | 3.4 | 4.5 | 4.3 | 4.7 | 0.4 | 1.8 | 1.5 |
| f. Miscellaneous Crops of which: | 8.33 | 3.0 | 2.6 | 2.2 | 4.3 | 2.4 | 3.0 | 1.3 | 1.0 | 1.0 |
| Sugarcane (Gur) | 7.01 | 4.4 | 1.5 | 2.1 | 5.6 | 2.4 | 3.1 | 1.1 | 0.9 | 1.0 |
| Tobacco | 1.14 | 1.7 | 0.3 | 0.8 | 2.4 | 2.2 | 2.1 | 0.7 | 1.9 | 1.3 |
| All Crops | 100.00 | 1.6 | 0.6 | 0.9 | 3.1 | 2.7 | 2.5 | 1.4 | 1.6 | 1.3 |

a/ Average annual compound growth rates have been estsimated by fitting semi-logarithmic least squares time trends to the relevant index number data.
b/ Relates to the period 1964/65 to 1978/79
c/ Relates to the period 1949/50 to 1978/79.

Source: Ministry of Agriculture, Office of the Economic and Statistical Advisor in World Bank Economic Situation and Prospects in India, 1981.

One of the most important impacts of the new food grain technology has been to push down the real prices of food grains. This is frequently missed by the casual observer and by some consumers because the nominal price continues to rise. Figure 1 shows the rapid decline in real prices of food grain since the introduction of the HYV grains in the late 1960's. This decline is particularly important to the poor who spend 50 to 60 per cent of their income on food grains. Thus they benefit much more from the price decline than the wealthier groups who spend a far smaller percentage of their income on grain.

Among producers many micro studies indicate that the big landowners benefitted more from the new technology of the 1960's and 1970's than small farmers or the landless. Thus income distribution in the countryside may have worsened somewhat during this period. However, one recent study of rural expenditure patterns shows that in 8 states, income distribution improved while in the rest there is no evidence of worsening distribution. 1/ Also, the lowest income groups - the landless laborers - seem to have improved their real income during the Green Revolution in most States. The most rigorous study of real wages shows that real wages of agricultural labor increased in 8 of 13 major States studied increased between 1960 and 1971. 2/ If this technology were not available, it seems likely that the income distribution problem would be even worse than it is today.

The fact that rates of return to research investment have been high in the past does not necessarily mean that the returns to all new research projects will be high or even positive. There has been and will continue to be considerable variation in the rates of return on individual projects. Almost all of the major crops have been the subject of major research projects in India but as Table 3 shows, the yield per acre of many of them have not grown appreciably. This is partly due to the small investment in research on these crops, but there still are many projects that are not successful or which have no practical application. However, the extremely high payoffs from the research projects that are successful are sufficient to make up for many that are not. Research projects always have some uncertainty, but the uncertainty of practical payoffs can be reduced by planning. Thus the next section examines the possible payoffs to the specific projects.

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1/ Montek S. Ahluwalia "Rural Poverty in India: 1956/57 to 1973/74" World Bank Staff Paper 279, May 1978.

2/ Deepak Lal "Agricultural Growth, Real Wages, and the Rural Poor" Economic and Political Weekly, June 1976.

## II. POTENTIAL BENEFITS OF THIS PROJECT

This project is intended to strengthen one of the largest and most productive agricultural research systems in the world. This system has developed beyond the stage of adopting technology developed elsewhere to the stage of planning and developing its own agricultural research. Thus USAID and the GOI have adopted the strategy of jointly agreeing on priorities through a Conference of Indian and American scientists. The projects identified in this manner more clearly reflect the concerns of Indian scientists and their perception of the areas in which they can have fruitful collaboration with American scientists than have AID financed research projects in the past. In addition, the priorities reflect the fact that local resources are quite readily available for applied research programs which have had highly visible payoffs such as wheat and rice breeding while local resources are not so readily available for new areas such as post harvest technologies for soybeans and for fruits and vegetables, where there have not been any breakthroughs in India. An additional factor in the choice of crops for post harvest work is that work on several of the other crops is being financed by other donors. The post harvest problems of the major foodgrains are the subject of research financed by UNDP. Research on apple processing and postharvest technology is being carried out by a project financed by the World Bank. Many of the other subprojects which have not been taken up are more basic research chosen on the basis of India's needs. Basic research has had to be strengthened in India to provide the backup for an effective applied research program.

The most reliable data on the level and trends in production of the crops considered here are data on potatoes and soybeans. The data on outputs of mangoes, citrus, grapes, onions and tomatoes are basically educated guesses. The available data on the production of these crops is presented in Appendix Tables 1-4. They indicate that the production of most of these crops except perhaps citrus has been rising. Soybean has had by far the most rapid growth largely due to the low base from which it started. Potato production has also grown very rapidly with production doubling in the last ten years. Both the available statistics and IARI scientists suggest that there has been slow growth in the production of the other crops over the last decade. The one exception to this may be grapes which has experienced rapid growth in some specific locations.

On the production side, most of these crops have not experienced a major shift in technology. Yield increasing technology

accounted for some of the growth in potato production. However, the only other reported breakthrough in production is the introduction of grape production into Nasik district and the use of Gibberelic acid to double yields there. A dwarf mango variety which starts yielding in 6 instead of 16 years has been developed, but not yet released by IARI. Other commodities at best experienced some improved management and increased in productivity.

A more important factor in explaining the trends of the recent past and near future is increasing demands. Per capita income has been rising in India over the last decade at the same time as the population was rising rapidly. Thus the demand for all of these commodities has been increasing. However, demand for fruits increases even more rapidly than per capita income growth. Table 4 shows the percentage change in demand for a 1% increase in per capita income.

TABLE 4: INDIA - EXPENDITURE ELASTICITY ESTIMATES

| | RURAL | URBAN |
|---|---|---|
| Pulses | 0.86 | 0.81 |
| Edible Oils | 1.00 | 1.01 |
| Meat, Fish Eggs | 1.15 | 1.12 |
| Vegetables | 0.82 | 0.94 |
| Fruits, Nuts | 1.56 | 1.54 |
| Sugar, Khandsari | 1.51 | 1.06 |
| Gur, Other Sweetners | 1.09 | 0.53 |
| Spices | 0.67 | 0.50 |
| Beverages | 1.20 | 1.43 |
| Tobacco, Pan, Intox. | 0.90 | 0.96 |
| Clothing | 1.82 | 1.68 |
| Milk and Products | 1.73 | 1.43 |
| Rice | 0.71 | 0.42 |
| Wheat | 1.01 | 0.55 |
| Maize | 0.03 | -0.76 |
| Sorghum, Millet | 0.07 | -0.59 |
| All Other | 1.11 | 1.28 |
| Foodgrains | 0.63 | 0.39 |

Source: Jan A. Hitchings "Demand Projects for India" in India; Demand and Supply Prospects for Agriculture, World Bank Staff Working Paper No.5000

Government intervention has also some impact on the demand on these commodities. With oilseeds, the Government has restricted imports of edible oils which raised the price of oils internally. Government purchases of soybeans were the key factor in their early diffusion. It has also purchased onions and potatoes which increased demand. Some of these crops have been exported every year to South East Asia, the Middle East and elsewhere. A small amount of potatoes do go to Nepal and some of the best quality mangoes are exported to the Middle East. Some hand-picked, selected groundnuts are exported and some of the oilseed cake too. Government restrictions on groundnut and cake exports have sometimes depressed local prices for groundnuts.

TABLE: 5 QUANTITY AND VALUE OF EXPORTS AND IMPORTS OF SELECTED OILSEEDS, FRUITS AND VEGETABLES

| | IMPORTS | | EXPORTS | |
|---|---|---|---|---|
| | Qty (MT) | Value (Lakh Re) | Qty (MT) | Value (Lakh Re) |
| Vegetable Oil (1978/79) | 953,300 | 51920 | - | - |
| Mango (67-68 -71/72) | - | -. | 1,276 | 25 |
| Grapes & Raisins (67/68-71/72) | 25,335 | 591 | - | - |
| Citrus (67/68-71/72) | 594 | 3 | 303 | 5 |
| Potatoes (79/80) | - | - | 13,985 | 201 |
| Onion | - | - | 56,014 | 872 |

Sources: NAFED, World Bank and National Commission on Agriculture 1976 Part VI.

The high income elasticity of demand also implies that the Indian demand for fruit will continue to expand more rapidly than other crops in the near future. This fact in conjunction with the slow growth of fruit production which is implied by the production trends of fruit implies that fruit prices will be increasing in the future. The demand for vegetable oil has also outpaced production in the last decade and promises to continue to do so in the near future unless there is a dramatic breakthrough in groundnut technology. This gap between supply and demand has been met by imports which could make edible oil imports the second largest user of foreign exchange in the near future. Only vegetables of the crops in this project have an income elasticity less than one. The size of this elasticity and the rapid growth of potato production has forced the price of potatoes down even further than foodgrains in real prices. There is insufficient data to deduce the relative growth rates of supply and demand for onions and tomatoes.

The production, marketing and consumption of these commodities are organized in very different ways. This has implications for the institutional means by which new technology can be diffused, the rate at which technology is diffused and the distribution of the benefits. The only data available on the farm size of growers of these crops is from the 1970-71 agricultural census. It does not have the individual crops but does show the area of fruits, vegetables and groundnuts grown by different size groups. This is summarized in Table 6:

TABLE 6:

CROP AREAS BY BID AND SMALL FARMERS

(Thousands of Hectares)

| FARM SIZE | FRUITS | VEGETABLES |
|---|---|---|
| 0-4 (ha) | 467.6 | 882 |
| 4 + (ha) | 421.2 | 395 |

Source: All-India Report on Agricultural Census, 1970-71, p. 118 & 119

Vegetables is the only group which is grown mainly by the small farmers. Fruits are split half and half, while groundnut appears to be mainly grown by larger farmers. This last is somewhat misleading in that groundnut is mainly an unirrigated crop and land holdings in unirrigated parts of the country are larger than in other parts. Thus, although they are larger landholders, they may not be wealthy since the quality of their land is not as good.

The harvesting and marketing channels also vary considerably between crops. The oilseed crops are harvested by the farmers themselves with the help of some outside labor. The oilseeds are then sold at the market or to itinerant merchants in the village. These go to privately owned expeller plants and/or solvent extraction plants. Some of the oil is consumed directly as cooking oil and some is hydrogenated in large scale industry for use in urban areas. Vegetables are primarily grown around large towns and harvested by the small farmers who produce them. They are then taken to market by the farmers. A portion of these vegetables are then shipped off to other cities. There are also some areas in the countryside which have good transport and specialize in vegetable production for urban markets. This would include Nasik district which produced onions and some areas of U.P. which produce potatoes. Fruits are harvested mainly by small contractors who purchase the output of an orchard

long before harvest and then protect the orchards from birds and thieves as well as harvest the crop. The contractors receive credit from merchants and then sell the harvest to the merchant. This is the primary means of harvesting the mangoes and citrus which are not eaten at the village level. Grapes in the Nasik are harvested by the farmers themselves, but in the other areas we have no information.

The fruits that we are considering except for some types of mangoes are primarily eaten by wealthy and middle class Indians. Grapes which cost at least Rs.10 per kilo and sometimes Rs.25 are out of reach of the common man. Citrus also is fairly expensive. Mangoes go the whole range from expensive, like the Alphonso which only the Gulf Sheikhs can afford, to the small juicy mangoes which can be purchased at 6 for a rupee when in season. Many of these crops become affordable to the poor only when there is a seasonal glut. Onions and potatoes are eaten as a vegetable by all sections of the population both urban and rural throughout most of the year. Tomatoes also are eaten by all parts of society, particularly at harvest time, when they usually are very cheap. However, their consumption is more concentrated in urban areas and they are not available throughout the year.

## III. POST HARVEST TECHNOLOGIES FOR FRUITS AND VEGETABLES

The section on trends in supply and demand of fruits and vegetables suggests the reasons that they are of concern to researchers. The trends in fruit supply and demand imply increasing prices which will induce more farmers to sell their crop and intermediaries to ship more fruit to distant markets. This implies that there will be more losses because more of the crop is being marketed. It also means that unless something is done to increase production and reduce the marketing losses, poor people, particularly in rural areas, will have less access to fruits and the essential vitamins that they provide. The trends in vegetable production particularly potatoes, but also onions and tomatoes are somewhat different, but they also have put increasing pressure on the marketing system. In the case of potatoes, the huge increase in volume of production has put pressure on the entire marketing and storage system. Thus, farmers would clearly like to have more and cheaper means of preserving their potatoes after harvest so that prices will not drop so low at harvest time. In recent years, the price of onions and their year to year fluctuations have become a highly visible political issue. Better storage and preservation methods could reduce some of the price variations within the year and also might improve export prospects which could alleviate some of the sharp drops in prices that have taken place some years.

The main purpose of the fruit and vegetable post harvest research is to cut down the losses of these commodities between harvest and consumption. At present, the size of these losses is unknown. Estimates of the losses vary from 10 percent of production to 60 percent in the case of onions. However, we were not able to find any systematic surveys on post harvest losses and since the production statistics themselves are not very reliable, there is no easy way to check the official estimates. The official estimates are that 20 to 40% of 50 million tons is lost. The value of this loss is placed at Rs.500 to Rs.1000 crores. The production of crops included in this project was about 32 million tons. Thus, the loss of these crops could be Rs.320 to Rs.640 crores. Any technique which is developed, will require some expenditure to popularize it and probably also some increased expenditure to implement the reduction in cost. For example, new methods of harvesting mangoes would at least require a training course for contractors and growers and might also require some extra equipment. Increasing the storage period of onions by treating them with malaic hydroxide, requires extension plus chemicals. Since the cost of these inputs is impossible to predict at the moment, all that can be said, is the reduction in loss would not be a net increase in benefits.

The benefits of the research will be divided between four

groups: market intermediaries, consumers, farmers and suppliers of inputs such as labor and chemicals. The initial beneficiaries of fruit postharvest research will undoubtedly be the market intermediaries who will lose less of their crop in transit or in storage. Assuming the market is competive, the increased supply will force traders to reduce retail prices so that they can sell their excess stocks. Thus, consumers will benefit from lower prices. The main group of consumers who will benefit are, well-off urban consumers, particularly in the case of grapes, citrus and high quality mangoes. However, lower prices will also make these fruits, particularly mangoes, available to a larger portion of the nutritionally deficit groups. Farmers will also benefit. When they realize that more of their product is actually being sold rather than lost, they can push up the price that they charge the contractor for the output of the orchard. Since fruits seem to be grown by both large and small farmers, both types of farmers will benefit from the higher prices. However, since the large farmers have larger orchards and sell a higher proportion of their crop, they will undoubtedly get more benefits.

One problem is that as prices go up in the countryside some of the rural poor may not be able to buy as much fruit. The impact on employment depends on technologies developed. Hopefully, they will be labor intensive rather than capital intensive. For instance, more careful harvesting would require more labor. More important, if farmers get higher prices, they will plant more area with orchards. During the early years of a new orchard, while field crops can be intercropped between the trees, the labor requrements may go up, but once intercropping stops, the labor requirements for orchards are less than the cropping systems they replace in most areas. This would be a negative effect on employment. The net effect is not clear as yet.

For vegetables, there is one less intermediary because few vegetable farmers hire intermediaries to harvest the crop. Also farmers may be in closer touch with the markets. Thus, the intermediaries probably will make less from improvements in post harvest technology and more will be passed on to consumers and producers. Since vegetable farmers are predominantly small farmers, it is they who would benefit from increased prices. Another difference from fruits is that higher prices would cause farmers to intensify their production or switch from less labor intensive grain, pulse or oilseed crops. Thus the demand for labor would clearly go up which will help the rural poor.

## IV. SOYBEAN PROCESSING AND UTILIZATION

The output of the soybean research subprojects would be classified as new products by economists although in some cases they will simply be more nutritious substitutes for old products. Thus their spread will require the market development costs which go with any new product. In addition, government price policies as well as the nature of the technology will play an important role in determining whether this gets to the vulnerable groups like pregnant and lactating women. If the government keeps soybean prices high by keeping oil prices high, as seems likely, the price of soybeans will not fall low enough to replace other dals or flour. Any kind of soybean dal will require more cooking or processing than more popular dals used today. Thus, if soybeans stay at the same prices as the preferred pulses which is where prices are at present, they are not likely to be used. As a protein supplement to wheat flour, soyaflour might be used even at the present price level which is twice the price of wheat flour. However, this would require a substantial nutrition education campaign to convince people of its value. There is some possibility that soybean prices will fall substantially. The current rapid increases in production promise to continue. This will put pressure on the government to let prices fall. Such a fall would help soybean products considerably.

If small scale production of some of these products is possible they offer opportunities for non-farm employment at the village level. The benefits would be most widely spread if they could be done through cooperatives. Products which could be processed at home would particularly help the position of women.

## V. RECOMMENDED SOCIO-ECONOMIC INPUTS INTO THE RESEARCH SUBPROJECTS

### A. Fruit and Vegetable Post-Harvest Technologies

1. The size of the losses at each stage in the marketing change-chain must be determined at an early stage in this project. At present the estimates are huge and have no apparent scientific basis. I would suggest that the Horticulture Division of IASRI, the Agricultural Economics Division of IARI and the section at the Horticulture Institute be involved with the food scientist and engineers. The studies must start at the village level to find out just how much the marketed surplus of these crops is. Then the size of the losses and what happens to those losses (poor people eat them? cattle eat them? completely wasted?) needs to be determined at each stage of marketing. Then the value of the losses can be more accurately calculated and the areas of greatest losses should receive the most research attention during the rest of the research.

2. At the same time or possible just after identifying losses the social scientists should be starting to identify the economic and social reasons for these losses. Apples are not packed in cardboard boxes instead of wooded because the cardboard boxes cost twice as much and shippers do not believe that the reduction in losses will make up for the extra cost. At the moment, there is apparently no economic benefit for the contractors who harvest citrus to harvest them carefully to prevent damage. Thus, even if the scientists find out that the way contractors are currently harvesting citrus results in a 20 percent loss, contractors will not change their picking method until there is some economic incentive to do so. Social scientists will be needed to identify what kind of social change is needed to give him or the orchard owner the proper incentive and identifying this change requires research. Traditional studies of the marketing margins need to be conducted in connection with these studies of the size of losses and the structure of harvesting and marketing fruits and vegetables. This would provide a sound basis for the extension of whatever technology is developed.

B. Soybean Processing and Utilization

1. Very early in the project an economist and anthropologist should examine the Pant Nagar program and the Bareilly private sector program to find out why soybean products have not become more popular there. They should also conduct a survey of the areas in U.P. and M.P. where soybean is consumed in various forms to find out how it is prepared, how much it costs and what it substitutes for in the diet. Soybean-fortified flour from the U.S.A. is apparently given out in the Intensive Child Development Scheme. The reaction of the consumers to this flour should be monitored.

2. An economist and an anthropologist should be involved with the village project so that they can monitor the reaction of the villagers to the new products and also the impact of the production systems that are introduced. Because both the reaction to the new product and the impact will be largely on the women, one of these scientists should be a woman.

APPENDIX A

TABLE: 1 AREA PRODUCTION AND YIELD OF POTATO

| YEAR | AREA (000 ha) | PRODUCTION (000 Tonnes) | YIELD (Qtls./ha) |
|---|---|---|---|
| 1950-51 | 240 | 1660 | 69.2 |
| 1955-56 | 280 | 1859 | 66.4 |
| 1960-61 | 375 | 2719 | 72.5 |
| 1965-66 | 479 | 4076 | 85.1 |
| 1970-71 | 482 | 4807 | 99.8 |
| 1971-72 | 492 | 4826 | 98.1 |
| 1972-73 | 505 | 4451 | 88.2 |
| 1973-74 | 543 | 4861 | 89.5 |
| 1974-75 | 587 | 6625 | 106.0 |
| 1975-76 | 622 | 7306 | 117.4 |
| 1976-77 | 620 | 7171 | 115.7 |
| 1977-78 | 665 | 8135 | 122.3 |
| 1978-79 | 807 | 10133 | 125.6 |
| 1979-80 | 693 | 8306 | 119.9 |
| 1980-81 (p) | 815 | 10236 | 125.6 |

P - Provisional Source: Directorate of Economics & Statistics, Government of India

APPENDIX B

TABLE:2 INDIA - ONION PRODUCTION

| YEAR | AREA (ha 000) | PRODUCTION (Tons - 000) |
|---|---|---|
| 1974-75 | 195 | 2048 |
| 1975-76 | 215 | 2242 |
| 1976-77 | 192 | 2164 |
| 1977-78 | N/A | 2388 |
| 1978-79 | N/A | 2564 |
| 1979-80 | 250 | 2490 |

Source: NAFED

APPENDIX C

TABLE: 5 INDIA - SOYBEAN PRODUCTION

| YEAR | AREA thousand ha | PRODUCTION thousand tons | YIELD kg/ha |
|---|---|---|---|
| 1969-70 | 24 | 11 | 458 |
| 1970-71 | 30 | 18 | 600 |
| 1971-72 | 32 | 20 | 625 |
| 1972-73 | 35 | 25 | 714 |
| 1973-74 | 90 | 30 | 333 |
| 1974-75 | 90 | 35 | 389 |
| 1975-76 | 100 | 70 | 700 |
| 1976-77 | 200 | 150 | 750 |
| 1977-78 | 225 | 180 | 800 |
| 1978-79 | 275 | 220 | 800 |
| 1979-80 | 400 | 300 | 750 |
| Compound Growth Rates | % | % | % |
| 1969/70-1978/79 | 2.9 | 3.4 | 0.5 |
| 1969/70-1979/80 | 2.9 | 3.4 | 0.5 |

Source: World Bank Estimates

APPENDIX D

TABLE:3 INDIA - AREA AND PRODUCTION OF IMPORTANT FRUITS

Area = 000 ha
Production = 000 tonnes

| Fruits | 1976 -77 | | 1977-78 | | 1978-79 | |
|---|---|---|---|---|---|---|
| | A | P | A | P | A | P |
| 1. Apple | 121.62 | 503.50 | 125.64 | 545.07 | 130.36 | 662.02 |
| 2. Banana | 265.56 | 4550.56 | 284.82 | 4754.84 | 202.39 | 5144.26 |
| 3. Citrus | 189.09 | 2047.68 | 191.80 | 1582.96 | 197.23 | 1612.48 |
| 4. Guava | 127.55 | 3022.65 | 128.32 | 1137.15 | 133.44 | 1177.41 |
| 5. Grapes | 9.35 | 150.63 | 8.56 | 166.00 | 9.56 | 182.16 |
| 6. Mango | 905.35 | 7456.34 | 925.48 | 7527.20 | 942.56 | 8216.51 |
| 7. Pineapple | 40.73 | 442.90 | 41.86 | 470.61 | 43.95 | 500.30 |
| 8. Other Fruits | 434.52 | 2005.31 | 447.36 | 2662.23 | 470.77 | 2734.54 |
| | 2093.76 | 18779.20 | 2154.24 | 18846.06 | 2210.27 | 20229.68 |

| Fruits | 1979-80 | | 1980-81 | | 198-82 | | 1982-83 | |
|---|---|---|---|---|---|---|---|---|
| | A | P | A | P | A | P | A | P |
| 1. Apple | 138.90 | 718.63 | 145.80 | 821.79 | 153.75 | 926.98 | 161.60 | 960 |
| 2. Banana | 291.15 | 5272.69 | 300.33 | 5377.32 | 311.94 | 5553.71 | 317.60 | 5608 |
| 3. Citrus | 708.30 | 215.68 | 1706.16 | 230.70 | 1759.10 | 234.57 | 1807.00 | |
| 4. Guava | 139.05 | 1216.93 | 144.68 | 1257.60 | 150.93 | 1314.83 | 155.78 | 1350 |
| 5. Grapes | 10.23 | 195.85 | 10.83 | 207.84 | 11.43 | 222.47 | 12.05 | 237 |
| 6. Mango | 958.43 | 8363.30 | 979.64 | 8515.71 | 1001.54 | 8662.81 | 1022.22 | 8833 |
| 7. Pineapple | 45.60 | 548.98 | 48.14 | 593.23 | 83.49 | 643.10 | 87.20 | 671 |
| 8. Other Fruits | 400.77 | 2841.86 | 511.46 | 2693.36 | 543.28 | 3085.92 | 960.88 | 3185 |
| Total | 2262.43 | 20810.24 | 2356.65 | 2144.52 | 2487.06 | 22168.92 | 2552.01 | 2266 |

N.R. Projection for 1979-80 onwards

Source: Indian Horticulture Research Institute

Annex B

# ADMINISTRATIVE ANALYSIS

## I. HISTORY AND BACKGROUND OF THE ICAR

As a result of the constitutional changes of 1919, the Government of India transferred much of the responsibility for directing and administering research projects to the seventeen State Governments. Even though administration of the Central agencies and institutions for research and technical training was retained at the Center, (federal-level), no specific provision was made for coordinating the work of these institutions with similar institutions in the States. Therefore, concern was expressed that, in the absence of coordination in the field of agricultural research, the existing cooperation between the Center and the States might be lost.

The Royal Commission on Agriculture was appointed in 1926 to examine the status of agricultural development and the rural economy in India. The Commission's study provide numerous observations, including the following points: (1) agricultural research in India was still in its very early stages; (2) that however efficient the organization established for demonstration, it wouldn't be entirely successful unless it was based on research; (3) that lack of coordination hampered the progress of agricultural research and (4) that it was the duty of the GOI (Center) to undertake the ultimate responsibility for the welfare of the agricultural population of the Country through advancing agricultural research as much as possible without encroaching upon the State's responsibilities. Based on its concerns, the Commission recommended the establishment of an Imperial Council of Agricultural Research.

After careful consideration of the Commission's recommendations, the Government of India established this Imperial Council. On June 10, 1947 after Independence, the name of the Council was changed to the "Indian Council of Agricultural Research" (ICA . Until 1965, the ICAR functioned primarily as a coordinating body financing selected ad hoc research projects through funds obtained from the Agricultural Produce Cess Act of 1940. In 1966, a major reorganization was undertaken which placed all research activities under the ICAR.

## II. ICAR

### A. Composition and Function

As the agency is responsible for the central government's contribution to both agricultural research and education, the ICAR ensures linkages between central and state governments and facilitates cooperation with international agricultural research institutions and other international organizations. India has

established effective working relationships with many of the international research centers and has made a substantial contribution to these centers and the international community. It has a budget of $378 million for the Sixth Five Year Plan. With this budget, it provides financial, technical and management support for the following institutions and projects.

1. The twenty-three state agricultural universities;

2. Thirty-five centrally controlled agricultural research institutes and centers and four project directorates;

3. More than sixty-five national coordinated research schemes on commodities on problems of widespread concern;

4. Operational research projects in selected areas and on applied subjects in various parts of the country;

5. A limited number of ad hoc research projects conducted by individual institutions; and

6. Implementing the Lab-to-Land through all its research projects, which aims to transfer technology from the laboratories to the marginal and small farmers.

These activities of the ICAR are discussed in the following sections:

## The State Agricultural Universities

The ICAR is responsible for the coordination and promotion of higher agricultural education in India. It provides incentive and leadership for the development of new and practical educational programs promoting innovation. One of its most important functions is to improve the standards of education and train qualified personnel to provide a sound technological and scientific base for Indian agriculture. To accomplish these functions, the ICAR provides assistance to the agricultural universities for: (1) their development programs; (2) the improvement of staff pay scales and (3) the institutions of scholarships, fellowships and teacher training programs. The ICAR handles this support through its educational divisions under the Deputy Director-General for Eduation. 1/

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1/ ICAR, History and Growth: Indian Council of Agricultural Research, New Delhi, December 1976, pp. 127-128.

The present system of twenty-three agricultural universities in sixteen states was developed over the last twenty years to provide scientific education which would serve the needs of the farming community. The universities were designed to be involved in both teaching and applied research and their students were expected to learn a practical orientation to agricultural problems. See Annex A for a list of State Agricultural Universities (SAU).

The basic objectives of the Indian Agricultural University system were very similar to the philosophy of the U.S. Land-Grant College System which combines instruction, applied research and extension to develop solutions to the practical constraints of agriculture. In fact, six U.S. universities provided technical assistance in the development of the nine Indian agricultural universities from 1951 -173.2/

The present Indian agricultural universities are state institutions and receive their basic financial support through the state governments. They are also provided grants from the ICAR for certain developmental activities and for a substantial number of research projects.3/

The SAU have now assumed, for the most part, responsibility for research and higher education in agriculture. As a result, the SAU are handling almost all research and experiment stations within their respective states. SAU participation in national coordinated research schemes sponsored by the ICAR has provided the universities with a wider range of genetic materials and has contributed to a greater exchange of information between scientists, both within the States and among States. It has also helped to improve the quality of SAU experimentation as well as extending the knowledge and applicability of their results.

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2/ During this period, over 300 staff members from six U.S. universities accepted assignments in India and over 1,000 Indian faculty members and graduate students studied in the U.S. The six universities were: Kansas State Univ., Univ of Illinois, Pennsylvania State Univ., Univ. of Tennessee, Univ. of Missouri and Ohio State Univ. The nine Indian agricultural universities are: Punjab Agricultural Univ., Haryana Agricultural Univ., G.B. Pant Univ. of Agriculture and Technology, University of Udaipur, Madhya Pradesh Agricultural Univ., Orissa University of Agriculture and Technology, Maharashtra Agricultural Univ., Andhra Pradesh Agricultural Univ., and Mysore Univ. of Agricultural Sciences.

3/ During the first five years ICAR financed almost all capital developments, plus a high proportion of improved salary scales for which staff became eligible. ICAR provides, generally three-fourths of SAU research budgets.

Research Institutes

The ICAR provides management and financial support to 35 centrally controlled research institutes and project directorates which have been established to ensure in-depth research on a wider range of commodities and scientific problem areas.

The Indian Agricultural Research Institute in Delhi is a major center of research and training in India. It was established in Pusa (Bihar) in 1905 and later transferred to Delhi in 1935. The major functions of the Institute include: basic and applied research into selected aspects of the agricultural sciences; teaching at the post-graduate level and conducting extension advisory services in the villages in the Union Territory of Delhi.

IARI is renowned for its contributions to the advancement of knowledge in agricultural sciences in India. Although it is a research institution, it acquired the status of a deemed university by the 1956 Act of University Grants Commission. It has now been training students for Masters of Science and Ph.D degrees in as many as fifteen disciplines and its functions are spread over as many as seventeen divisions.4/

The other research institutes for specific scientific research are located throughout India. When the network of these Institutes was merged with the work at the Center through the ICAR, it enabled the problems of agriculture to be viewed comprehensively.5/ Therefore, the Institute system incorporates a wide variety of research endeavors countrywide and provides a significant mechanism for the development and transfer of applied agricultural technology.

All-India Coordinated Research Projects

ICAR also organizes and finances more than sixty-five national coordinated research schemes on commodities or problems of widespread interest.6/ These projects operate

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4/ Seed Technology, Plant Pathology, Microbiology, Agronomy, Soil Science, and Agricultural Chemistry, Agricultural Physics, Biochemistry, Agricultural Chemicals, Entomology, Mycology and Plant Pathology, Horticulture, Vegetable Crops and Floriculture, Agricultural Engineering, Agricultural Economics and Agricultural Extension.

5/ The ICAR Institutes are listed in Appendix B

6/ The All-India Coordinated Research Projects are listed in Appendix C.

through ICAR institutes as well as through agricultural universities and therefore, provide a link between Center and State level institutions. While the ICAR Institutes and agricultural universities organize research on fundamental and applied aspects of production, preservation and utilization of crops, animals and fish, the coordinated projects undertake applied research on specific commodities. The coordinated projects then complement the work which is carried out at the SAU and research institutes and research output is maximized without duplication.

The National Coordinated Maize Improvement Scheme, instituted by ICAR in cooperation with the states in 1957, laid the foundation for more effective national planning of research on a commodity or problem basis. It provided a model for the development of other nationally coordinated schemes. The basic format of the program included a national coordinator, based at IARI, four main centers and nine smaller substations. Within four years, four highly productive maize hybrids were developed, tested and prepared for release with wide adaptability in the Gangetic Plain, the Terai and the Deccan. The scheme resulted in the development of plans for the National Seeds Corporation which would arrange for production and distribution of foundation and certified seeds of these hybrids and improved varieties and hybrids of other crops for use by farmers throughout the nation. Therefore, this model of research was thought to be an effective means to tackle particular commodity-specific problems.

Major advances have been achieved thorugh this coordinated research model for the production of several crops, but most notably wheat and rice. Indian scientists further developed basic genetic materials from abroad to incorporate among other things, the desired grain quality, broad-based resistance to pathogens and better adaptation to the country's differing ecological zones.

Seven of the All-India Coordinated projects will be related to the research to be financed under the Project - Soybeans, Oilseeds (Groundnut), Post-harvest Technology, Fruits, Vegetables, Citrus and Potato.

Other Research Projects

The ICAR also conducts operational research projects in specific areas of the country to gain an insight into the socio-economic constraints affecting the adoption of research results.7/ The Soybean Processing and Utilization Subproject

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7/ These projects are listed in Appendix D.

will finance an operational research activity for testing and demonstrating the subprojects research results. ICAR also supports a number of ad hoc research projects conducted by individual institutions.

The Lab-to-Land Program

In 1979, the ICAR instituted an experimental program which aims to transfer the latest proven and viable agricultural technology to 125,000 farm families belonging to the group of small and marginal farmers, landless laborers and other communities in rural settings representing the poorer socio-economic groups. The Lab-to-Land program is being implemented by the Council through the existing research centers of the ICAR institutes, Agricultural Universities, Affiliated Agricultural Colleges and Voluntary organizations. A team of scientists in over 300 research locations of the ICAR are participating in this program.

In essence, the Lab-to-Land program is operating in eight agroclimatic zones in India and involves the selection of target farm facilities who receive assistance, emphasizing families having one - two hectares of land, and willingness to adopt new agricultural technology. ICAR scientists are developing and implementing individual farm plans for the selected families. In addition, training of farm youth and farm women is also being undertaken, to accelerate the adoption of new agricultural technology.

This program represents the ability of the ICAR to develop innovative solutions to the difficult problem of extending research results and technology to the farmer who can benefit from this information. Experience has shown that it is possible to increase the employment, production and income of marginal farmers and landless laborers two to three fold depending upon the motivation of the farmers and the resources which can be mobilized. The program has provided a farm level interaction for research scientists that will permit the design of highly relevant research activities to cope with farmers's problems. Based on the success of the program, the ICAR has decided to extend it until May 1985. About 75,000 new farm families are expected to be involved in the program's second phase.

B. Scope for Decision Research

The ICAR has the authority to identify and develop research projects which are consistent with the agricultural development priorities of the Sixth Five Year Plan and are within the ICAR's budget allocation.

C. Administration of the ICAR

The Minister for Agriculture and Irrigation in the Government of India is the President of the Council and the Minister of State in the Ministry dealing with ICAR is the Vice-President. The Director-General of the Council is the principal executive of the Council. He is concurrently Secretary to the Department of Agricultural Research and Education of the Government of India. He also functions as the principal advisor to the Central Government on all matters connected with agriculture, animal husbandry and fisheries research and education.

The Council functions through the following bodies:

1. Governing Body: The Governing Body is the Chief Executive and decision making authority of the Council. It is presided over by the Director-General, ICAR and is preeminently a body of scientists and others with interest in and knowledge of agriculture. It decides policies of the ICAR, approves of research programs and projects and controls the budget of the Council.

2. Standing Finance Committee: This Committee is presided over by the Director-General, ICAR and is in a way a sub-committee of the Governing Body. It examines all proposals of the Council including research projects involving financial implications and also examines the annual budget of the Council before submission to the Governing Body.

3. Norms and Accreditation Committee: The Director-General, ICAR presides over this Committee which consists of five Vice-Chancellors of Agricultural Universities nominated by the President of the Council. The Deputy Director-General (Education) is a member of the council. This Committee determines the norms for financial assistance from the ICAR to the Agricultural Universities and Colleges and ensures maintenance of standards of education in agricultural and animal sciences.

4. Regional Committees: Eight Regional Committees have been constituted, one each for eight broad agroecologicl regions covering the entire country. These committees are headed by the Director-General, ICAR. Included as members are members of the ICAR society and Directors of ICAR Institutions in the region; technical representatives of the Agricultural Universities, Central institutes and Department of Agriculture of Government of India in the region and the State Departments; and farmers of the region

nominated by the President. These committees review the status of agricultural research and education in the respective regions and make necessary recommendations to the Government Body relating to location-specific problems of that region.

5. Scientific Panels: The ICAR has Scientific Panels for various disciplines to consider schemes and projects relating to these disciplines. There are also joint panels between ICAR and related research organizations. Besides considering schemes for research, the Scientific Panels may also advise the Governing Body on technical matters and draw its attention to gaps in the current research and training efforts.

6. The ICAR has at present 35 institutes under its control. Each institute has a Managing Committee constituted according to the rules of the ICAR Society.

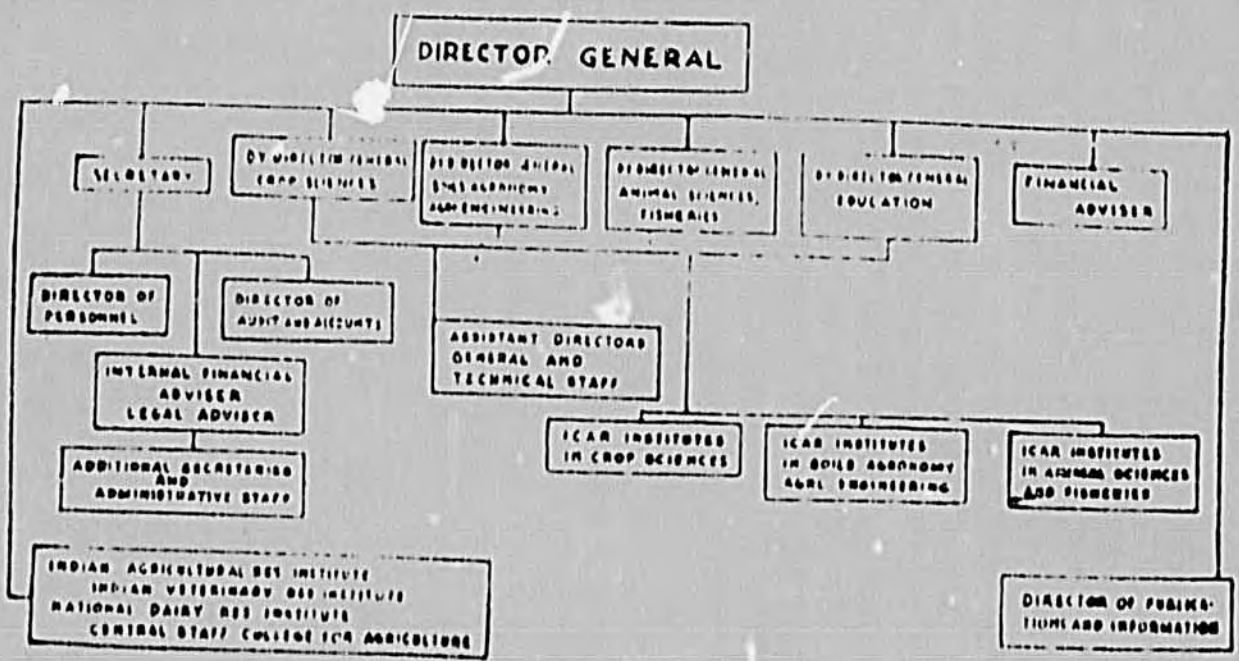
At the headquarters of the ICAR, the Director-General is, on the technical side, assisted by four Deputy Directors-General one each in the fields of: (a) Crop Sciences, (b) Soils, Agronomy and Agricultural Engineer, (c) Agricultural Education and (d) Animal Sciences. The Deputy Directors-General are assisted by Asst. Directors-General and other technical officers. Each Deputy Director-General is responsible for the preparation, scrutiny and control of technical matters within his division.

On the administrative side, the Director-General is assisted by the Secretary of the Council who is also the Joint Secretary in the Department of Agriculutural Research and Education. The Secretary is assisted by a Director of Personnel, a Director of Finance and a number of additional and Under Secretaries and other administrative staff.

The activities of the Council are financed by the Government of India by: (a) outright grants-in-aid and (b) receipts of Agricultural Products Cess Fund. In order to impart the desired degree of operational flexibility and speed in project implementatio, the GOI has agreed to give a lump sum grant to the Council every year. This will be composed of two parts, viz., (a) Plan and (b) Non-Plan. The Society can economize on certain items and reappropriate funds for other purposes within its charter. As regards Plan outlay, the Society has competence to reappropriate funds for other purposes within its charter. As regards Plan outlay, the Society has competence to reappropriate from one approved scheme to another provided the total outlay of all schemes for

a five-year period does not exceed the approved outlay in the Five-Year Plan, subject to such guidelines and restrictions, if any, as may be prescribed from time to time by the Department of Agricultural Research and Education in consultation with the Ministry of Finance. The Finance Secretary is associated with the ICAR as a member of the Governing Body and advises the Society on all matters relating to its budget and expenditure.

D. Organizational Chart of ICAR



## III. AGRICULTURAL RESEARCH SERVICE OF THE ICAR

To implement the scientific programs with the appropriate expertise, the ICAR decided to restructure its personnel policies towards all categories of staff: scientific, technical, administrative and supporting. For scientific staff, it decided to establish an Agricultural Research Service (ARS) starting from October 2, 1975.

Three of the most significant features of the new policies are:

1. No scientist needs to shift hereafter his or her field of specialization just for the sake of an improvement in salary; a scientist doing his or her job with dedication and distinction can hope to get the highest salary possible within the organization without recurrent application and competition with professional colleagues and without having to shift to a research management position;

2. Every scientist may have to help for some time during his or her career to solve the problems of neglected and tribal areas; and

3. All research management and coordinating positions will be filled up on a tenurial basis, so that no scientist needs to give up his or her active research career for too long.

The purposes of the establishment of the ARS were to induct the best talents available for the service of Indian Agriculture and to allow both in-country and overseas career development opportunities.

## IV. ICAR STAFFING POLICIES

The ICAR has established bylaws for the selection of its staff, which are grouped in the following categories:

1. scientific;

2. auxilary technical;

3. administrative, ministerial and accounts; and

4. subordinate staff

The ICAR has constituted various Selection Committees/Interview Boards for the selection of personnel for scientific and technical posts at the ICAR headquarters and at the Institutes.

Boards have also been set up for the selection of Directors in various grades at the Institutes. This Board includes the Chairman of the Agricultural Scientist's Recruitment Board, the Director-General or his representative and two to three advisors.

The Prsident, the Vice-President, the Director-General, the Directors of the Institute and the Secretary also have specific appointing authorities for specific salary levels.

Although the provisions for the aforementioned authorities are contained in the ICAR Bylaws,8/

> "the work relating to recruitment to all or any category of posts in the Council's headquarters and its Research Institutes/laboratories/centers may be entrusted by the President/Vice President to the Agricultural Scientists Recruiting Board set up by the Society with the approval of the Government of India, as an independent recruitment agency."

This Recruitment Board is responsible for the recruitment to posts in the Agricultural Research Service and other such posts and services as may be specified by the President.

Therefore, the ICAR has a comprehensive personnel policy and procedures to recruit qualified staff, provide career development opportunities at all staff levels and offer them a good promotion potential. Through this system, including the ARS, the ICAR has been able to attract numerous qualified Indian scientists and technicians, employing over 5,500.

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8/ ICAR, History and Background, p. 73.

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3. Fact Sheet No.23: United States Economic Assistance to India, June 1951 to April 1971; U.S. Information Service; New Delhi, 1971.

4. Lab-to-Land; Indian Council of Agricultural Research, New Delhi; 1979.

5. Annual Report, 1981-82; Government of India, Department of Agricultural Research and Education, Ministry of Agriculture, New Delhi, 1982.

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Appendix A

## LIST OF AGRICULTURAL UNIVERSITIES IN INDIA

1. Govind Ballabh Pant University of Agriculture and Technology, Pantanagar (U.P.)
2. Punjab Agricultural University, Ludhiana (Punjab)
3. University of Udaipur, Udaipur (Rajasthan)
4. Orissa University of Agriculture and Technology, Bhubaneswar (Orissa)
5. Andhra Pradesh Agricultural University, Hyderabad (A.P.)
6. University of Agricultural Sciences, Bangalore (Karnataka)
7. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.)
8. Bidhan Chandra Krishi Vishwa Vidyalaya, Haringhate, Kalyani (West Bengal)
9. Konkan Krishi Vidyapeeth, Dapoli (Maharashtra)
10. Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra)
11. Punjabrao Krishi Vidyapeeth, Akola (Maharashtra)
12. Assam Agricultural University, Jorhat (Assam)
13. Haryana Agricultural University, Hissar (Haryana)
14. Rajendra Agricultural University, Pusa (Bihar)
15. Kerala Agricultural University, Mannuthy (Kerala)
16. Himachal Pradesh University, Agricultural Complex Simla (H.P.)
17. Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)
18. Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra)
19. Gujarat Agricultural University, Ahmedabad (Gujarat)
20. Chander Shekar Azad University of Agriculture and Technology, Kanpur (U.P.)
21. Narendra Deva Avam Prodyogik Vishwa Vidyalaya, Faizabad (U.P.)

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Appendix B

## LIST OF THE ICAR INSTITUTES AND NATIONAL RESEARCH CENTERS

1. Indian Agricultural Research Institute, Delhi
2. National Dairy Research Institute, Karnal
3. Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh
4. Central Rie Research Institute, Cuttack
5. Jute Agricultural Research Institute, Barrackpore
6. Jute Technological Research Laboratory, Calcutta
7. Central Institute of Cotton Research, Nagpur
8. Cotton Technological Research Laboratory, Bombay
9. Central Tobacco Research Institute, Rajahmundry
10. Central Plantation Crops Research Institute, Kasargod, Kerala.
11. Central Tuber Crops Research Institute, Trivandrum
12. Central Potato Research Institute, Simla
13. Indian Institute of Horticultural Research, Bangalore
14. Sugarcane Breeding Institute, Coimbatore
15. Indian Institute of Sugarcane Research, Lucknow
16. Central Arid Zone Research Institute, Jodhpur
17. Central Soil Salinity Research Institute, Karnal
18. Central Soil and Water Conservation Research and Training Institute, Dehradun
19 National Bureau of Soil Survey and Land Use Planning, Nagpur
20. Central Institute of Agricultural Engineering, Bhopal
21. National Bureau of Plant Genetic Resources, Delhi
22. Central Sheep and Wool Research Institute, Avikanagar
23 Central Inland Fisheries Research Institute, Barrackpore
24 Central Marine Fisheries Research Institute, Cochin
25. Central Institute of Fisheries Technology, Cochin
26. Indian Grassland and Fodder Research Institute
27. Institute of Agricultural Research Statistics, Delhi
28. Vivekananda Parvitheya Anusandhan Shala, Almora
29. Indian Lac Research Institute, Ranchi
30. National Academy for Agricultural Research Management
31. Central Goat Research Institute, Mathura
32. Central Asian Research Institute, Izatnagar
33. Central Institute of Fisheries Technology, Cochin
34. Central Agricultural Research Institute for Andaman and Nicobar
35. National Research Center for Groundnut, Junagarh
36. ICAR Research Complex for North Eastern Hills Region, Shillong

## PROJECT DIRECTORATES

1. Dryland Research Project, Hyderabad
2. North East Himalayan ICAR Research Complex, Shillong
3. Oil Seeds Research Project Directorate, Hyderabad
4. Pulse Research Project Directorate, Kanpur

Appendix C

## INDIA

## LIST OF ALL-INDIA COORDINATED RSEARCH PROJECTS

(i) Food Crops

1. Rice
2. Wheat
3. Barley
4. Maize
5. Sorghum
6. Millets
7. Pulses
8. Forage Crops

(ii) Commercial Crops

1. Sugarcane
2. Sugarbeet
3. Cotton
4. Jute
5. Oilseeds
6. Soybean
7. Tobacco

(iii) Horticultural Crops

1. Fruits
2. Tuber Crops
3. Potato
4. Vegetables
5. Medicinal and aromatic plants
6. Floriculture
7. Spices and Cashewnut
8. Coconut and Arecanut
9. Citrus
10. Semi-arid Fruits

(iv) Soils, Agronomy and Agricultural Engineering

1. Water management and soil salinity and new cropping patterns
2. Use of saline water
3. Water management in high raintall areas and temperate hill zones
4. Correlation of soil test with crop responses
5. Micronutrient research
6. Measurement evaluation and improvement of soil structure

7. Microbiological decomposition and recycling urban and rural wastes
8. Dry farming research
9. Agronomic research
10. Operatinal research (including national demonstration and integrated pest control project)
11. Research and development of farm machinery, implements, production of prototypes and their evaluation

(v) All-India Coordinated Research Projects (Animal Sciences)

1. Cattle breeding
2. Buffalo breeding
3. Sheep breeding
4. Poultry breeding
5. Goat breeding
6. Pig breeding
7. Other animal breeding
8. Agricultural by-products and industrial waste materials
9. Specialized dairy farming (economics of milk production under intensive dairy farming conditions)
10. Epidemiological studies on foot and mouth disease

(vi) All-India Coordinated Research Projects (Fisheries)

1. Composite culture of Indian and exotic fisheries and riverine fish seed production
2. Propagation of air-breathing fishes in swamps
3. Ecology and fisheries of fresh water reservoirs
4. Utilization of trash fish transportation of fresh fish
5. Brackish water fish farming

(vii) Other

1. Nematode pest control
2. Seed-borne diseases
3. White grubs
4. Economic ornithology
5. Honeybees
6. Biological center of crop pests and weeds
7. Rodent control
8. Tribal area research

Appendix D

## OPERATIONAL RESEARCH PROJECTS

| Name of the Project | Name of the Implementing Agency |
|---|---|
| 1. Operational research project at Chittorgarh District, Rajasthan for stepping up oilseeds, cereals and animal husbandry production. | Udaipur University, Udaipur, Rajasthan. |
| 2. Integrated milk and crop production for increased productivity, employment and farm income in villages around Karnal. | National Dairy Research Institute, Karnal. |
| 3. Operational research project for arid land management. | Central Arid Zone Research Institute, Jodhpur. |
| 4. Operational research project for stepping up production of seed potato and other crops grown in areas in Shillong and Patna. | Central Potato Research Institute, Simla. |
| 5. Operational research project for stepping up cotton production, cereals and pulses and animal husbandry in Amravati. | Punjabrao Krishi Vidyapeeth, Akola. |
| 6. Operational research project for stepping up production of groundnut, cereals and pulses on acic soils in Puri District. | Orissa University of Agriculture and Technology, Bhubaneshwar. |
| 7. Operational research project for stepping up production of jute, mesta and other agricultural crops and fisheries. | Jute Agricultural Research Institute, Barrackpore. |

| Name of the Project | Name of the Implementing Agency |
|---|---|
| 8. Operational research project for the reclamation of saline and alkaline soils in District Kapurthala (Punjab). | Punjab Agricultural University, Ludhina. |
| 9. Operational research project on sheep and wool development. | Central Sheep and Wool Research Institute, Avikanagar, Malpura. |
| 10. Operational research project for the reclamation of alkali soils. | Central Soil Salinity Research Institute, Karnal. |
| 11. Operational research project for integrated land use planning of plantation crops like coconut palm, cashewnut, arecanuts, etc. | Central Plantation Crops Research Institute, Kasargod, Kerala. |
| 12. Operational research project on integrated control of the rice pests in the States of Andhra Pradesh, Orissa, West Bengal, Madhya Pradesh and Kerala. | J.N.K.V.V. Jabalpur, C.R.R.I. Cuttack, Dept. of Agriculture, West Bengal, Kerala. Ag. University, A.I.C.R.I.P., A.P.A.U., Hyderabad. |
| 13. Operational research project in root-wilt-affected area. Quillon District. | Central Plantation Crops Research Institute, Kasargod, Kerala. |
| 14. Operational research project on control of white grubs in the jowar farming system in Nanded District. | Marachwada Krishi Vidyapeeth, Parbani, Maharashtra. |
| 15. Operational research project for transferring rural economy through technological changes around Sevagram in Wardha District. | Punjabrao Krishi Vidyapeeth, Akola. |

| Name of the Project | Name of the Implementing Agency |
|---|---|
| 16. Operational research project for stepping up crop and fish production in Sundarabans area. | Jute Agricultural Research Institute, Barrackpore, West Bengal. |
| 17. Operational research project for maximizing lac production in Chhota Nagpur area (Bihar). | Indian Lac Research Institute, Ranchi, Bihar. |
| 18. Operational research project on Integrated control of cotton pests to be undertaken in District Ludhiana (Punjab) and Coimbatore (Tamil Nadu). | Punjab Agricultural University, Ludhiana and I.A.R.I. Sub-station, Coimbatore. |
| 19. Operational research project on livestock and fodder improvement in district Bareilly. | Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh. |
| 20. Composite fish culture. | Central Inland Fisheries Research Institute, Barrackpore. |
| 21. Operational research project on rice in the District of Cuttack, Bapatla Hoogly and Burdwan. | C.R.R.I. Cuttack, Dept. of Agriculture, West Bengal, A.P.A.U., Hyderabad. |

Annex C

NOTES ON PID ISSUES
(State 186743; July 24, 1978)

FROM STATE 186743

1. "APAC suggest deleting "education" in title at project as proposed in PID will not train university faculty or lead to changes in curriculum at agricultural universities, except as a by-product."

Response: The word "education" has been deleted from the project title since the project is not addressing strictly educational concerns such as curricula development. It will primarily support research work with the state agricultural universities and accordingly with ICAR institutions. Nonetheless, faculty members will be trained in India and the U.S. in research applicable to specific crops and functional sientific areas covered by subprojects.

2. "APAC noted and accepted that overall thrust is problem solving rather than institutional development. Accordingly, project purpose.....should be amended. Also, major outputs are primarily relief of development constraints and only secondarily higher level of competence and improved facilities, i.e. institutional developments."

Response: During the project development process the need for institutional strengthening became evident. State outlined the Mission's plans for regarding the project as institution-building as well as problem-solving and this expanded focus is consistent with the Agency's priorities of institutional development and technology transfer. The project will strengthen implementing ICAR institutions to address particular problem areas by funding additional staff resources, providing research equipment and specialized facilities for research work. Each of these elements will enhance the institutions capability to develop innovative solutions to crop-specific or functional scientific problems.

3. "APAC concerned that linkage to mandate target beneficiaries be as direct and measurable as possible while at the same time project guidelines not be unduly restrictive. We would prefer to avoid or minimize selection criteria approach because this can rapidly get very complicated and lead to misunderstandings, rejected proposals and project delays. Preferred approach

would be to identify at least half (six) of the research topics in PP with perhaps a GOI-Mission agreed illustrative list from which the remaining topics will be chosen. Another approach would be to delay selection of remaining topics for about a year after project authorization and reconvene project design team to select remaining topics then. The concern is that research be in mainstream areas of potential benefit to significant portions of India's agricultural sector, especially small farmers. We would want to avoid research which would benefit only crops grown on large farms or which would have little or no impact on important food crops."

Response: Significant attention has been given to research projects which will provide potential benefits to small farmers and which are also appropriate for Indo-U.S. collaboration. An initial list of twelve possible subproject areas was identified at the Indo-U.S. Subcommission meeting of September, 1980. The project will fund subprojects from that list, or other mutually agreed topics according to the criteria specified in the project paper. This method of selection and criteria allow sufficient flexibility for the most advantageous choice of subprojects. Not all subprojects will focus on small farmers. The GOI is particularly anxious to tap into the advanced agricultural research in the U.S. and some subprojects can be expected to have basic research elements. A reasonable balance will be maintained.

4. As stated in para 3 above, APAC accepted project's research focus, with no emphasis on institutional aspects of extension. However, it is important that the research findings resulting from this project be promulgated quickly and effectively to users and not be shelved and forgotten. Thus, project should address and, if necessary, include resources for the quote extending unquote of its own findings as widely as possible, unless existing system deemed adequate to do the job.

Response: The Indian agricultural extension system was established in 1952 with the launching of the Community Development Program and is now being further strengthened by the adoption at the state level of the Training and Visit system developed by the World Bank. ICAR's Lab-to-Land program has been created to transfer agricultural technology to farm families, particularly small and marginal farmers, landless labourers and other communities in rural settings representing poorer socio-economic groups. This program has proven to be a success and plans to reach 125,000 farm families by 1985. As a result of these capabilities, the Indian extension system is regarded as adequate to dessiminate the results of this project. Nonetheless, the project itself should also provide extension linkages through selected subprojects. The Soybean

Processing and Utilization project has an operational research component which will extend the research results on a pilot basis to the village level. In the Groundnut Research Project, research results will be dessiminated to experiment stations of universities and institutes involved in the All India Coordinated Oilseeds Project (Groundnut). At these locations varieties are developed which are adaptable to local conditions and are made available for extension. Therefore, the Indian extension system itself and the linkages planned through certain subprojects should be adequate to assure adoption of the research results at the farmer level.

5. "APAC noted large numbers of low income farmers in unirrigated arid or semi-arid areas. Perhaps at least some of the research undertaken should, therefore, be for the benefit of rainfed agriculture in dryer areas."

Response: It is recognized that the problems of low-income farmers in unirrigated arid or semi-arid areas require attention. This will be accomplished both by choice of crops to be researched - both groundnuts and soybeans are primarily rainfed and the resarch content of some of the subprojects. The land and water management subproject should aim at developing an effective scientific basis for managing land and water within watershed systems under difference agro-climatic zones in India. This information should be directly useful to small farmers as they learn how to manage rainfall and other variables which are necessary to maximize productivity for the rainfed agro-climatic zones. In view of the high productivity of irrigated agriculture and its essential contribution to GOI food production goals, both rainfed and irrigated conditions will be researched.

6. "Is dealing exclusively with ICAR as principal implementing agency sufficient, or should we develop direct relationships as well with state institutions, independent of normal ICAR channels, in order to ensure identification and conduct of high priority research."

Response: The Indian Council of Agricultural Research is the central coordinating body for all central (federal) and state level agricultural research. It includes all 21 state universities, 36 research institutes and centers, over 65 coordinated research schemes and other projects. It finances three fourths of the agricultural research conducted by states. It is the most appropriate implementing agency for the identification and conduct of high priority research (see Annex B, Administrative Analysis for further description of the ICAR).

7. "As Mission aware, USDA/SEA has on-going rupee-funded agricultural research in India. Project design team will have to explore ways to coordinate or at least avoid duplication with USDA efforts.

Response: The USDA's rupee-funded work in agricultural research supports small, discreet research activities in the broad field of agricultural research, including: utilization, marketing, economics, plant and animal sciences, forestry and human nutrition. The projects are not, therefore, of the magnitude envisioned in this agricultural research project. Nonetheless, duplication will be avoided and coordination maintained within the U.S. Mission. In addition, the ICAR has approval authority for all of the USDA rupee-funded projects as well as subprojects financed under this Project. ICAR has demonstrated its concern for avoiding duplication of work by various donors and can be expected to keep a close eye on this. In the case of post-harvest technologies for fruits and vegetables, the planned subprojects will expand on USDA's work in this area.

Annex D

# INDO-US SUBCOMMISSION ON AGRICULTURE

## REPORT OF
## THE WORKING GROUP ON RESEARCH AND EDUCATION

## 1982

1. The Working Group on Research and Education met on June 3 and 4, 1982, in Washington, D.C. The names of the members of the Working Group who participated in the meeting are given in Attachment 1 and 2 of this report.

2. After introductory remarks by the U.S. Co-Chairman (Dr. David M. Daugherty) and the Indian Co-Chairman (Dr. O.P. Gautam), the Working Group reviewed the progress made since the last meeting of the Subcommission held at New Delhi on 23rd and 24th September 1980. It was noted that satisfactory progress has been made on both sides in developing research projects in the priority areas. It was reaffirmed that the 12 areas of collaboration agreed to in 1980 continued to be of joint interest. This list of 12 areas is given in Attachment 3 of this report. The Working Group noted that at least three agricultural research projects out of the above 12 areas are currently being developed by the ICAR with assistance from U.S. Agency for International Development for funding from the $20 million allocated by AID for agricultural research for three years from the effectve date. These projects are:

(a) Soybean processing and utilization,
(b) Groundnut research and
(c) Post-harvest technology for fruits and vegetables.

3. The Working Group viewed this USAID/ICAR Project as a possible model for future cooperative agricultural research programs that may be developed under this collaborative arrangement. Both sides, however, agreed that the overall procedures and guidelines with regard to project formulation, implementation, funding and monitoring will have to be decided by the two Governments in mutual consultation, keeping in view existing agreements.

4. The Working Group identified the following four areas as high priority items for future project preparation:

(a) Integrated plant nutrient management systems, including biological N-fixation,
(b) Haemoprotozoan diseases, especially thielariasis with special reference to development of immunoprophylaxis,

(c) Embryo transplantation in livestock,
(d) Microbial degradation of lingnocellulose for livestock feeding.

5. The Working Group accepted biotechnology as a new area of collaboration.

6. The U.S. side enquired whether India would be interested in developing collaborative projects in the following two areas:

(a) Agricultural Economic Research,
(b) Biological Weed Control.

The Indian side reported the present status of research in these areas and felt that the projects already proposed during the Government of India's Sixth Plan as part of the Indian National Program would perhaps meet the current objectives. However, the importance of these areas was recognized as deserving further consideration in the future.

7. It was affirmed by both sides that the main objective of collaboration would be to strengthen research capabilities of ICAR and the U.S. collaborating research laboratory or university.

8. It was noted that 43 cooperative research projects are currently in operation in India under the Special Foreign Currency Program from U.S.-owned rupee funds. Most of these projects also relate to the 12 priority topics identified by this Subcommission for scientific cooperation. It was agreed that it would be desirable to review and streamline the working procedures governing the projects funded from U.S.-held rupees.

9. It was reported that the various agencies such as USAID, USDA, Ford Foundation, Rockefeller Foundation and others are currently providing funds for research programs in India, but a great deal more can be achieved if appropriate cooperative and communication mechanisms are developed between these agencies. For this, an effort should be made to keep these agencies apprised of the research priorities recommended by the Subcommission.

Attachment 1

THE WORKING GROUP ON RESEARCH AND EDUCATION

INDO-US SUBCOMMISSION ON AGRICULTURE

June 3 and 4, 1982

U.S. DELEGATION

| | |
|---|---|
| David Daugherty<br>Co-chairman | Senior Deputy Administrator<br>Office of International Cooperation and Development<br>U.S. Department of Agriculture |
| Bill D. Blair | Staff Leader<br>Plant and Pest Management Sciences<br>Extension Service<br>U.S. Department of Agriculture |
| Donald Fiester | Director<br>Office of Agriculture, Science and Technology Bureau<br>Agency for International Development |
| John L. Hyde | National Program Staff<br>Agricultural Research Service<br>U.S. Department of Agriculture |
| William H Janssen, Jr. | Chief<br>Office of Agriculture and Rural Development<br>Agency for International Development<br>U.S Embassy, New Delhi |
| Ben H. Kopacz | International Activities<br>Agricultural Research Service<br>U.S. Department of Agriculture |
| Stan Krugman | Director<br>Timber Management Research Forest Service<br>U.S. Department of Agriculture |
| Maurice R. Landes | Agricultural Economist<br>International Economics Division<br>Economic Research Service<br>U.S.Department of Agriculture |

| | |
|---|---|
| Jitendar Mann | Agricultural Economist<br>Economic Research Service<br>U.S. Department of Agriculture |
| John A. Naegele | International Coordinator<br>Science and Education<br>U.S. Department of Agriculture |
| Carmen O. Nohre | Branch Chief<br>Asia Branch<br>Economic Research Service<br>U.S. Department of Agriculture |
| Richard M. Parry | Program Leader<br>Special Foreign Currency Programs,<br>Office of International Cooperation and Development<br>U.S. Department of Agriculture |
| Stanley S. Stone | Director<br>Far Eastern Regional Research Office<br>International Research Division<br>Office of International Cooperation and Developement<br>U.S. Department of Agriculture |
| Ronald B. Stryker | Soil Science Specialist<br>Agency for International Development<br>U.S. Embassy, New Delhi |
| John M Yohe | Chief<br>Agriculture Production Division<br>Office of Agriculture Science and Technology<br>Bureau Agency for International Development |
| Lloyd Fredrick | Soil Microbiologist<br>Office of Agriculture, Science and Technology Bureau<br>Agency for International Development |
| Charles M. Smith | Soil Scientist<br>Cooperative State Research Service<br>U.S. Department of Agriculture |

Attachment 2

THE WORKING GROUP ON RESEARCH AND EDUCATION

INDO-U.S SUBCOMMISSION ON AGRICULTURE

June 3 and 4, 1982

INDIAN DELEGATION

| | |
|---|---|
| O.P. Gautam | Secretary<br>Government of India<br>Director General,<br>Indian Council of Agricultural Research |
| R.M. Acharya | Deputy Director General<br>Indian Council of Agricultural Research |
| G.L. Kaul | Assistant Director General<br>Indian Council of Agricultural Research |
| R.N. Rau | Joint Secretary<br>Government of India<br>Secretary,<br>Indian Council of Agricultural Research |
| Sukdev Singh | Vice Chancellor<br>Punjab Agricultural University |

Attachment 3

# REPORT OF THE WORKING GROUP ON RESEARCH AND EDUCATION

## INDO-U.S SUBCOMMISSION ON AGRICULTURE

(1980)

The Working Group on Research and Education met on 23rd and 24th September, 1980, in New Delhi. The names of the members of the Working Group are given in Attachment 4 of this report.

At the outset, the high priority areas identified by the Working Group on Agricultural Research of the Indo-U.S. Subcommission on Science and Technology were broadly recalled. It was, thereafter, decided to identify areas of current relevance rather than to reiterate areas of priority identified earlier.

The following areas of mutual interest were identified and these areas will guide cooperative efforts in the field of agricultural research and education in the immediate future:

1. Integrated Plant Nutrient Management System with emphasis on Biological Nitrogen Fixation both symbiotic and non-symbiotic.

2. Energy Management in Agriculture

3. Soil and Water Management

4. Post Harvest Technology

   a. Soybean processig and utilization research
   b. Durable agricultural commodities
   c. Fruit and vegetable preservation

5. Citrus Management

6. Groundnut Research

7. Agro-forestry, silvi-pastural development of suitable food, fodder, fuel system, etc.

8. a. Pest Management utilizing insect pheromones
   b. Meloidogyne Nematode project

9. Reproductive physiology and breeding of Penaeid prawns

10. Haematozoan diseases of livestock and their control

11. Livestock Breed Development Methodology

    a. Efficient Nutrient utilization in livestock
    b. Studies on nitrogen conversion in cattle/buffaloes

12. a. Exploitation of unutilized and underutilized plants
    b. Plant hormones and other bioregulants

There was consensus in the group on the priority to be accorded to the subjects identified, keeping in mind of course that new areas relevant to emerging priorities in the field of agricultural research could be identified in subsequent meetings of the subcommission or the Working Group.

GOI and AID have proposed a bilateral agricultural research and eduation project to try to solve a limited number of problems of high priority to India. The project would be sufficiently flexible to accommodate a wide variety of research requirements. A dollar grant by AID, totaling $20 million over three years, to the GOI/Indian Council of Agricultural Research has been proposed to finance the U.S. share of project costs. Costs paid by the grant would include training and the interchange of Indian and U.S. scientists, scientific equipment, publications and local costs of research. In many cases, U.S. universities or other U.S. research institutions are expected to have expertise and interest which could accelerate solution of these problems. In such cases, collaborative arrangements can be arranged between or among appropriate Indian and U.S. institutions under the aegis of the Indian Council of Agricultural Research and AID. The AID/ICAR project will, to the extent possible be consistent with the priorities as reviewed and endorsed by the Subcommission.

Identification of collaborating institutes and scientists will be taken up by the ICAR and decided in consultation with a team of U.S. scientists who may visit India in the next 4 months. Draft project/proposals would also be discussed, but details would be left to the collaborating scientists. Each project in its final form would have to be approved by the ICAR in consultation with USAID (Delhi).

Following a proposal by the Office of International Cooperation and Development of the USDA, the Working Group also agreed that the U.S.-held rupee supported research projects in India should be reviewed and evaluated, possibly in 1981, so that these may be complementary to the bilateral research project to the extent possible. The review may include the project formulation, implementaton and monitoring procedures.

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1. Integrated Plant Nutrient Management Systems with Emphasis on Biological Nitrogen Fixation both Symbiotic and Non-Symbiotic

   a. Gentical studies to enlarge host spectrum by mutation, conjugation, transduction and transformation

   b. Somatic hybridization, tissue culture, techniques and fusion of protoplast using host plants nitrogen fixing bacteria

   c. Development of efficient methods for rapid screening of effective strains

   d. Studies on lectin for breaking cross innoculation groups and fixation of nitrogen in rhizobium species in pure cultures

   e. Utilization of low phosphate sources and development of phosphate solubilizing organisms.

2. Energy Management in Agriculture

   a. Solar energy for drying, irrigation, small-scale refrigeration and cooking

   b. Bioconversion for biogas and fermentation

   c. Use of wind power and utilization of biomass.

3. Soil and Water Management

   a. Small watershed management

   b. Water harvesting and recycling

   c. Design criteria for small and medium size from ponds

   d. Screening of sealing materials for minimizing seepage losses

   e. Conjunctive use of surface and ground water

   f. Use of saline water.

4. Post-Harvest Technology

   a. Soybean processing and utilization research

1) To develop simple detoxification technology for soybean to be able to use soybean directly as food and feed

2) Pilot Plant to produce soya flour at village level as a rural industry

3) To perfet technology of handling and storage of soybeans so that field losses and loss of viability of seeds lots are minimized

4) To extend the proven technologies in the dry farming areas of the black soil region where soybeans have proven as potential kharif crop both from crop husbandry and soil management aspects

5) To benefit from the experience of USDA Regional Laboratory, Peoria, Illinois, in respect of utilization technology to produce popularly consumable soya based products

b. Durable agricultural commodities

1) Diversification of potato processing including storage

2) Quality control throughout the food chain

3) Contaminants such as pesticide residues and mycotoxins

c. Fruit and vegetable preservation

Development of frozen foods and vegetable industries including freezing techniques, packaging and processing of tropical fruits (including laminated packaging and retortable pouches).

5. Citrus Management

a. To survey causal factors responsible for citrus decline in different citrus growing regions of the country

b. To screen different rootstocks and action materials for their resistance against diseases, pests and nematodes

c. To solve problems prevailing throughout the country such as virus fungal nutritional complex

d. To formulate effective control measures against factors responsible for "citrus dieback" in different citrus growing regions of the country

6. Groundnut Research

   a. Exchange of germplasm and breeding materials with specific reference to segregating material from interspecific hybrids and exchange of breeding and plant protection methodologies

   b. Seed technology

   c. Production physiology and microbiology

7. Agro-Forestry, Silvi-Pastural Development of Suitable Food, Fooder and Fuel Systems, etc.

   a. To develop suitable technology for raising of fuel and fooder species of trees and crops respectively

   b. To screen suitable species of trees and shrubs for adaptability to different agro-climatic zones

8. a. Pest Management Utilizing Insect Pheromones

      1) To undertake fundamental, basic and applied research

      2) To study the effects of various concentration/dosage requirments and combinations of pheromones on the behaviour of lepidopterous pests.

      3) To investigate the biochemical aspects of pheromones synthesizing chemical constituents

      4) To investigate behavioral and physiological factors of test insects

      5) Use of various types of traps, number of traps, capsules and adhesives

      6) Dispersal population studies in relation to use of pheromones at various locations, altitudes and in different agro-climates.

   b. Meloidogyne Nematode Project

      1) Collection of nematode populations

      2) Identification of species and/or variants in the field collections

      3) Differential host tests to detect pathogenic variation

4) Host susceptibility and/or resistance studies of major food crops in the region

5) Utilization of crop response information in the development and implementation of effective rotation schemes for control of root-knot ematodes in each region

9. Reproductive Physiology and Breeding of Penaeid Prawns

a. To study the reproductive physiology of the commercially important Paneid prawns, spawning behavior and factors influencing it

b. Develop technologies for inducing the spawning activity through hormonal manipulation and rematuration

10. Haematozoan Diseases of Livestock and Their Control

a. Research studies would be undertaken on different protozoan parasites with a view to evolve killed or live vaccines for prophylaxis and reduction of vectors in the vicinity of villages/farms

b. Systematic control of ticks would be studied and measures for reducing the risk of transmission of diseases through them evolved

c. Systems of application of chemicals for controlling of tickcide-resistance will be studied

11. Livestock Breed Development

a. Methodology and efficient nutrient utilization in livestock

1) Semen biochemistry and embryo transfer techniques

2) Efficient use of low nutritive value feeds and forages

b. Studies on nitrogen conversion in buffaloes/cattle

1) To evaluate the concentration of ammonia at which it tails to limit the bacterial growth

2) To eliminate the toxic effects of the feeds from non-protein nitrogens (NPN) sources due to release of ammonia and its absorption

3) To evolve a device for slow release of ammonia from NPN sources

4) To study the effective utilization of feeds from NPN sources in combination with unconventional feeds such as agricultural by-products and industrial waste materials

12. a. Exploitation of Unutilized and Underutilized Plants

To introduce germplasm of underutilized species available in the U.S.A. with a view to identify the productive and adaptability of genotype to different agro-ecological conditions in India

b. Plant Hormones and Other Bioregulants

The importance of the work on plant hormones and bioregulants was emphasized. The following fields were identified:

1) Studies concerning the effect of plant hormones on the mobilization and translocation of dry matter from the leaves to the grain to enhance partitioning efficiency for increasing the field crop yields securing more favorable harvest index

2) Control of other vegetativeness (foliar and other) by bioregulation to channelize plant energy for higher grain productivity in crop plants (e.g. pigeon pea, cotton, etc.)

3) Control of flower drop (e.g. chickpea) fruit drop and boil shedding in plants such as cotton

4) Regulation of growth of trees, hastening growth in energy plantation and dwarfing in fruit plantation toachieve controlled growth including suitable plant types for different agro-climatic conditions

5) Fundamental investigations concerning the mechanisms of actions of growth regulators concerning aspects related with crop productivity

Attachment 4

U.S. DELEGATES

Dr. David M. Daugherty - Co-chairman

Dr. John Naegele

Dr. David McHaffey

Dr. Floyd Williams

Dr. Dean Peterson

Dr. Orville Bentley

Dr. Russel Burns

INDIAN DELEGATES

Dr. O.P. Gautam, Secretary
Dept. of Ag. Research & Education & Director-General
Indian Council of Agricultural Research

Dr. R. Venkataraman, Vice Chancellor
Tamil Nadu Agricultural University
Coimbatore

Dr. N.S. Randhawa, Deputy Director-General
Indian Council of Agricultural Research

Dr. D.N. Srivastava, Deputy Director-General
Indian Council of Agricultural Research

Dr. V.R. Bhalerao, Deputy Director-General
Indian Council of Agricultural Research

Dr. C.Prasad, Deputy Director-General
Indian Council of Agricultural Research

Dr. D. Sundaresan, Director
National Dairy Research Institute
Karnal

Dr. C.M. Singh, Director
Indian Veterinary Research Institute
Izatnagar

Dr. H.K. Jain, Director
Indian Agricultural Research Institute
New Delhi

Shri M. Bhatia, Director
Department of Food

Dr. R. Raghuprasad, Assistant Director-General
Indian Council of Agricultural Research

Dr. G.S. Sirohi, Head
Division of Plant Physiology
Indian Agricultural Research Institute
New Delhi

Dr. J.P. Singh, Assistant Director-General
Indian Council of Agricultural Research

Dr. C. Kempanna, Assistant Director-General
Indian Council of Agricultural Research

Shri G.B. Bhardwaj, Deputy Commissioner (Storage)
Department of Food

Smt. Rathi Vinay Jha, Deputy Secretary - Secretary & Rapporteur
Department of Agricultural Research & Education

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Annex E

Project Title and Number: Agricultural research - India 386-0407
Life of Project: From FY 83 to FY 89
Total US Funding: $20 million
Date Prepared: May 1982
Loan:

| NARRATIVE SUMMARY | OBJECTIVELY VERIFICABLE INDICATORS |
|---|---|
| **Program or Sector Goal**<br><br>Increased agricultural productivity. | **Measures of Goal Achievement**<br><br>1. Selected crop yields.<br>2. Expanded, applied knowledge base. |
| **Project Purposes**<br><br>To strengthen the capacity of the Indian agricultural research system in selcted key areas. | **Conditions that will Indiacate Purpose has been Achieved. End of Project Status**<br><br>1. Tehcnological capacity of collaborating Indian institutions strengthened in selected areas of research and development and is adequate to deal with current and future problems.<br>2. Improved research organization and managment established in selected functional areas.<br>3. Facilities adequate to conduct necessary research and development.<br>4. Certain constraints to food production, preservation and consumption removed. |
| **Outputs**<br><br>Develop new agricultural technologies in collaboration with U.S. institutions to address key constraints to increased agricultural production and utilization in approximately 6 selected areas. | **Magnitude of Outputs**<br><br>1. Research problems identified, research pogram organized and subproject approval procudures in place.<br>2. Three subprojects with 25 major components in progress.<br>3. Five research areas defined more generally and four research areas noted.<br>4. ICAR administrative machinery in place to organize and supervise research subprojects as implemented. |
| **Inputs**<br><br>1. Participant training (contract).<br>2. Scientific collaboration (contract).<br>3. Equipment (contract).<br>4. Physical facilities.<br>5. Rupee cost of research. | **Magnitude of Inputs**<br><br>1. Trained staff in place Indian scientists trained in the U.S. for 6 to 12 months each.<br>2. Physical facilities in place: sq. meters of laboratory, screen houses and office space available to project: ha. of experimental fields available to project.<br>3. Research equipment in place that is appropriate to the research being conducted: laboratoreis, cold stores warehouses, etc., available to project and properly equipped. |

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK (Contd.)

| MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|
| Data<br><br>1. MOA reports<br>2. ICAR records | Assumptions for Achieving Goal Targets<br><br>1. An appropriate adaptive research system exists.<br>2. Suitable extension program exists. |
| Data<br><br>1. ICAR staffing patterns for three subprojects.<br>2. ICAR records on building space allocation of three subprojects.<br>3. ICAR records on assignment of experimental land.<br>4. ICAR records on laboratory and similar space and equipment inventories for these physical facilities.<br>5. ICAR annual reports to AID.<br>6. AID monitoring.<br>7. Contractor reports. | Assumptions for Achieving Purposes<br><br>1. ICAR able to get needed new positions approved.<br>2. ICAR can achieve timely construction of necessary buildings, laboratories, etc. or such facilities available for hire. |
| Data<br><br>1. ICAR reports to AID.<br>2. Contractor reports to ICAR and AID.<br>3. Published scientific reports by Indian and U.S. scientists.<br>4. Final evaluation results. | Assumption for Achieving Outputs<br><br>1. ICAR and GOI makes required budget avialable on a timely basis.<br>2. AID and U.S. contractor able to deliver collaborating U.S. scientific expertise of high quality. |
| Data<br><br>1. Contractor records.<br>2. ICAR/AID monitoring<br>3. ICAR reports to AID.<br>4. GOI/ICAR audits.<br>5. AID audits. | Assumptions<br><br>1. Inputs by AID and GOI/ICAR provided as scheduled. |

STATUTORY CHECKLIST ANNEX F

Listed below are, first statutory criteria applicable generally o FAA funds, and then criteria applicable to individual fund ources: Development Assistance and Economic Support Fund.

General Criteria tor Country Eligi ility

| | |
|---|---|
| 1.FAA Sec. 113. Has particular attention been given those programs, projects, and activities which tend to integrate women into the national economies of developing countries, thus improving their status and assisting the total development effort? | This project is designed to improve the productivity and incomes of the rural poor throughout India; both men and women will benefit equitably. |
| 2.FAA Sec. 116. Can it be demonstrated that contemplated assistance will directly benefit the needy? If not, has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights? | The assistance will benefit the needy through providing improved agricultural technologies which should result in increased food production preservation and utilization. |
| 3.FAA Sec. 481. Has it been determined that the government of recipient country has failed to take adequate steps to prevent narcotics drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the United States unlawfully? | No. |
| 4.FAA Sec. 620(b). If assistance is to a government has the Secretary of State determined that it is not controlled by the international Communist movement? | No. |

ANNEX G.


D.O.No. (18)AID/82

भारत सरकार
वित्त मंत्रालय
आर्थिक कार्य विभाग
Government of India (Bharat Sarkar)
Ministry of Finance (Vitta Mantralaya)
Department of Economic Affairs (Arthik Karya Vibhag)

S. Sundar,
Joint Secretary(AC)
Tele.No. 372734

नई दिल्ली/New Delhi, the 30th June, 1983.

Dear Mrs. Boughton,

Kindly recall our discussions in recent months regarding the Agricultural Research Project to be implemented by the ICAR. The total cost of this project is estimated to be $ 28 million, of which the Government of India/ICAR plans to contribute $ 8 million in rupee equivalent. You had indicated during our discussions that subject to your obtaining authorisation from your Government, US AID would be prepared to provide grant assistance to the extent of $ 20 million during the life of this project in instalments. Government of India hereby request you to authorise the first instalment of $ 6.5 million as early as possible.

Yours sincerely,

( S. Sundar )

Mrs. Priscilla M. Boughton,
Director, US AID,
American Embassy,
New Delhi.

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Annex H

# PROJECT AUTHORIZATION

Name of Country: INDIA

Name of Project: Agricultural Research

Number of Project: 386-0470

Pursuant to Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Agricultural Research Project for India involving planned obligations of not to exceed $20.0 million in grant funds over a seven year period from the date of obligation, subject to the availability of funds in accordance with the A.I.D. OYB/Allotment process to help in financing foreign exchange and local currency costs for the project.

The Project will provide technical and financial support to the Indian agricultural research system through collaborative research investigations between Indian and American agricultural research institutions and scientists.

The Project Agreement which may be negotiated and executed by the officers to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

A. Source and Origin of Goods and Services

Goods and services financed by A.I.D. under the project, except for ocean shipping, shall have their source and origin in the United States or in India, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the project shall be financed only on flag vessels of the United States, except as A.I.D. may otherwise agree in writing.

B. Conditions Precedent to Disbursement

(1) Disbursements for Subprojects. Prior to any disbursement under the Grant for any specific subproject or other activity specified in the mutually approved implementation plan or to the issuance by A.I.D. of documentation pursuant to which such disbursements will be made, the Grantee will, except as the parties may otherwise agree in writing, furnish to A.I.D., in form and substance satisfactory to A.I.D., a detailed operational and financial plan for each subproject activity.

| | |
|---|---|
| 5.FAA Sec. 620(c). If assistance is to government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested by such government? | No. |
| 6.FAA Sec. 620(e)(1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities? | No. |
| 7.FAA Sec. 620(a), 620(f), 620D; Continuing Resolution Sec 511, 512, and 513; ISDCA of 1980 Secs.717 and 721. Is recipient country a Communist country? Will assistance be provided to Angola, Cambodia, Cuba, Laos or Vietnam? (Food and humanitarian assistance distributed directly to the people of Cambodia are expected). Will assistance be provided to Afghanistan or Mozambique without a waiver? Are funds for El Salvador to be used for planning for compensation, or for the purpose of compensation, for the confiscation, nationalization, acquisition or expropriation of any agricultural or banking enterprise, or property or stock thereof? | No. No assistance will be provided to these countries. |
| 8.FAA Sec. 620(i). Is recipient country in any way involved in (a) subversion of or military aggression against the United States or any country receiving U.S. assistance or (b) the planning of such subversion or aggression? | AID is not aware of any such involvement. |
| 9.FAA Sec. 620(j). Has the country permitted or failed to take adequate measures to prevent the damage or destruction, by mob action, of U.S. property? | No. |

| | |
|---|---|
| 10.FAA Sec. 620(k). Does the program furnish assistance in excess of $1000,000,000 for the construction of a productive enterprise, except for productive enterprises in Egypt that were described in the Congressional Presentation materials for FY 1977, FY 1980 or Fy 1981? | No. |
| 11.FAA Sec. 620(l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, inconvertibility or confiscation, has the AID Administrator within the past year considered denying assistance to such government for this reason? | Not applicable. |
| 12.FAA Sec. 620(m). Is the country an economically developed nation capable of sustaining its own defense burden and economic growth and, if so, does it meet any of the exceptions to FAA Section 620(m)? | Not applicable |
| 13.FAA Sec. 620(o); Fishermen's Protective Act of 1967, as amended, Sec.5. If country has seized or imposed any penalty or sanction against, any U.S. fishing activities in international waters: | No such actions have been taken against U.S. fishing activities in international waters. |
| a. has any deduction required by the Fishermen's Protective Act been made? | Not applicable |
| b. has complete denial of assistance been considered by AID Administrator? | Not applicable |
| 14.FAA Sec. 620(a); Continuing Resolution Sec.518. | |
| (a) Is the government of the recipient country in default for more than 6 months on interest or principal of any AID loan to the country? | No |
| (b) Is counry in default exceeding one year on interest or principal on U.S. loan under program for which App. Act appropriates funds? | No. |

| | |
|---|---|
| 15. FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the percentage of the country's budget which is for military expenditures, the amount spent for the purchase of sophisticated weapons systems? (An affirmative answer may refer to the record of the annual "Taking Into Consideration" memo: "Yes as reported in annual report on implementation of Sec. 620(s)". This report is prepared at time of approval by the Administrator of the Operational Year Budget and can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur). | Yes. India spends a relatively small amount of its foreign exchange on military equipment. Latest available figures are an estimated $300-$500 million military imports or 3% of $15.8 billion in total imports in Indian Fiscal Year 80-81 and in 81-82. India proposes to spend only 16% of its budget on defense in U.S. FY 82-83. |
| 16. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption? | Diplomatic relations have not been severed. |
| 17. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget? | India is not in arrears regarding its U.N. obligations. |
| 18. FAA Sec. 620A; Continuing Resolution Sec. 521. Has the country granted sanctuary from prosecution to any individual group which has committed an act of international terrorism? | No |
| 19. FAA Sec. 666. Does the country object, on basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. there to carry out economic development program under FAA? | No. |

20. FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials or technology, without specified arrangements or safeguards? Has it detonated a nuclear device after August 3, 1977, although not a "nuclear weapon State" under the nonproliferation treaty?

Based on information received from the State Department/Embassy the answer to both of these questions is no.

B. Funding Criteria for Country Eligibility

1. Development Assistance Country Criteria

a. FAA Sec. 102(b)(4). Have criteria been established and taken into account to assess commitment progress of country in effectively involving the poor in development, on such indexes as: (1) increase in agricultural productivity through small-farm labor intensive agriculture, (2) reduced infant mortality, (3) control of population growth, (4) equality of income distribution, (5) reduction of unemployment and (6) increased literacy?

Yes. These criteria are based on India's Five Year Development Plan as Revised (1980-85) and are incorporated in the Country Development Strategy Statement (CDSS).

b. FAA Sec. 104(d)(1). If appropriate, is this development (including Sahel) activity designed to build motivation for smaller families through modification of economic and social conditions supportive of the desire for large families in programs such as education in an out of school, nutrition, disease control, maternal and child health services, agricultural production, rural development and assistance to urban poor?

Yes

2. Economic Supportive Fund Country Criteria

This section not applicable, Assistance is provided under the Development Assistance category.

II. PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual fund sources: Development Assistance (with a sub-category for cirteria applicable only to loans); and Economic Support Fund.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP-TO-DATE? Yes.

HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT? Yes.

A. General Criteria for Project

| | |
|---|---|
| 1.Continuing Resolution Unnumbered: FAA Sec. 653(b); Sec. 634A. (a)Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more that $1 million over that figure)? | Congressional Committees will be notified through the Congressional Notification procedure. |
| 2.FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000 will there be (a) engineering, financial and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance? | |
| 3.FAA Sec. 611(a)(2). If further legislative action is required wihin recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance? | Not applicable. |
| 4.FAA Sec. 611(b); Continuing Resolution Sec. 501. If for water or water-related land resource construction has project met the standards and criteria as per the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973? | Yes |
| 5.FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project? | Not applicable. |

| | |
|---|---|
| 6.FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not executed? Information and conclusion whether assistance will encourage regional development programs. | No, because multilateral and other donors have similar projects and the GOI requested A.I.D. assistance in this case. A.I.D. has better access to the U.S. research community than regional or multilateral entities. |
| 7.FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c)encourage development and use of cooperatives, credit unions, and savings and loans associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce and (f) strengthen free labor unions. | (a) Not applicable<br>(b) Yes, in letting of certain technical assistance contracts.<br>(c) Not applicable<br>(d) Not applicable<br>(e) Yes, especially agricultural research as managed by the ICAR<br>(f) Not applicable |
| 8.FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise). | U.S. technical assistance provided under this project; technical collaboration between private U.S. firms and ICAR institution will be encouraged. |
| 9.FAA Sec. 612(b); Sec. 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services. | The GOI will finance 25 to 30 percent of all project costs including local currencies for contractual and other services. (See item 10 for U.S. owned currencies). |

| | |
|---|---|
| 10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and if so, what arrangements have been made for its release? | The U.S. owned Rupees are being used for various U.S. government agencies' program and administative support and these currencies are expected to be liquidated over the next 7 years. |
| 11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise? | Yes. |
| 12. Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity. | Not applicable. Agricultural products produced will be consumed in India. |

B. Funding Criteria for Project

1. Development Assistance Project Criteria

| | |
|---|---|
| a. FAA Sec. 102(b); 113; 281a. Extent to which activity will (a)effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b)help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c)support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries? | (a) The project will provide agricultural technologies which will increase the access of the poor to the local economy. Labor-intensive production will be increased; appropriate technology will be applied and the poor will participate widely in the benefits developed under the project. U.S. Land Grant universities will be heavily involved in the project.<br>(b) Not applicable.<br>(c) This project entirely supports Indian self-help in agricultural development.<br>(d) See Socio-Economic Analysis in the Project Paper.<br>(e) Not applicable. |

| | |
|---|---|
| b. FAA Sec. 103, 103A, 104, 105, 106, & 107. Is assistance being made available: (include only applicable paragrph which corresponds to source of funds used. If more that one fund source is used for project, include relevant paragraph for each fund source). | |
| (1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is designed to increase productivity and income or rural poor. | The project is specifically designed to increase productivity of the rural poor, especially small farmers. |
| c. [107] is appropriate effort placed on use of appropriate technology? | c. Yes, especially regarding agricultural inputs |
| d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed country)? | Yes. |
| e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification sttisfactory to the Congress been made and efforts for other financing or is the recipient country "relatively least developed"? | Not applicable |
| f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires and capacities of the people of the country; utilize the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective particiption in governmental and political processes essential to self-government. | The project addresses the need for increased food production and will provide research in particular problem areas in food production, preservation and utilization. Institutional development will be fostered insofar as the implementing agency the Indian Council for Agricultural Research, and its institutions, will acquire a strengthened capacity to desig: and execute an effective agricultural research system. |

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|---|---|
| g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase or productive capacities and self-sustaining economic growth? | Yes |
| 2. Development Assistance Project Criteria (Loans Only). | |
| a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan including reasonableness of repayment prospects. | India's foreign exchange reserves are currently $4.5 billion. This project represents a negligible percentage of India's average yearly exports. |
| b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan? | Not applicable |
| 3. Project Criteria Solely for Eonomic Support Fund | |
| This section not applicable. | |

(2) Disbursements for Training. Prior to any disbursements under the Grant for long-term or short-term training for any of the approved subprojects or for other training activities under this Project or to the issuance by A.I.D. of documentation pursuant to which such disbursements will be made, the Grantee will furnish to A.I.D. a detailed description of the procedural mechanism to be established and utilized by the Grantee for the selection of individuals for and implementation of training abroad.

C. Covenant

Training. Except as the Parties may otherwise agree in writing, the Grantee agrees to make all reasonable efforts to assure that professional staff receiving training under this project are retained in service by the Grantee on applicable subproject activities for the period of time provided for by the Government of India in its standard bonding requirement for persons receiving training.

Priscilla M. Boughton
Director
USAID/India

Date

Clearances: ARD:WHJanssen (Draft)
PRO:JWestley (Draft)
CO:DEHickson
LEG:BMRao (Draft)
RLA:SJSpielman (Draft)

PD:RWNachtrieb:sg:04/09/83

Annex I

## Other Donors in Agricultural Research*

### I. BILATERAL

Several countries are providing assistance in the field of agricultural research. In general terms, the form of the assistance is similar to the proposed AID agricultural research in which scientific consultation, training, research equipment and staff support is provided on selected agricultural research topics. This mode is favored by the ICAR, since the agricultural research system in India is relatively well-developed and excellent Indian scientists are available.

#### a. CANADA

The Canadian International Development Agency (CIDA) has provided approximately US$4.8 million to support research in dryland agriculture for over two years. Through their project, applied research has been undertaken on topics which include: cropping systems; farm machinery; the development of technological packages which can be distributed at the regional and farmer level and watershed management. CIDA has provided its assistance through long and short-term, senior level consultations; some training and the construction of facilities. Through the project, the All India Center for Coordinated Dryland Research was constructed and is essentially completed. Canadian scientists have provided technical assistance which included monitoring of the AICP projects work at 23 centers on similar crops in differing agro-climatic zones.

CIDA is in the process of negotiating a US$3.3 million extension of the project which will concentrate on delivering technological packages to the farmers. The duration of the project is five years and signing of the agreement is imminent.

#### b. BRITAIN

The United Kingdom signed a Memorandum of Understanding with the Government of India in 1978 to provide technical collaboration and support in approximately fifteen different subproject areas. The subprojects will implemented by ICAR in collaboration with British institutions in three years at approximately US$44,000 per year. Five subproject areas, have beenn chosen: wheat research; sugarbeet; agricultural engineering; soil sciences and horticulture. Research work has commenced on three subprojects:

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* General ICAR Annual Report; contacts with donors.

(1) Wheat Research. IARI, Delhi;

(2) Sugarbeet, G.B. Pant University of Agricultural Technology, Pantnagar; and

(3) Agricultural Engineering, Central Institute of Agricultural Engineering, Bhopal.

These subprojects are providing scientific consultation and collaboration; training of Indians in U.K.; equipment and library facilities.

c. OTHER

Other countries are also providing assistance in agriculture: Mexico has signed an agreement with the GOI to collaborate in several research areas with the mutual exchange of experts to draw up work plans for projects. Korea has recently signed a protocol with the GOI to provide long-term cooperation in the fields of agricultural research, education and irrigation. In this agreement, scientific exchange, genetic materials, scholarships and equipment will be provided.

2. INTERNATIONAL ORGANIZATIONS

a. THE WORLD BANK

The World Bank is providing $27 million for a National Agricultural Research Project which was initiated in 1979 to strengthen the capability of Agricultural Universities to conduct zonal research. It has endeavored to achieve this goal through reforming the existing university-based agricultural research. It concentrates on research oriented towards the needs of local agro-ecological zones, with special emphasis on foodgrains (cereals and pulses) and oilseeds. Foodgrains grown under rainfed conditions and integration of cropping patterns and animal husbandry practices are also emphasized.

An IDA credit is being provided to cover 50 percent of the total project costs, excluding duties and taxes and would be equivalent to the foreign exchange costs of the project, estimated at US $5.6 million and 44 percent of local costs, amounting to US $21.4 million. These funds are primarily supporting civil works and equipment which include items such as laboratories, office space, seminar rooms and accommodations for visiting extension staff, farm buildings, staff housing and on-farm development.

b. UNDP

The UNDP has been supporting the further development of selected agricultural universities in education and research since 1970. The first project provided approximately US $4 million to create centers of excellence in the following universities and research institutes.

(1) Plant Protection Department, University of Agricultural Sciences, Bangalore;

(2) Dairy Sciences, National Dairy Research Institute, Karnal;

(3) Soil and Water Department, Haryana Agricultural University; Hissar (Haryana);

(4) Agricultural Engineering Department, Punjab Agricultural University, Ludhiana (Punjab);

(5) Poultry Sciences Department, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh; and

(6) Agricultural Economics Department, IARI, Delhi.

To accomplish its assistance objectives, the UNDP has provided short-term senior-level consultants from agricultural universities worldwide, specialized laboratory equipment, and training. The assistance to these initial six projects will be completed in June 1982.. In 1979, UNDP agreed to provide US $5.8 development assistance to seven more universities or research institutes over the next seven years.* A third phase is being contemplated.

3. OTHER

The International Development Research Center and the Ford Foundation have been funding discreet research projects with ICAR institutes and universities. These have focused on either basic agricultural research or training.

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* Department of Plant Physiology, IARI; Dairy Processing, National Dairy Association; Fisheries, Central Marine Fisheries Research Institute; Microbiology, Tamil Nadu Agricultural University; Temperate Agriculture, Himachal Pradesh, Tropical Horticulture; Institute of Horticultural Research; and Agricultural Communication, Pantnagar Agricultural University.

Robert W. Nachtrieb - PD

Project Authorization for Agricultural Research Project
Thru: Richard M. Brown - DD
Ms. Priscilla M. Boughton - D

Problem: You are requested to authorize a $20.0 million grant for the Agricultural Research Project from the Food and Nutrition account (Section 103).

Discussion: In order to help India achieve its objectives of sustained growth in agricultural production and concomitant increases in rural employment and income, we propose to support the creation of new agricultural technologies to address constraints to food production, preservation and consumption. This requires enhancement in the capacity of the Indian agricultural research system. We propose to contribute to such enhancement through collaborative research investigations between Indian and American agricultural research institutions and scientists.

The Agricultural Research Project addresses scientific areas identified by the Indo-U.S. Agricultural Subcommission as high priority for U.S. collaborative assistance. The first three subprojects to be supported focus on groundnut research, soybean processing and utilization and post harvest technologies for fruits and vegetables. Additional subprojects will be jointly developed for support, using basically the same procedures and criteria as have been used in preparation of the first three.

The Project provides $20 million in grant funds. The Government of India will contribute $8 million in local currency or in-kind support. The life of the project is recommended to be seven years, with individual research subprojects each to be completed in about five years. A.I.D. project funds will be used for advanced training for Indian scientists in the United States and in India; U.S. scientific collaboration; scientific equipment and for certain specialized facilities necessary for individual subprojects.

USAID/India, as you know, is seeking to acquire two specialists through the newly introduced Joint Career Corps program to assist our direct hire staff in the implementation of the project. Contractual arrangements

with one or more U.S. universities or with the U.S. Department of Agriculture will be made to handle logistical arrangements for scientific consultations and training of Indian scientists at U.S. institutions.

Based on the costs of the first three subprojects, we expect that an additional two or three subprojects can be supported with the remaining funds available under the grant. If these subprojects go well, and especially if the support framework we have agreed on for subproject selection and implementation proves to be satisfactory, we may consider follow-on projects to finance even more subprojects.

Procurement Plan: Because each of the subprojects to be financed under this project may be structured differently, it is not possible to describe in detail the procedures to be used for procurement of equipment and commodities. In some cases procurement may be undertaken by the university or other U.S. entity contracted to support a given subproject; in others it may be done by the U.S. Department of Agriculture, or by A.I.D. The Regional Commodity Management Officer prepared a procurement plan for this project outlining the various alternative procurement modes that may be used. This plan is available in the project file; detailed procurement plans will be worked out for each subproject, and will be reviewed by the USAID Project Committee and approved by the RCMO.

Source and Origin: The authorized source and origin of goods and services procured under the project will be the United States and India. As the project paper indicates, however, a limited amount of short term training may take place in countries included as eligible in A.I.D. Geographic Code 941. In these instances, waiver of source and origin requirements will be requested on a case by case basis in accordance with the provisions of Redelegation of Authority 40.10.

FAA Section 612(b): When the development assistance program in India was re-established in FY 1978 the Development Coordinating Committee on December 21, 1977, determined that project local costs could be dollar financed rather than funded with U.S. owned excess rupees. This policy was reaffirmed by PPC by memorandum dated March 7, 1980, with the understanding that henceforth all interested parties would have an opportunity to express their views on the matter at the annual CDSS and ABS reviews. Consistent with this policy, the ABS submissions for FY 1981 and 1982, both of which included the Agricultural Research Project,

were reviewed and approved by AID/W thus confirming the use of dollars for local costs of this and other projects. The ABS review messages received from AID/W for these submissions do not indicate any objection to continuation of this policy. Therefore the provisions of Section FAA 612(b) have been considered and the use of dollars for local costs of this project can be approved. Your signature on the attached authorization will provide the basis for certification required under this section.

Justification to the Congress: A Congressional Notification advising of A'D's intention to obligate funds for this project in FY 1983 was forwarded to Congress. The fifteen day waiting period expired on December 6, 1982.

Authority to Authorize this Project: Redelegation of Authority 133.1 dated April 21, 1982 provides Asia Mission Directors the authority to authorize projects up to $20 million, provided there are no significant policy issues or waivers that exceed the Director's authority, and provided that the project life does not exceed seven years. This project falls within these criteria.

Clearance Obtained: All appropriate AID/W and Mission clearances have been obtained.

Recommendation: That you approve the project and sign the attached project authorization.

Approved _____

Disapproved _____

Date _____

Clearances: PRO:JWestley (Draft)
ARD:WHJanssen (Draft)
ARD:RBStryker (Draft)
CO:DEHickson _____
RLA:SJSpielman (Draft)

PD:RWNachtrieb:sg:04/09/83