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**TOWARD SOLUTIONS FOR STRESSED LANDS**

*Final Report to USAID*

THE BOSTID-PARC RESEARCH PROGRAM



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AUGUST 1994

## **TOWARD SOLUTIONS FOR STRESSED LANDS:**

### **THE BOSTID-PARC RESEARCH PROGRAM FOR SCIENCE AND TECHNOLOGY DEVELOPMENT IN PAKISTAN**

#### **I. SUMMARY**

The U.S. National Academy of Sciences, through its Board on Science and Technology for International Development (BOSTID), undertook a collaborative program to carry out high quality scientific and technological research, build research capabilities, and strengthen the scientific community in Pakistan. This involved organization and management of competitive research grants with funding support for 25 investigator-initiated projects on the technical problems of stressed land. The program stimulated high quality work by Pakistani scientists, enabled research results to be critically reviewed and prepared for publication, and assisted with potential applications of research findings. It also developed the capacity for the Pakistan Agricultural Research Council (PARC) to develop and manage a similar research program. Specialized assistance was provided by volunteer U.S. scientists. Administrative and logistic support was provided by BOSTID, in cooperation with PARC.

#### **II. PROJECT DESCRIPTION**

##### **OBJECTIVES**

The BOSTID-PARC Research Program in Pakistan had four objectives:

1. Mobilize the Pakistani research community to make a significant impact on a specific problem area that constrains agriculture, forestry, soil conservation, and economic development in Pakistan. The research area selected was improvement of agricultural productivity in land stressed by drought, salinity, pests, and poor fertility.
2. Build capability, human and material, in participating institutions to carry out research meeting the highest international standards.
3. Establish active links for Pakistani researchers with U.S. scientists through the National Academy of Sciences/National Research Council. Most U.S. scientists will participate voluntarily because of their professional interest in the research, leading to enduring scientific relationships.
4. Create a self-sustaining research promotion and support system in Pakistan. The Pakistan Agricultural Research Council (PARC) will strengthen its experience and relationships with the national scientific community that will enable it to run a high quality research support program.

## **ACTIVITIES**

The major activities of the BOSTID-PARC research program are given in chronological order, several activities being concurrent.

### **Selection of Priority Research Areas**

A planning meeting of researchers in Pakistan and the U.S. was held in Islamabad in December 1989 to select promising research areas for the program. About a hundred agricultural researchers from all over Pakistan and eight from the U.S. reviewed several promising areas before selecting "Improvement of agricultural productivity in land stressed by drought, salinity, pests, and poor fertility."

### **Program Announcement and Proposal Preparation Workshops**

The program grant was signed in July, 1990. The program announcement (Appendix A) and guidelines for proposal preparation (Appendix B) were circulated the following month. U.S. scientists addressed several groups of researchers in centers covering all provinces on the preparation of successful proposals (Appendix C) and discussed promising projects. These proposal preparation workshops were each attended by 30-100 researchers.

### **Review of Proposals**

Detailed technical reviews were obtained for each proposal from three or more U.S. and some Pakistani experts in the areas covered by the proposal. The reviews were prepared in a standard format (Appendix D).

### **Site Visits**

Visits were made to each of the 117 proposal sites by Pakistani and U.S. researchers to discuss the unattributed reviews and encourage drafting of proposals to include valuable suggestions from these reviews.

### **Review of Revised Proposals**

Detailed reviews of the revised proposals were obtained from three or more U.S. and Pakistani reviewers.

### **Committee Meetings**

A joint committee of the following seven Pakistani and five U.S. members was appointed:

Dr. Cyrus McKell, Dean of College of Natural Sciences, Weber State University, Ogden,

Utah, Co-chairman  
Dr. Hanif Qazi, Member, Crop Sciences, Pakistan Agricultural Research Council,  
Islamabad, Co-chairman  
Dr. Manzoor Ahmed Bajwa (now deceased), Director General, Research, Punjab  
Dr. Mary Carter, South Atlantic Area Director, Agricultural Research Service, U.S.  
Department of Agriculture, Athens, Georgia  
Dr. Bashir Chandio, Pakistan Council of Research in Water Resources, Islamabad  
Dr. Donald Duvick, Affiliate Professor of Plant Breeding, Iowa State University, Ames,  
Iowa  
Dr. Wilford Gardner, Dean of College of Natural Resources, University of California,  
Berkeley, California  
Dr. Riaz Qureshi, Professor of Soil Science, University of Agriculture, Faisalabad  
Dr. D. William Rains, Professor of Agronomy and Range Science, University of California,  
Davis, California  
Dr. Iqbal Shah, North West Frontier Province Agricultural University, Peshawar  
Dr. Saleem Shirani, Forestry Department, Quetta  
Dr. Safdar Sial, Chairman, Livestock Breeder's Association, Islamabad

The committee met for two days in Islamabad in August 1991, and in Irvine, California, in December 1991. The committees selected the most promising proposals for funding support and participated in program meetings in Islamabad.

### **Memorandum of Grant Provisions**

The research grants signed by principal investigators and their institutions each included a memorandum of grant provisions (Appendix E) which described the program requirements for scientific and financial reporting.

### **Advisory Group Meetings**

The 25 projects were divided into five groups (Appendix F) according to subject area and research technologies being used. Each group was advised by a U.S. expert in the general subject area, and researchers in each group met on several occasions to share their experience--progress and problems--and to discuss the broader findings of research from these and related projects.

### **Consultant Visits**

Individual research projects were visited regularly by the group advisor, and many also had visits from other U.S. researchers with specific expertise (Appendix G). The consultants spent time in the laboratories and field sites, discussed the progress of the project, assisted with problems, provided pertinent literature, assisted with analyses to be undertaken in the U.S. or other supportive activities, invited researchers to present their findings at U.S. and international meetings, assisted in preparation of journal papers,

discussed applications for the research, and generally collaborated on the research being undertaken. They reported back to BOSTID on achievements, needs, and problems in projects they visited.

### **Grantee Visits to the U.S.**

Almost all projects had one or more researchers visit U.S. laboratories, field sites, agricultural businesses, and research meetings (Appendix G). They conducted joint studies, undertook specialized analyses, presented their research, and discussed their findings with several groups of researchers with interest and expertise in different aspects of their projects. These visits were initiated by a grantee plan for the objectives of the trip, specifically how these would be accomplished, and the relationship of the objectives to his/her BOSTID-PARC research project. When this was satisfactorily completed, the most appropriate collaborations were organized. Grantee visits provided new insights, access to recent literature, and an opportunity to solve technical problems.

### **Participation at U.S. and International Conferences**

Several researchers presented findings from their BOSTID-PARC research projects at conferences (Appendix G) and were also able to discuss relevant studies--their own and others--with conference participants.

### **BOSTID-PARC Research Conferences**

These were held in Pakistan when the grants were awarded, during the research, and at the end of the program. Grantees and invited guests participated in the conferences.

**Inauguration of the BOSTID-PARC Research Program.** The Federal Minister for Food, Agriculture, and Cooperatives, Lt. Gen. (Retd) Abdul Majid Malik, and Chairman of PARC Dr. Zafar Altaf addressed grantees and guests at the May 13-14, 1992 conference to inaugurate the BOSTID-PARC Research Program. The principal investigators for the 25 successful projects were introduced. Dr. Harold Dregne of the International Center for Arid and Semiarid Land Studies at Texas Tech University presented "Sustainable Solutions for Agriculture on Stressed Lands," which was followed by panel discussions on related topics. The research projects were then discussed individually, covering scientific and financial aspects, research staff, and purchases of equipment and supplies.

**"Agricultural Research and the Private Sector,"** the second conference, was held in Islamabad in January 1993. Keynote speakers included Dr. Cyrus McKell, Co-chair of the Committee on BOSTID-PARC Research Grants; Dr. Riazuddin, University of the Punjab, Lahore; and Dr. Arnold Radi, USAID. A panel of private sector participants and researchers together addressed two questions:

- What are the important opportunities for research and private sector collaboration in

agriculture for Pakistan in the next decade?

- What changes will be necessary to accomplish these opportunities--changes needed by research, the private sector, and government?

Ideas developed by the groups were used to prepare a proposal for the study "Fostering a Research-Agribusiness Partnership: A Strategy for Effective Technology Transfer."

"**Toward Solutions for Stressed Land,**" the final conference, was opened by the Secretary of Agriculture, Chairman of PARC, who addressed the theme "Excellence in Research." All 25 grantees presented their research findings, highlighting their successes and the opportunities that follow from them. Awards were presented by the Secretary of Agriculture, Chairman of PARC, to grantees with outstanding performance. The five U.S. group advisors, along with Pakistani experts, chaired the conference sessions. There was general agreement among them that all grantees had made significant steps toward solutions for stressed land.

### **Publications**

All researchers prepared papers from their findings, as shown in Appendix H. During their preparation, these had been discussed at meetings of the advisory groups, during consultations with other experts, and with U.S. researchers during visits to the U.S. They were then reviewed by at least three U.S. reviewers on the specific area of the study, and valuable suggestions were incorporated into the drafts, which were reviewed again, and then edited. Each project has at least one paper published or discussed and worked on as far as the data will allow. As final data is collected over more seasons and incorporated into papers, the process of completing papers for publication by international journals will be assisted by the review and discussion that has already taken place.

### **Equipment**

Grantees specified equipment needed for their research in proposals. These needs were reviewed in light of the reviews and, as appropriate, were included in the grant document. Most purchases were handled by BOSTID to comply with the requirement of purchasing U.S.-made items. Purchases of equipment and supplies required considerable expertise in BOSTID and in several cases became a major undertaking involving numerous experts on how to accomplish some challenging projects. The major equipment purchased is shown in Appendix I.

### **Financial Management**

The grantees were visited three times by financial personnel. In May 1992 when the grants were awarded, grantees met together in a financial session with Richard Billig, who apprised them of the strict financial requirements in the program. In the next several

months, each grantee completed two or more expenditure reports (each on three months of expenditures) and corrected problems that had been communicated by letter from the program auditor. With this experience of the problems being encountered, each grant was visited in May 1993 by Ben Stevens. This visit focused on assisting grantees with financial management and program requirements. In addition, the receipts and their filing were checked for consistency with expenditure reports. At the end of the program, in July 1994, a final visit was made by Anthony Mavrogiannis, who reviewed the final expenditures, the associated receipts, closeout of the project account, and review of equipment received during the project.

## **EXPECTED OUTPUTS/OUTCOMES**

The program has outcomes at several levels, as described below: development of capability in individual research teams, experience in Committee oversight, and PARC experience in organization of competitive research.

### **Capability in Individual Research Teams**

This has developed in several aspects: research management, financial management, proposal preparation, scientific collaboration in Pakistan and the U.S., and equipment.

**Research management.** There is a striking development in this capability in all but the already highly experienced research groups. Researchers have learned to plan projects ahead, to present appropriate details, to improve their staff management by providing appropriate expectations and giving credit for accomplishments, and to generally recognize that research management involves much more than conducting experiments.

Younger researchers have played an important role in several projects--they have developed specific expertise, written research papers or theses, discussed their studies with leading scientists in Pakistan and the U.S., and generally established their scientific capability.

The program rewarded grantees for performance on this project rather than for their insistence on the priority of their requests, or any other reason. It is strongly recommended that this approach be supported to encourage continued growth in research capability.

**Financial management.** The continuous training in financial management and monitoring of grants has been noted by grantees and their accounting staff as having prepared them well for similar competitive programs. The guidelines BOSTID was required to adhere to and which at first sounded impossible to grantees, were in fact attainable, and the grantees deserve credit for their ability to conform to the strict requirements.

**Proposal preparation.** Assistance on proposal preparation was provided to a broad group of Pakistani researchers interested in applying to the program. They were responsive to the

need for fully designed and detailed research proposals and improved their proposals dramatically in response to the reviewers' suggestions. The national response to the program announcement with 117 proposals on stressed land was overwhelming and an indication of strong interest in being part of a competitive research program. All investigators who submitted proposals received a letter on the reasons for the Committee decision, along with unattributed reviews from a wide range of experts in specific areas covered by the proposals.

**Scientific collaboration** was another highlight of the program. U.S. researchers provided many thousands of hours of their time and expertise without financial reimbursement. Their support, guidance, and experience transformed many projects and provided access to U.S. expertise in broad areas of research. These collaborations can flourish long after the research grants program has been completed. Equally important was the development of Pakistani collaborations. These were encouraged by bringing the 25 research teams together for three conferences. They were also encouraged by the more frequent meetings of the smaller advisory groups, which discussed research details of their projects, shared problems, and began to support other projects where specific expertise could be particularly useful. For example, two researchers with experience in statistics and field trials, respectively, each worked directly with a colleague who needed that expertise. It is anticipated that many program collaborations will continue, even in the absence of a program. However, continued assistance and encouragement of collaborations among research teams is recommended for its importance in assisting researchers to be more productive.

**Equipment.** The program provided important equipment and supplies to projects, many of which had limited funding or access to international purchases. The equipment purchased in the program was required for the research being undertaken and was selected for quality, price, flexibility, and long-term service. Frequently, long-term service restricted selection of models that were so automated that they were likely to fail often and require servicing that would be difficult to obtain and support. The laboratory equipment and supplies provided have very significantly upgraded both field and laboratory capabilities. With a BOSTID staff person experienced in purchasing parts as well as equipment, many grantees were able to obtain special parts and return old equipment to effective operation.

### **Committee Oversight**

The joint Pakistani-U.S. Committee worked extremely well, and both Pakistani and U.S. members praised the efforts and expertise that were directed toward selection of the most competitive grants. The review of 117 proposals was accomplished with two meetings. One third of the proposals had major flaws after review, revision, and second review, and these were eliminated by telephone/mail before each meeting. The remaining proposals received intense discussion in the Committee meetings in order to select 25 projects.

One Committee member had submitted a proposal. It was considered important that potential grantees not be excluded from the Committee because of the perspective they provided. However there was an intense discussion of how to avoid bias or the appearance

of bias. These issues are taken seriously at the National Academy of Sciences and were discussed fully. Committee members agreed to leave the room during decisions involving proposals for which they *might have bias or could be perceived to have bias*. A record was kept of members who excused themselves from such discussions and decisions.

The Pakistani Committee members were impressed by the quality and detail of reviews from U.S. researchers and by the constructive way these reviewers provided suggestions and recommendations for or against funding.

After selection of the most competitive proposals, only one was from North West Frontier Province (NWFP). This was considered an inadequate distribution of funds to an area with much stressed land. The Committee worked out a solution--while the projects selected competitively on a national basis were supported at a level of about \$70,000, a separate competition of NWFP proposals would be made for smaller projects of about \$25,000. The Committee thus preserved funding on the basis of competitiveness and allocated a share of funds to NWFP for smaller projects.

### **PARC Experience in Organization of a Competitive Research Program**

PARC began well positioned for this undertaking: strong leadership with the same goals for research, well qualified staff to work with BOSTID and the U.S. consultants, and already leading and organizing national research programs.

The coordination of the program with PARC was highly successful, and itself generated long-term relationships. PARC's role was critical to the success of the program in several aspects: identifying Committee members, speakers, private sector participants, and reviewers; communicating with researchers; for solving problems with their in-country knowledge and expertise; and making numerous other arrangements and collaborations. This key participation has provided PARC with considerable experience in all aspects of competitive research grants and the ability to set up and manage a similar program.

## **III. PROJECT PERFORMANCE**

### **ACHIEVEMENTS AND SHORTFALLS**

The achievements of the program include all four initial objectives and others as well. Pakistan was well positioned for this to be a successful program:

- Well trained scientists, many of them trained in USAID programs
- Well organized, well equipped research laboratories
- Limited or no support of research projects by a competitive grants program.

However the success has been overwhelming, as noted in the outcomes discussed above.

Major accomplishments are as follows:

- Rejuvenation of agricultural research on stressed land
- Heightened awareness of the importance of submitting research results to peer review journals to maintain excellence
- Interest in and potential for commercial application of research findings
- Establishment of collaborations with other researchers in Pakistan and the U.S. (the more difficult and perhaps most important collaborations are those with other Pakistani researchers)
- Establishment of rigorous financial management
- Acknowledgment of research success and credit to the individuals responsible, as well as to group leaders
- Experience of committee members in selecting and monitoring research grants in a competitive program
- Experience of PARC in leading a competitive research grants program.

The only disappointment of the program has been the inability to continue USAID support long enough to complete research that has already moved so well in the two years that studies have been active. The actual program time was shorter than anticipated due to some frustrating delays:

- in signing the contract for the MART program
- in making pre-grant site visits to potential grantees because of the Gulf War
- in obtaining signed grant documents from some institutions.

The short time for the program has had a positive consequence--research was set up quickly and the effort has been intensive. Many grantees accomplished more than they thought possible. The program was active long enough to develop strong support for continuation of competitive research grants.

## **CHALLENGES AND CONSTRAINTS**

The challenges for conducting world class research are constant whenever that research is being undertaken. Constraints that were more unique to this program are reduced down to the time constraint. While an intensive effort can move some aspects of a project ahead, it cannot overcome the need for field studies to be done over a number of seasons to produce reliable findings. The program endeavored to overcome this problem by insisting that research be written up despite this limitation. About 40 papers were submitted for review and discussion, in the last months. Some others were published. The preparation of papers enabled very full discussion of the variables, the adequacy of controls, results to date, and anticipation of future findings. The revised and edited papers are an important step and simplify the work required when data is accumulated over more seasons.

#### **IV. LEARNING FROM THE EXPERIENCE**

##### **TACTICS/WHAT COULD HAVE BEEN DONE DIFFERENTLY**

Since BOSTID has conducted several research programs in developing countries, it was clear that the program should be clearly defined and the requirements--scientific and financial--be clearly explained from the beginning. It was also clear that a new three-month payment should not be advanced if there were important deficiencies in the accounting for the next-to-most-recent payment. While it was not easy to hold the line when more funding was needed, the grantees adjusted to the system, and sent in timely, well detailed reports. The final closeouts of 25 grants were vastly simplified by this process.

##### **CONCLUSIONS AND RECOMMENDATIONS/ACTIONS FOR SUSTAINABILITY**

USAID/Islamabad deserves enormous credit for its accomplishments over the last decade in assisting agricultural research in Pakistan. By supporting scientific training and development of laboratory and field capability, then supporting a competitive research program to provide challenge and recognition for excellence, they have provided an important legacy to Pakistan.

The USAID staff in Islamabad has been exceptional in their insight and management of the parts of the MART project with which I am familiar. Several staff were instrumental in the success of the program over the years of developing it and conducting it, but the following staff deserve special mention: Dr. Patrick Peterson, Dr. Curtis Nissly, Dr. John Swanson, Mr. Dennis Weller, Dr. Ronald Senykoff, and Dr. Muhammad Khalid, along with AID contractor Dr. Bill Wright of Winrock. At every stage of the program, these staff members have been knowledgeable, effective, and supportive. They deserve credit for accomplishments of the program, particularly in the short time available.

##### **LESSONS LEARNED**

Development of commercial applications and demonstration of applications from the research became more central in USAID as the projects proceeded. While researchers accomplished realistic expectations for the time available on their research, the expanded emphasis on actually producing marketable opportunities has recently suggested a new mechanism for funding research with clear and immediate applicability. This mechanism would be to select specific key areas for research and describe specific topics and problems to be addressed by proposals. The funding organization can in this way direct the program toward key gaps in knowledge and prospective opportunities. In this way, the proposals received would be more directly focused on country needs. Researchers would have to limit their proposals to research on specific problems. The response to such a request may not be as large but may better produce the more directed research results that have become increasingly important to USAID over the last few years.

## **APPENDICES**

- A. Program announcement**
- B. Guidelines for proposal preparation**
- C. Preparation of a successful scientific research proposal**
- D. Review form**
- E. Memorandum of grant provisions**
- F. Project advisor groups**
- G. Consultant and grantee research visits**
- H. Publications**
- I. Equipment**



## BOSTID-PARC RESEARCH PROGRAM



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Telephone: 51-823966  
Tele: 5604 PARC PK  
Telegrams: AGRESCOUNCIL  
Fax No.: 51-812968

### GRANTS FOR RESEARCH ON INCREASING AGRICULTURAL PRODUCTIVITY IN PAKISTAN WITH EMPHASIS ON STRESSED LANDS

The Board on Science and Technology for International Development (BOSTID) of the U.S. National Research Council and the Pakistan Agricultural Research Council (PARC) will fund a limited number of research grants to scientists working in Pakistani institutions, public or private, aimed at increasing productivity of stressed lands, such as saline, waterlogged, sodic, arid or semiarid environments. Proposed projects should deal with concrete problems which limit production in affected areas. Grants will be awarded on a competitive basis by a binational Committee on Research Grants. The Committee will consider proposals for basic research, applied research, field studies, and engineering. It seeks innovative studies that address the gaps in knowledge for important systems. Multidisciplinary studies are especially encouraged.

Cooperative activities in this research program provide additional collaboration and training. Examples include:

- Periodic meetings of grantees to discuss topics of general importance for stressed lands research.
- Collaboration with scientists in the United States.
- Short-term training on new technologies related to project activities.

Grant funds may be used for research expenses, including purchases of project-related equipment, travel, short-term training, institutional overhead, and salaries of technicians and scientists. Long-term training and purchase of vehicles should not be included.

Public and private institutions in Pakistan are eligible for grants. Grants are available for a period of two or three years with total funding of between US\$50,000 and US\$100,000, depending upon the research proposed. Funds for the BOSTID-PARC program are provided by the U.S. Agency for International Development/Islamabad.

Attached is a sheet containing examples of possible research topics. These were suggested at a planning meeting of U.S. and Pakistani scientists held in Islamabad in December 1989. These are meant to be suggestions only. Proposals derived from this list are not guaranteed approval, and proposals on other topics related to stressed lands are also expected. Criteria for funding include: scientific merit, relation to increasing the productivity of stressed lands in Pakistan, originality and innovation. Proposals involving multidisciplinary collaboration among Pakistani researchers are especially favored.

Further information and guidelines for proposal preparation are available from PARC or from BOSTID at the addresses above. Copies of proposals should be submitted to PARC and to BOSTID before October 31, 1990.

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## EXAMPLES OF RESEARCH TOPICS

### Soil and Water Management

#### Waterlogged and Salt-Affected Lands

- Determine the effect of water table depth and salinity on growth and yield of major crops under field conditions.
- Assess the fate of fertilizers, through studies using labelled sources, to improve their effectiveness for major cropping systems in stressed areas.
- Conjunctive use of water from good and poor quality sources to extend irrigated area and reduce disposal requirements.

#### Eroded Areas and Watersheds

- Development of resource management strategies to raise productivity of eroded areas and watersheds using computer-aided techniques and field validations.
- Development of cost effective and innovative techniques for storage, conservation and management of runoff water in small ponds for supplemental irrigation.

#### Arid Lands

- Determination of water-fertilizer-yield functions for horticultural crops.
- Improving aquifer recharge through watershed management practices.
- Development and testing of water-use efficient irrigation systems.

#### Coarse Soils

- Development of simplified and innovative irrigation techniques using concept of surge irrigation.
- Improved nitrogen management in irrigation systems for increased crop production and reduced hazards of groundwater pollution.

### Cropping Systems and Plant Improvement

#### Genetic Improvement of Crops for Production under Stress Conditions

- Elucidation of the biochemistry and physiology of stress tolerance mechanisms.
- Identification and cloning of stress resistance genes in plants and associated bacteria.
- Use of molecular, cellular and genetic approaches to accelerate the selection, creation, and production of stress-tolerant plants.
- Improved soil microorganisms for increasing plant productivity on salt-affected lands.

#### Crop Management to Increase Productivity of Stressed Lands

- Development of farming systems for stressed areas which may include cover crops, agroforestry, and mixed cropping, or intercropping with legumes for soil improvement, to ameliorate soil stresses and provide field and fodder crops.
- Elaboration of integrated pest management techniques, including biologically active compounds of botanic origin, for cropping systems on stressed lands.

### Livestock Production and Range Management

#### Range Management

- Screening and evaluation of grass forage and fodder shrub species, both local and exotic, for different ecological zones, including rangelands and irrigated stressed lands.
- Development of field propagation and planting techniques for forestation of degraded rangelands: soil preparation, water harvesting and conservation, seasonal factors.

#### Animal Nutrition

- Evaluation of the nutritional value and seasonal variation of major forage species currently consumed in Pakistan.
- Processing and enrichment of crop residues, undesirable and "unpalatable" plant species, and the use of industrial waste as resources for animal feed.

#### Genetics and Breeding

- Upgrading local breeds of small ruminants for increased milk, meat and wool production and improved adaptability to stressed areas.

#### Livestock Diseases

- Epidemiology of important parasitic and contagious diseases in stressed lands and identification of associated risk factors.
- Determination of etiology and pathogenesis for development of control measures for caprine pleuropneumonia.



## BOSTID-PARC RESEARCH PROGRAM

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### Guidelines for Proposal Preparation

#### INTRODUCTION

The BOSTID-PARC Research Program is a competitive research grants program supporting research in Pakistani institutions on problems related to increasing agricultural productivity of stressed lands. An announcement describing the priority areas for funding under this program is available from BOSTID or from PARC. BOSTID is the Board on Science and Technology for International Development of the United States National Academy of Sciences. PARC is the Pakistan Agricultural Research Council. The BOSTID-PARC Research Program is supported by funds provided by the U.S. Agency for International Development in Pakistan.

The basic aim of the program is to support research in Pakistan on the priority areas. Basic research, applied research, field trials, pilot projects may be included. Advanced degree training, travel grants, and conferences will not be considered for funding. Most grants will be in the range \$50,000 to \$100,000 US dollars for a period of two or three years, and will be awarded by the U.S. National Academy of Sciences directly to the recipient institution in Pakistan. Funds may be used for salaries, travel, consultants, research expenses and equipment. Equipment may be purchased locally or procured overseas by BOSTID for the grantees. In general, dollar expenses like equipment and international travel will be arranged by BOSTID, and funds for local expenses will be transferred to the Pakistani grant recipient in quarterly installments. Quarterly financial reports and semi-annual technical reports will be required.

Proposals are submitted for independent technical review in the United States and Pakistan prior to consideration by the Committee on Research Grants, a binational committee of active research scientists. Assistance is available from BOSTID or PARC staff on preparation of proposals. Proposals must be received by the date indicated in the announcement, and applicants will have an opportunity to respond to the comments of the technical referees before funding decisions are made. The period from proposal deadline to grant award is usually about six to eight months. All applicants receive summaries of the comments of the Committee and the technical reviewers regardless of the decision on their proposals.

**PROPOSAL PREPARATION**

Proposals must be submitted in English. The cover page must be signed by the person responsible for the proposed research and by an official authorized to sign on behalf of the institution. It is assumed that signature of the latter official implies approval of the technical and financial components of the proposal, and compliance with all local and national requirements. If facilities at an institution other than the proposed grantee institution are to be used, a letter confirming availability of the facilities for the research signed by a competent official of that institution must also be included.

The institution submitting the proposal is responsible for securing any necessary authorization for the receipt of funds, and for compliance with local and national laws.

The following proposal outline and budget guidelines provide additional details needed to prepare a proposal.

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**Sample Cover Page**

**NAME OF PROPOSING INSTITUTION**

**Mailing Address:**

**Street address if different from mailing address or if mailing address is a P. O. Box:**

**Telex Number:**

**Phone Number:**

**Fax Number:**

**Title of Proposed Research**

**Institutional Administrator:**  
**(must be an official authorized to sign on behalf of institution)**

**Research Project Director:**  
**(person who is responsible for conducting research project)**

**Signature:**  
**Typed name of signing individual**  
**Title of of signing individual**

**Signature:**  
**Typed name of signing individual**  
**Title of signing individual**

**Date**

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**BODY OF PROPOSAL**

Total length of the proposal should not exceed 20-30 pages equivalent, typed double-spaced. PLEASE NUMBER THE PAGES.

**1. Abstract**

Prepare a summary of about 200 words describing the proposed research work and its relationship to the program objectives. This summary should be informative for other scientists in the same or related fields. Include total amount of funds requested and proposed duration of project. If the proposal is approved, this summary may be included in international data registries, so please be clear and complete.

It is often a good idea to prepare the abstract last to insure its consistency with project objectives.

**2. Background**

Write a brief technical description of the problem that you are proposing to solve that is understandable to other scientists, including a discussion of the scientific and technological background. In general the solution of the problem proposed will lead to an increase in production on stressed lands or will eliminate a constraint to production, and a brief discussion of the importance of the specific topic of the proposal to national development goals should be included. In this section the specific problem to be addressed and the hypotheses to be tested should be clearly stated, with an explanation of how the proposed research will lead to a solution of the problem. Proposals which appear to consist of data collection without a clear hypothesis are unlikely to be competitive.

**3. Scientific Antecedents**

Provide a description of present status of scientific knowledge relevant to the proposed research, with explicit references to earlier or ongoing work. This is important to demonstrate applicant's familiarity with the scientific literature in the field. A description of earlier work by the applicant related to the problem will be helpful.

**4. Objectives**

Please distinguish two types of objective for your project:

- o General, related to the problem defined in the background discussion. You may describe how the result of your project will ameliorate or resolve the problem being addressed.

- o Specific objectives of the proposed research, related to the activities proposed or the different stages of the project. Specific objectives should be expressed in verifiable terms, for example, using words like "determine" or "identify" rather than "study" or "investigate." These objectives will serve as guideposts to evaluate the success of the project, so please be precise.

## 5. Research Plan

This is the heart of the proposal, and discussion in this section should be directed to specialists in the field. Experienced scientists in the U.S. and Pakistan will be asked to referee your proposal, and this is the discussion which will allow them to evaluate the quality, timeliness, and potential for success of your proposed work. For each phase of the project, please provide the following information.

a. Purpose and Hypothesis to be tested. This should provide a clear statement of the purpose of this phase of the work and what question(s) will be investigated.

A valid hypothesis is often most clearly presented as a deniable statement, for example, "The purpose is to determine whether yield of seed per hectare of [species] may be increased by optimizing plant spacing."

b. Methodologies to be used. Here experimental procedures should be fully described in detail and in technical terms.

c. Activities to be carried out. The number and purpose of samples to be tested, cultures to be grown, apparatus to be constructed, etc. should be indicated. In some cases it may be reasonable to combine this section with (b) above.

d. Inputs required. List and describe the purpose and function of the equipment or material to be purchased, laborers to be hired, experts brought, etc. with grant funds.

e. Timetable and duration of this phase. Dates should be given if possible. A chart of activities over the proposed time period may be useful.

## 6. Data Management and Analysis

Describe the methods and the timetable to be employed for processing and analysis of data. If a computer or microcomputer is used, indicate the software packages for data entry, management and analysis. Also give the name and cv of the individual responsible for data processing. This is particularly essential if a microcomputer is to be purchased with grant funds.

## 7. Resources

In this section, you may describe the physical and human resources available at your institution to carry out the project. Since the program is not intended to create new centers or institutes or major facilities, nor to support advanced degree training, it is important to demonstrate that the basic capability to carry out this proposed project exists in your institution.

- o Information about the proposed Grantee institution, sources of financial support, existing regional and/or international linkages, research facilities (including equipment and vehicles available for use in this project).
- o Details about education and experience (or curriculum vitae) of the personnel who will conduct the research. The curriculum vitae for any individual must include education, positions held, and references to published works relevant to the work proposed. Describe previous research experience related to the proposed project. Lengthy lists of honors received or publications unrelated to the proposed project are not necessary.

It is important to specify the task or contribution to the research project of every individual who is to be paid with grant funds.

## 8. International Collaboration

Please provide a brief summary of your plans for collaborating with institutions and scientists outside of Pakistan in carrying out the project. Describe the nature of the collaboration required: use of research facilities, short term training, exchanges of scientists, visits of experts, etc. If you have already identified a collaborating institution please specify; if not, BOSTID or PARC staff can assist you after the project is approved. All assistance and collaboration required must be included in the budget calculations below.

## BUDGET

### General Instructions

The budget portion of the proposal is intended to give an estimate of the costs required to carry out the project. It is important to be as accurate and precise as possible, for two reasons. First to make certain that all resources necessary to complete the project are included. Secondly, however, submitted budgets are often taken by referees and the CRG as an indication of seriousness of purpose, and excessive personnel or other expenses may reflect poorly on the proposal. A good budget should be modest but not so tight that the research can not be completed.

The budget may be calculated in rupees or U.S. dollars. The prevailing exchange rate should be indicated. If inflation factors are used to calculate costs for years following the first, they must be stated. A detailed budget for each year of the project must be prepared, as well as a summary budget, using the attached sample formats.

### Salaries

- o Existing staff. For those persons who will be paid from grant funds, indicate name, title, annual salary and the fraction of work time to be spent on grant-supported work. Curriculum vitae (resumes) of all researchers who will contribute to the project should be included with the proposal. Others who will allocate time to grant-supported work but will not receive salary from grant funds can be included also (with zero salary charged) in order to indicate the entire research team; those should also be listed in the Grantee Contribution section (see below). Honoraria are permitted in conformance with institutional policy and practice, and should be so labelled. Note that Pakistani law restricts honoraria of university personnel to forty per cent of annual salary.
- o Proposed new staff. Provide proposed title, duties, annual salary, and fraction of time to be spent on grant-supported work. After the individual has been identified, a copy of his or her curriculum vitae must be sent to BOSTID and PARC. Casual or field labor need not be included in the salaries section, but below as a research expense.

### Consultants

Consultants are short-term advisors who assist with specific aspects of the research work, generally on areas in which the permanent staff may lack special expertise. In this section, you should list the fees which are to be paid to consultants. Travel for consultants from abroad or local travel to visit field sites is listed under Travel below.

- o Consultants from Pakistan. Provide the name and curriculum vitae, a short description of the work to be performed, the number of days required, and the proposed daily rate. Local consultants are to be contracted by the Grantee according to its own institutional policy.
- o Consultants from other countries. Provide a short description of the work to be performed, name and curriculum vitae (if known), the number of days required, and the estimated total fee. In many instances services of consultants or advisors can be arranged without fee (but travel costs for them should be included below). If you have doubts, please consult BOSTID and PARC staff, who can also assist with selection of advisors after the grant is approved.

**Travel**

- o Travel within Pakistan. Provide the purpose of travel, name of the traveller, the number of trips, and the estimated cost of trips. Include travel of consultants and trainees in these travel costs.
- o International Travel. This includes travel by a major investigator, trainee, or international consultant. Identify the traveler, purpose of travel, destination, duration of travel, and estimated cost of fare and subsistence. Travel is at economy or excursion fare.

**Materials and Services**

- o Training materials or fees. Indicate the purpose of training, the proposed location and duration, and the estimated cost. (Salaries for trainees or trainers should be included in "Salaries" or Consultants" sections as appropriate. Travel costs for trainees or trainers should be included in "Travel.") Normally no long-term degree training (such as pursuing a Master of Science or Doctorate degree) is funded from the grant.
- o Research expenses. Materials and services needed for research are to be included here. Provide a list of items needed and the estimated cost for each. Examples of items that might appear in this category are:

Expendable supplies (items that usually have a useful life of less than 1 year). These need not be itemized.

Casual, contract, or field labor

Information services, reference materials

Computer services

Vehicle operation and maintenance

Equipment maintenance and insurance.

Land, equipment, or vehicle rental

Overhead charges, where required by institutional regulation. State the method of calculation.

- o Publications. Indicate the number of publications/reports to be published by the Grantee and the approximate cost of each. If publications are to be produced by other institutions, indicate the number and approximate cost of each. Page charges for publishing research results in scientific journals may be included.

**Equipment**

Grant funds may be used to purchase equipment specifically for grant-supported research or to initiate a technical service, but not to purchase standard items to establish new laboratories. In the proposal budget, list type of equipment, its specific function in the proposed research, the proposed source if known, and the approximate cost of each item, including shipping charges, taxes and customs duties. BOSTID or PARC staff can advise on the calculation of these costs.

### Motor Vehicles

Motor vehicles may not be purchased with grant funds. Costs for vehicle rental, operation and maintenance may be included.

### Sample Budget Format

Please prepare a separate detailed budget for each year of the proposed grant using the format below. Indicate details of salaries, consultants, travel, materials and services, and equipment as discussed in the preceding pages. Then combine the amounts for each item into a Summary Budget for the entire proposed grant using the format below.

#### DETAILED BUDGET (Rupees or U.S. Dollars)

Year \_\_\_\_\_

#### Salaries

Existing staff	Name	Title	Annual Salary	% of work time devoted to project	Salary charged to project, if any
	1.				
	2.				
	..				
Proposed new staff	Title or Function	Annual Salary	% of work time devoted to project	Salary charged to project	

#### Fringe benefits

Benefits covered; method of calculation

Consultants	Name	Function	Number of Days	Proposed daily rate	Total cost
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Local  
International

Travel	Name of Traveler(s)	Number of Trips	Purpose	Cost per trip	Total cost
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Local  
International

#### Materials and Services

Training	Name	Purpose	Location	Cost
Research Expenses	Description			Cost

<u>Publications</u>	<u>Number</u>	<u>Cost of each</u>	<u>Total Cost</u>
<u>Equipment</u>	<u>Item</u>	<u>Purpose</u>	<u>Cost</u>
Purchased locally			
Purchased inter- nationally			
<b>TOTAL</b>			

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**Sample Budget Format**

Please combine the detailed yearly budgets into one summary budget for the entire proposed grant using the format below.

**SUMMARY BUDGET**  
(Rupees or U.S. Dollars)

	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>TOTAL</u>
<b>Salaries</b>				
Existing staff				
Proposed new staff				
<b>Fringe benefits</b>				
<b>Consultants</b>				
Local				
International				
<b>Travel</b>				
Local				
International				
<b>Materials and Services</b>				
Training				
Research expenses				
Publications				
<b>Equipment</b>				
Purchased locally				
Purchased internationally				
<b>TOTAL</b>				

**GRANTEE CONTRIBUTION**

Items and services which the Grantee will contribute to the proposed research work. Dollar or rupee equivalents are not required.

**Salaries**

Name, title, and percent  
of time devoted to project each year of  
scientific staff and technicians  
involved in the project  
whose salaries are not  
paid from grant funds.

**Materials and Services**

Training, research expenses  
and publications contributed  
by Grantee.

**Equipment**

Use of institution-owned  
equipment such as laboratory  
equipment, vehicles, office  
equipment, etc.

**Facilities**

Use of laboratory space, test  
plots, office space,  
utilities, administrative  
services, etc.

## CHECKLIST

The following items, all described in the previous pages, are essential for technical review and evaluation of the proposal to proceed. Proposals lacking these items will be delayed until the information is supplied.

1. Title page signed by research project director and responsible officer of institution. Where obtaining signatures causes serious delay, a draft proposal may be sent early, and the signed title page forwarded as soon as possible.
2. Research plan clearly described so that a scientific reviewer, in most cases a senior U.S. or Pakistani scientist in the field, may understand exactly what technical procedures are proposed, and see the justification for each item in the budget.
3. Biographical data for each member of the research team, including publication list and evidence of experience related to research topic.
4. Complete description of each budget item.

## **Preparation of a Successful Scientific Research Proposal: Guidelines for Researchers and Reviewers\***

This guide is prepared to assist researchers to prepare proposals, and reviewers and others who read their scientific research proposals. The principles are the same. The proposal writer must understand and apply them well, because the reviewer will employ them to comment on the application. Since it is desirable for both of these groups to know what the other expects, the same guidelines can serve for both.

The researchers should appreciate that reviewers of their proposals, who advise on allocation of research money, are people and institutions with their own purposes and ideas. Grant funding is intensely competitive, and no one can expect to have a proposal funded automatically.

From the researchers' point of view it is splendid that there are people and organizations prepared to pay them to do what they most enjoy. Proposal writers must first try to appreciate why this is, and then identify the people who make the decisions and administer the program, so the proposal can address their aims and concerns. These guidelines attempt to assist this process for the BOSTID-PARC Research Program. It may also help those who prepare or review proposals for other programs because analogous information will be required for them, though the specific format may differ.

### **The BOSTID-PARC Research Program**

This program is jointly administered by the Board on Science and Technology for International Development (BOSTID) of the National Research Council, an arm of the U.S. National Academy of Sciences and by the Pakistan Agricultural Research Council (PARC). Programmatic decisions are made by the BOSTID-PARC committee composed of equal numbers of eminent scientists and scientific administrators from the United States of America and Pakistan. The funds come from the U.S. Agency for International Development (AID), Islamabad, and are available only to scientific institutions based in Pakistan.

The primary goal of the program is to promote high quality research directed at improving agricultural productivity in Pakistan with emphasis on the marginal lands. This is not an institution-building program, as such, although we feel that the capacity to do good research is best developed by doing it. All activities in each project must be directed toward its research objectives.

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\*This paper is based on one prepared for the BOSTID Research Program by Michael P. Greene

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The program announcement is available from BOSTID and PARC and sets forth some specific topics that, among others, could be interesting and potentially fruitful. These announcements have been disseminated among the institutions of Pakistan and most or all of the proposals funded will be directly focused on improvement, in the short term, of agricultural productivity in marginal lands.

Proposal writers are asked to follow proposal preparation guidelines, which are available from BOSTID and PARC along with the announcements. These require a full, detailed proposal, including scientific antecedents, researchers' resumes and time commitment, and a budget.

Proposals received are sent for review to scientists specializing in the particular field of research. These reviewers are asked whether the proposed research appears to be promising and to make suggestions for improvement. The more promising proposals are selected for site visits by BOSTID and PARC staff. Both successful and unsuccessful applicants are given copies of the reviewers' (unattributed) comments. These may stipulate dropping part of an overambitious project, recommend inclusion of a training component where this would strengthen local capability, or suggest cooperation between the investigators at different institutions. Budget revision may be required.

Reviewers are selected for their knowledge of the field, and their unattributed comments are generally transmitted to applicants in the original form; the tradition of the review is to value frankness above diplomacy. When an applicant knows specifically why his proposal is not funded, he can often correct the deficiencies. It should be remembered that reviewers are human too; their comments are not always correct, and they do not always fully appreciate the content and implications of the proposals that they review. Review comments may assist an applicant to clarify the proposal.

In some countries it is rare for professionals to confront each other directly as to the merits of a research proposal. For scientists from such countries, the comments provided on their proposals may sometimes appear insensitive. However, we believe that frank peer review is the best way to assure the quality of the scientific enterprise.

The most successful researchers appear to value the comments of reviewers. They carefully appraise each comment. Those which appear valid and useful are incorporated into the plan of work of the research. Those which do not appear valid are challenged, and the response provides additional rationale or evidence to support the researcher's position. The committee that makes the final funding decision considers carefully the judgement of the PI in project revisions and/or the response to reviewers' comments. A successful research proposal is the basis of a contract for the research project so the PI, while revising the proposal and responding to review comments, must continue to present the research in the way he/she is prepared to do it.

The reviewer should evaluate the project as if it was his own. It is no kindness to allow colleagues to fall into errors that can be foreseen and, therefore, avoided. The most helpful comments are specific and clear, with substantiation where appropriate.

Those institutions whose proposals are considered promising by the reviewers are visited by BOSTID and PARC staff/consultants. One purpose of the visit is to discuss with the investigator the reviewers' comments and to advise how the proposal might be revised or the reviews answered in a separate letter. By far the great majority of proposals require revision or an explanatory letter. When the revised proposal is received, it is again sent for technical review, and finally the (revised) proposal, reviewers' comments, and site visit report are presented to the BOSTID-PARC committee for a funding decision.

#### Purpose of the Proposal

The proposal is primarily a means of communication between the prospective grantee and the BOSTID-PARC Committee on Research. It is not the final document and is generally subject to adjustment and negotiation. If a grant is awarded, the objectives, budget, and statement of work are contained in a new grant document negotiated with the staff and signed by officials of BOSTID, PARC and the recipient institution.

The proposal writer should try to understand the philosophy or purposes of the people he/she is addressing, and those who provide the funds. Why are people willing to provide money to pay for other people's research projects? What are they looking for? Who are the reviewers who write the technical reviews? Are they first-rate scientists, experts in the field, who will be impatient with too many words explaining the obvious and too few describing the project? And the agency staff who handle the proposals? Can the researcher get assistance and advice from them to improve the chances of the proposal?

On the receiving side, reviewers should attempt to appreciate the situation of the proposal writers, especially those in other countries and other cultures. English is a foreign language to them, so that awkwardness in expressing some complex ideas may be unavoidable. Do they have access to the latest scientific literature? If they seem serious but do not seem to know the latest developments, can you provide good advice to rectify the omission? Are they unfamiliar with the United States system of proposal writing, and do they use excessive florid language? The reviewer's job is to extract the scientific content. They must try to understand the importance of a project to Pakistan. Above all, the reviewers should keep in mind the objectives of the program, to foster good research that improves agricultural productivity in the marginal lands of Pakistan, and that, in general, it does so in a five year time frame.

Although the proposal is primarily a request for a grant, it can also be, for the proposal writer, an instrument for conceiving, planning, and organizing a research project. All the questions asked in the proposal guidelines are questions that researchers must ask themselves before undertaking the project. In that sense, the time spent in preparing a proposal is never "wasted" if the proposal is well prepared. It is frequently evident that many researchers would rather confront the difficult choices after they receive the funding. The proposal, however, forces them to make the hard decisions beforehand, and scientists usually find that thorough planning increases the quality and productivity of their work. Much inadequately

planned research is wasted when it is discovered later that a key variable is uncontrolled in a long and costly series of experiments.

Nowadays, research funding is so competitive that all agencies require detailed proposals. On the other hand, any part of the project, or budget, or research plan may be changed by mutual agreement after the grant is approved if results of initial experiments suggest a more promising line of research. The BOSTID-PARC Committee on Research will actively encourage researchers to evaluate the progress of their research, and discuss with staff how the protocol can be improved throughout the life of the funded project.

### The Elements of a Research Proposal

There are many formulas for preparing a good research proposal. One is suggested by the proposal preparation guidelines. The proposal writer should refer to them directly; here we will comment on but not repeat these instructions. These notes are intended to complement but not replace the guidelines.

#### 1. Cover Page

The cover page should contain the title of the proposal and the name and address of the institution. It should also feature the names and signatures of the principal investigators and the administrative head of the host institution. For the reviewer, the important point to note is whether the administrator who signs is likely to be able to guarantee the contribution of all of the resources promised by the host or other local institutions. For example, if the grant is awarded to institution A, but some of the work or personnel or resources are to be made available by institution B, somewhere in the proposal package there should appear a letter from the responsible official of institution B signifying its commitment to provide the required contribution.

#### 2. Abstract

Logically the abstract, or scientific summary, should be read first and written last. Since it usually appears first, frequently it is written first, and sometimes before crucial decisions are made. It is both an introduction to the proposal, and a summary of the argument. The reviewer should ask himself whether the abstract accurately conveys the substance of the project and its rationale and objectives. If there is a conflict, there may be a problem. Proposal writers should preferably write the abstract last, and try to have it convey accurately the logic of the project. Often, in this era of computerized data bases, it is the abstract alone that conveys the substance of the project so the researcher needs to be sure it accurately represents the project.

#### 3. Background

Here we expect to learn what scientific problem the researcher seeks to solve. The reviewer's first task is to determine whether or not there is a problem. It is surprising how many research proposals do not address any problem at all. Instead they plan to "study" this or "examine" that, which is not the same as solving a problem. For example, the fact that there is a

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natural phenomenon that is not understood may or may not represent a problem worth investigating. The argument that there has been much work on the genetics of maize but no one has studied pigweed is not likely to yield a grant. When a real problem has been identified, then we must not simply "study" but "find out" particular information. The reviewer must distinguish a poor choice of words from genuine vagueness. Most donors want only to support research that seeks to solve a clearly defined problem, and the BOSTID-PARC program is directed toward solving problems that lead, in only five years or so, to increased agricultural productivity from the marginal lands of Pakistan. So the committee might reject a general study of pigweed genetics, but be interested in the problem of how this pernicious weed can be controlled.

When a problem has been identified, there are two further important questions:

- Is the problem of sufficient interest to the program to warrant support?
- Will the proposed research project solve it?

The latter question will be answered when the proposed research plan is discussed, but the importance of the problem should be clearly argued in this background discussion. Is the problem posed likely to have significant benefit to agricultural production in Pakistan? Or is it something of interest only to the research community? Some donor agencies, perhaps, support research for its own sake and need not ask this unfortunate and sometimes unanswerable question. But even they must require that there be a concrete problem to solve, however theoretical, and not just material to "study."

#### 4. Scientific Background

Here the investigator must review the literature and show how his work builds on what has already been accomplished. It may be difficult to obtain the latest journals. If the researcher has contacts in institutions abroad with good libraries, it would be wise to request assistance with library searches and obtaining papers.

Reviewers must check whether the proposals are up-to-date and whether they include references to all important relevant background research. They should identify omissions, and if possible, provide copies of critical papers. They must also draw on their own knowledge to decide whether the proposed research has already been done, or would in any other way be superfluous. Some researchers in developing countries, working in a highly nationalistic atmosphere, tend to assume that their problems are so special that if the research has not been done in their country, it has not been done. This seems to be particularly common in agricultural projects, and is sometimes, but not always, correct. Most donor agencies do not have the resources to repeat experiments whose results can be predicted from other published work.

A careful discussion should refer to current knowledge, identify gaps in that knowledge, and review methodology. The aim should be to diagnose and reveal key problems rather than merely provide an academic review. The discussion must not simply cite references but demonstrate a clear

understanding of what is important and relevant in the literature. A good presentation will state the results of the pertinent articles to show their relation to the proposed research.

## 5. Objectives

Two kinds of objectives should be presented--general and specific. General objectives may deal with the ultimate goal of the research, and should have some relation to the goals and interest of the donor agency. They should be limited to specific scientific or technical issues and not involve political changes that are beyond the scope of research. For example, the goal of an agricultural research project should not be to transform the agricultural or economic system of the country. Instead, it should address a particular problem in crop production.

The specific objectives should be directly related to the activities proposed in the project. They should be expressed in verifiable terms. As in the background, words like "study" or "examine" should not be used to describe the objective because they suggest a vagueness of purpose. How would one know whether an objective to "study" a certain phenomenon has been accomplished satisfactorily? In the better proposals, one finds words such as "determine," "identify," "create," or "construct" used. The specific objectives are important as a clear statement of the proposed investigations of the researcher. They should directly respond to the problem identified earlier for solution, and the research plan, described below, should enable the researcher to complete the identified objectives. If the specific objectives would not lead to a solution to the problem, or if the research plan does not lead to satisfaction of the objectives, the proposal cannot be considered a good one, no matter how good the project might be in other respects. When powerful techniques are used without addressing the researcher's stated objectives, the reviewer may have to conclude that the investigator does not know what he is doing. Question, then: do the specific objectives address the problem described in the background discussion?

## 6. Research Plan

The research plan is the most important part of the proposal, and the one on which most proposals will pass or fail. Where other parts of the proposal may be read by a general audience, this section is to be written for specialists.

For purposes of presentation, the project should be divided into stages, each stage corresponding to a different specific objective. For each stage, the writer should present the particular hypothesis to be tested, the research plan with methods and activities to be carried out to test the hypothesis, the resources required, and the timetable or duration of the stage. Complete details are required. Vagueness or lack of precision are often interpreted as lack of knowledge or experience. Some procedures, of course, are sufficiently well known that a standard reference is sufficient, but the reviewer will be the judge of that. If an essential procedure is not included in the experiment or not described, it is fair to conclude that it will not be carried out. Of course, one purpose of the early review process is to advise the researchers, so they will be able to present better projects in the next version.

The resources listed must be related to the particular stage of the project. Some of these will be supplied by the grant, while others are already available at the institution. Poorly written proposals list only those materials for which funds are requested, forcing the reader to skip ahead to the discussion of institutional resources or counterpart contributions to be sure that all necessary equipment is available. If something essential is lacking the reviewer should point it out; the omission may be only an oversight in writing the proposal. On the other hand, many writers view a grant as an opportunity to equip an entire laboratory, whether the items are essential to the project or not. We wish to discourage this attitude.

The reviewer should pay particular attention to whether the proposal is realistic in what can be accomplished with the time and resources available.

#### 7. Data Management, Data Processing

Every research project involves the collection and analysis of data. If the analysis is not done correctly (and promptly), the project will have limited value no matter how ingenious the research. The proposal should include a plan for data processing and analysis, which includes the methods to be used and the timetable. Data processing should not be left for the end of the project, but should commence early and be an integral part of the protocol. Only in this way can the data be monitored to detect errors early and to note emerging results in time to make any adjustments in future experiments.

If the project involves a questionnaire or survey instrument, a copy of the actual document should be included with the proposal, and be referred to in the plan for data processing. A proposal which mentions an instrument but does not include a sample appears strangely mysterious and deficient.

Data processing frequently involves a microcomputer. When a microcomputer will be used for data management and analysis, indicate which software packages will be utilized and identify the individual who will be responsible for data management, and provide his or her curriculum vitae. This is essential if a microcomputer is to be purchased with grant funds. Microcomputers do not solve any problems, except in the hands of experienced personnel.

#### 8. Institutional Resources

After a complete detailed description of the research plan, describe the institution and resources available for the project. Does the institution have the capability to carry out the project, and are the required equipment and laboratory facilities available to the project? If the institution is new, little known, or small, a more detailed justification is needed.

The proposal writer is asked also to provide biographical material or a curriculum vitae for each principal researcher. This is extremely important; and no proposal is complete without it. Information on each individual should include education, employment history, and experience relevant to the project, especially scientific publications. Although donors may wish to encourage

young investigators and demand less of a proven capability, some evidence must be presented. Publications in reviewed journals are the best, if not the only, measure reviewers can apply.

The reviewer should realize that in some developing countries, publications in international journals are harder to produce because of language problems and because publication costs may be required in hard currency. However, many local journals are unrefereed and not as demanding as the major international journals. Publication in these local journals does not provide comparable proof of capability. A researcher with few international publications might be well advised to include a copy of a manuscript or publication on topics related to the proposal.

Many projects are multidisciplinary and, in these cases, it is essential that one or another of the researchers have the required skills for every important aspect of the project. Lack of experience is a major defect in a proposal and it cannot always be corrected with a short-term consultant. Reviewers should pay particular attention to this. In negotiating a grant, expansion of the research team to include needed skills is frequently required.

#### 9. Budget

Many proposal writers think that this is the critical part of the proposal, that the decision to fund the project depends heavily on the numbers presented. In fact the budget is rarely the sole cause of rejection; a poorly prepared budget usually reflects unclear thinking elsewhere in the proposal. With a well-defined project, the initial budget estimates provide a measure of the seriousness of the proposer. Investigators should aim for a tight and efficient budget, but not one so low that resources are severely strained or the work may not be completed.

If the preceding parts of the proposal have been carefully prepared, devising the budget is a simple matter. For each stage of the project, the resources have been listed. The work plan and timetable order the stages and allow easy calculation of salaries, supplies, and equipment costs. The reviewers should check whether each item, such as a trip or piece of equipment, is essential to the project, and if the costs are roughly the expected amounts. It is the task of the BOSTID-PARC Committee on Research to decide whether the project is worth the total cost, and the reviewers' recommendations are influential.

The proposal writer should note that some items, such as expendable supplies, should be globally estimated--that it is neither necessary nor advisable to list every item down to the last paper clip and pencil.

Overhead or administrative costs are usually figured either as a percentage of salaries or as a percentage of the funds administered by the institution.

#### 10. Salaries

There are two types of salary items, and they are sometimes difficult to distinguish in the proposal. One is "replacement" salary, salary paid to the

investigator by the grant for the time dedicated to the project at the rate normally paid by the institution. The second is an "honorarium"--salary payments in addition to the regular salary paid by the institution. Both may be allowable, but the proposal must make clear whether each item is salary or honorarium.

The same requirement applies to local consultants. It is important to describe the role of each local consultant in the research project, and to provide a curriculum vitae.

An important question is the amount of time to be dedicated to the project by the investigators. If their salaries are paid by the institution, that information should appear as a grantee contribution. If the grant is to pay partial salaries, the salary line also should appear in the grant budget. In every case, the percentage of time dedicated to the project by each researcher must be stated clearly. Without that information, the proposal is not complete. Obviously, the time the researchers will spend must be adequate to carry out the work.

Another important area is the leadership and direction of the project. Some projects are more complex and require more coordination than others. Some involve collaboration among different institutions, or different departments within a single institution. The time and energy dedicated by the principal investigator is critical to the success of the project. The reviewer should consider this carefully. Good, relevant experience and ability of the researchers are not enough. They must, in addition, be able to commit the necessary time to the project.

## Conclusion

Ultimately, the single question that must be answered for each proposal is "will it be funded?"

The answer depends upon many things. This discussion has focused on the technical issues and their relevance to the goals of the grants program. However, as every experienced researcher knows, there are also chance factors. These range from the idiosyncracies of individual reviewers or committee members to the choice of other proposals that are presented to the committee at the same time, to the total amount of funds allocated for grants at the time of presentation.

The most frequent cause of rejection or deferral of a proposal is lack of information. There is simply insufficient information for reviewers or a committee to judge the proposed research:

- whether the proposal meets the criteria
- whether the PI really understands the research to be undertaken
- whether the researcher is likely to produce the desired solutions.

Faced with many proposals, often far more than can be funded, lack of information is a major reason for rejecting proposals.

Dr. George N. Eaves has noted in Federation Proceedings (1972, 31, No.1, quoted in TDR news, No. 30, December, 1989, p. 7) that some of the more common reasons for disapproval of applications to the National Institutes of Health, in this case:

- a diffuse, rambling, superficial, or unfocused research plan
- a lack of background and experience in the essential methodology
- an experimental approach that involves questionable reasoning
- the absence of an acceptable scientific rationale
- an attempt to conduct an unrealistically large amount of work
- a lack of sufficient experimental detail.

The serious proposal writer can examine his/her proposal before submission for these common deficiencies.

Rejection of a proposal is not a disgrace; it should be a challenge. The reviewers' comments should be studied and, where appropriate, a response sent. A negative decision in an ongoing program does not have to be final, and a new proposal, embracing or rejecting the reviewers' criticisms, could be the next order of business. Persistence in seeking a grant is a good indicator of persistence in carrying out a project, and most granting agencies would not discourage a continued, polite, and responsive display of interest that showed a thoughtful response to the reasons for rejection. Some of the best projects have been developed from proposals that were initially rejected. Furthermore, all granting agencies are not alike, and proposals rejected by one may be adopted by another. In fact, having experienced the reviews of the first agency may help make the proposal a better candidate for the second.

A proposal should be thought of as a wager on the future. Writing a good proposal is an arduous exercise, which has a real cost to an investigator's laboratory. However, getting a grant is a major benefit. An investigator should weigh the cost of preparation of the proposal and the odds of being successful carefully. In the United States, many laboratories take odds of one-in-three as the breaking point--if the scientist does not believe after initial investigation that he has one chance in three of winning a grant, he should not go to the trouble of writing a proposal. On the other hand, if one does not fail twice as often as he succeeds, he is probably not competing often enough, or for important enough grants.

In short, a proposal rejection is not the end of the world. It is an experience from which something can be gained by both the funding agency and researcher. It is a single incident in a continuing struggle to support and carry out the best research possible.



3. Research Plan. Soundness, optimal plan, breadth, budget, staffing.  
Recommended changes.

4. Research Methodology. Adequacy, up to date, alternate methods,  
additional measurements, appropriate equipment. Recommended changes.

5. Institutional Capability. Institutional support. Qualifications of the research team. Choice of consultants. Training required.

-----

Summary. Recommendation for modification and/or funding.

NATIONAL ACADEMY OF SCIENCES  
BOARD ON SCIENCE AND TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT  
PAKISTAN-BOSTID AGRICULTURAL RESEARCH GRANTS PROGRAM

MEMORANDUM OF GRANT PROVISIONS NO. 060592

The Grantee agrees that NAS support for the grant and the payment of any funds (including Subgrants) under this grant are subject to compliance with the terms and conditions set forth in this Memorandum and in Appendixes A, B, C, D and E.

The Institutional Administrator named herein will serve as the primary liaison with responsible technical and administrative officers of the NAS. The Institutional Administrator will also assume responsibility for all local activities and program coordination directly related to the activities detailed in this grant.

1. BUDGET REQUIREMENTS

NAS will not pay for any costs incurred prior to the effective date of the grant or subgrants. NAS will not pay costs other than those listed under the different headings in the approved budget labeled "NAS Contribution". The Grantee must obtain written approval from NAS prior to:

- replacing any individual named in the approved budget,
- selecting and executing an agreement with any consultant (local or international)
- making an expenditure which:
  - increases the corresponding budget category by more than 10 percent above the budgeted amount,
  - increases the individual salary rates above those shown in the approved budget,
  - was not included in the budget.

In no event may adjustments among budget line items result in an increase in the total amount of the grant, nor may the total amount of the grant be exceeded.

For the salaries or wages of all persons paid from the grant, the Grantee agrees to comply with the laws of its country regarding limits on income from external (non host-government) sources, withholding of income taxes and other such taxes required by law to be withheld and paid to the Government of that country.

NAS/BOSTID MEMORANDUM OF GRANT PROVISIONS NO. 060592

If any employee benefits required by law have not been included in the approved budget and are expected to be paid from NAS grant funds, NAS must be advised before the project begins. Any changes required by law during the performance period of this grant, which are applicable to employees compensated under this agreement must be approved in writing by NAS. Any payment for the purpose of augmenting an employee's salary is contrary to A.I.D. policy. In accordance with A.I.D. policy, salary supplements do not include employee benefits required by the laws of the host country, per diem, invitational travel, honoraria and payment for work performed outside of normal working hours.

2. ADVANCE PAYMENTS AND REPORTING REQUIREMENTS

An initial advance payment of 25 percent representing the first three months of the Grantee-Administered first year's budget will be transferred automatically to the Grantee upon receipt by NAS of the signed grant and banking information form. A second advance payment of 25 percent representing the second three months of the Grantee-Administered first year's budget will be transferred upon request of Grantee. The Grantee may request the second payment approximately six weeks before the first payment is fully spent. Subsequent advance payments will be made upon request of the Grantee and will be dependent upon regular and timely submission of financial, activity, and annual progress reports. A financial report (using Expenditure Report forms provided under Appendix A) covering the first payment for the first three months of activities must be received by NAS before a third payment will be processed; a report on the second payment for the second three months' activities must be received by NAS before a fourth payment will be processed, and so forth.

Subgrants are awarded independently and assigned different starting dates and financial reporting dates. Initial and subsequent advance payments to Subgrantees are subject to the same requirements specified for Grantee, above. The Grantee will approve and submit to the NAS/BOSTID in an expeditious manner quarterly financial reports and requests for payment prepared and initiated by Subgrantees.

The schedule and format for submission of activity and annual progress reports is described in Appendix B.

3. MAINTENANCE AND USE OF FUNDS, SUPPLIES, AND EQUIPMENT

The funds and supplies provided through the grant may only be used by the Grantee to support the work defined in the accompanying Purposes and Objectives Statement. Under no circumstances may funds, supplies, or equipment (to include motor vehicles) be used for activities that are not program related. However, equipment may be made available to other programs if such use does not interfere with the work of this program for which the property was acquired. The A.I.D. requirement that grant and subgrant funds be held in separate interest-bearing bank accounts has been waived for purposes of this grant program. An exception to this policy has been approved by NAS on the basis of the letter dated March 30, 1992 from Dr. Zafar Altaf of the Pakistan Agricultural Research Council.

Program funds cannot be used to pay duty on any supplies or equipment provided under A.I.D. sponsored agreements. The Grantee will arrange duty free entry of such items in accordance with A.I.D. regulations.

The Grantee and subgrantees will not charge the grant for depreciation, amortization, or use of the property purchased directly under the grant. The Grantee agrees to maintain such equipment in good working condition. For equipment with an acquisition cost of US \$1,000 or more, the Grantee will maintain a control system which will permit its ready identification and location, and identify who has been assigned custody and who is responsible for maintenance.

Grantee will arrange that all materials and supplies purchased with grant funds are issued only on properly approved requisitions and are stored in an orderly fashion.

4. PROCUREMENT OF GOODS AND SERVICES

The authorized countries of origin of all goods and services procured under this grant are the United States and Pakistan. All procurement, whether undertaken by the Grantee or NAS, must be in accordance with A.I.D. provisions governing procurement and eligibility for goods and services (See Appendix C attached). All local procurements must be made in accordance with A.I.D. provisions governing local-cost financing (See Appendix D attached).

5. TITLE

Title to all equipment purchased with funds provided by NAS, whether procured by the Grantee or NAS, shall be retained by NAS until completion of the project or discontinuance of NAS support, at which time NAS will issue instructions for disposition.

NAS/BOSTID MEMORANDUM OF GRANT PROVISIONS NO. 060592

6. ACCOUNTING, AUDITING, AND RECORDS

The Grantee and subgrantees will be visited by NAS personnel or representatives during the course of the project for the purpose of reviewing project progress and record keeping. Ledgers, invoices, vouchers and other accounting evidence and documentation must be maintained by the Grantee to substantiate charges to the grant, and preserved for audit purposes for a minimum of three years from the date of termination of the grant, and for such longer period, if any, as is required to complete an audit to resolve all questions concerning expenditures.

In the event that the Grantee's existing procedures and practices do not provide expenditure data by budget line-item, separate auxiliary records will be established to provide such data for financial reporting (Expenditure Reports) and audit purposes. Such records shall be available for examination by NAS or any person or entity NAS may designate. (See Appendix E for General Recordkeeping Requirements). NAS arranges for periodic audits of their Grantees' financial records to determine the propriety and necessity of the Grantee's expenditures in terms of the purposes for which the funds were made available, and the adequacy of the Grantee's financial management. The Grantee agrees to make available information requested by NAS or its auditors with respect to questions concerning the audit.

It should also be understood that, as a U.S. organization, NAS is subject to the laws of the United States, and that the work to be conducted hereunder is funded under a grant from the U.S. Agency for International Development [391-0489-G-00-0994-00], which specifies that the U.S. Government, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers and records of subrecipients, which are directly pertinent to the specific program for the purpose of performing audits, examinations, excerpts and transcriptions.

In addition, as a non-profit U.S. institution, NAS is required to follow U.S. Government regulations governing the audit requirements of its prime agreement with A.I.D. This requirement is also applicable to all non-profit institution subrecipients receiving \$25,000 or more during a subrecipient's fiscal year. Accordingly, please note that the audit requirements for all grants awarded in the amount of \$25,000 or more will be conducted in accordance with the provisions of OMB Circular A-133.

7. REFUNDS

Within 30 days after the expiration or termination date of the grant (unless a written request for an extension has been made by the Grantee and approved by the NAS), the Grantee will return to NAS any Grant funds not expended for work under the grant except for commitments legally incurred by the Grantee under this grant prior to the expiration date. The Grantee will return to NAS any funds remaining from commitments which are not liquidated within 90 days after the expiration or termination of the grant.

NAS/BOSTID MEMORANDUM OF GRANT PROVISIONS NO. 060592

If it should be determined that grant funds have been expended for purposes other than as stated in this agreement, the Grantee agrees to refund the equivalent amount in U.S. dollars to NAS.

8. GRANTEE CONTRIBUTION

The Grantee agrees that its contributions will be made as indicated in the page entitled "Grantee Contribution."

9. PROTECTION OF HUMAN RESEARCH SUBJECTS

No research involving human subjects is supported by this grant unless prior written approval is obtained from NAS and the following conditions are met:

Where research involving human subjects is included in grant activities, the research protocol and the procedure for protection of human subjects must be reviewed and approved by the NAS Committee to Review Human Studies before such research may be initiated. The Grantee acknowledges:

- receipt of Health and Human Services publication titled Protection of Human Subjects, Federal Regulations 45CFR46,
- that said document has been carefully reviewed,
- that patient informed consent forms have been reviewed and approved by relevant institutional ethical review committee and that a copy of the approved form will be furnished to NAS, and
- that a copy of the signed consent form will be maintained in each client's file which will be readily available for review by NAS staff, consultants, and auditors.

10. CARE OF LABORATORY ANIMALS

No laboratory animals will be used in the research under this grant unless prior written approval is obtained from NAS.

11. PUBLICATION OF RESULTS

The Grantee and NAS must approve in writing any manuscripts presented by the project Principal Investigator prior to their submission for publication of any results of the work conducted under this grant. The Grantee shall acknowledge the support of NAS and the U.S. Agency for International Development (A.I.D.) in any publication resulting from work performed under this grant using the following statement:

NAS/BOSTID MEMORANDUM OF GRANT PROVISIONS NO. 060592

"Financial support for this research was provided by the U.S. National Academy of Sciences/Board on Science and Technology for International Development by means of a grant from the U.S. Agency for International Development (391-0489-G-00-0994-00)."

The Grantee agrees to supply NAS with three (3) copies of each publication produced in connection with the work conducted under this grant. The Grantee may copyright any books, publications, or other copyrightable materials developed in the course of the work, but NAS reserves a royalty-free nonexclusive and irrevocable right throughout the world to use, duplicate, disclose, or dispose of such publications in any manner and for any purposes and to permit others to do so. Should the Grantee use grant funds to underwrite the cost of publication, rather than the publisher assuming this cost as is the normal practice, any profits or royalties shall be credited to this grant up to the amount of grant funds used for such publication.

12. PATENTS

The Grantee may retain the entire right, title and interest throughout the world to each subject invention in accordance with A.I.D. provisions governing Patent Rights. (See Appendix D attached).

13. TRAVEL AND TRANSPORTATION

All international travel will be coordinated by BOSTID. The Grantee is required to present to the NAS program officer for written approval an itinerary for each planned international trip financed by this grant, which shows the name of the traveller, purpose of the trip, origin/destination (and intervening stops), and dates of travel, as far in advance of the proposed travel as possible, but in no event less than six weeks before travel is planned to commence. International air travel and shipments (outside the Grantee country) under this grant must be made on U.S. flag carriers to the extent service by such carriers is available. Exceptions to this rule must be authorized by NAS in advance. In addition, vouchers and documents must be certified and retained as part of the grant record.

14. PARTICIPANT TRAINING

"Participant Training" refers to individuals travelling outside of their home country funded by this grant and benefiting from the visit more than making a contribution to the work of the program. Individuals are classified as "participants" (i.e. as trainees) if they are enrolled in formal classes or scheduled for on-the-job training for most of their stay. It is not expected that Participant Training will take place under this grant. In the event that such training is deemed necessary and is approved by the NAS, all such training will be governed by A.I.D. regulations under Handbook 10.

NAS/BOSTID MEMORANDUM OF GRANT PROVISIONS NO. 060592

Participant training procedures are estimated to require a minimum of four months to complete and should be initiated as far in advance of intended travel as possible. NAS will provide Grantee with participant training requirements upon request.

15. NONLIABILITY

NAS does not assume liability with respect to any legal claim for damages arising out of work supported by this grant.

16. TERMINATION

(a) For Cause. This grant may be terminated for cause at any time, in whole or in part, by NAS upon written notice to the Grantee, whenever it is determined that the Grantee has failed to comply with the conditions of the grant.

(b) For Convenience. This grant may be terminated for convenience at any time by either party, in whole or in part, if both parties agree that the continuation of the grant would not produce beneficial results commensurate with the further expenditure of funds. This grant may also be terminated if, for any reason, the prime grant to NAS from the Agency for International Development is terminated or allowed to expire. Both parties shall agree upon termination conditions, including the effective date and, in the case of partial terminations, the portion to be terminated.

(c) Termination Procedures. Upon receipt of and in accordance with a termination notice as specified in either paragraph (a) or (b) above, the Grantee shall take immediate action to minimize all expenditures and obligations financed by this grant, and shall cancel such unliquidated obligations whenever possible.

17. JURISDICTION

This grant shall be construed under the laws of the District of Columbia, United States of America. Notices and correspondence herewith shall be addressed to the National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 and to the Grantee at the address listed on the cover page of this grant.

NATIONAL ACADEMY OF SCIENCES (NAS)  
BOARD ON SCIENCE AND TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT (BOSTID)

GRANTEE EXPENDITURE REPORT

Grant No.: \_\_\_\_\_ Grant Period: \_\_\_\_\_ Payment No. \_\_\_\_\_

Institution: \_\_\_\_\_

Principal Investigator: \_\_\_\_\_

STATUS OF GRANTEE ADMINISTERED BUDGET (US dollars)				
(a)	(b)	(c)	(d)	(e)
Category	Approved or amended budget	Amount sent in this payment	Amount sent to date	Amount yet to be sent
Salaries				\$0.00
Consultant fees				\$0.00
Travel				
International				\$0.00
Local				\$0.00
Equipment				\$0.00
Materials and Services				\$0.00
Indirect Costs (overhead)				\$0.00
<b>TOTAL</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>

NAS/BOSTID GRANTEE EXPENDITURE REPORT

GRANT NO.: \_\_\_\_\_

GRANT PERIOD: \_\_\_\_\_

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SECTION II -- To be completed by grantee

EXCHANGE TRANSACTIONS DURING THE REPORTING PERIOD  
(ACTUAL NOT APPROXIMATE EXCHANGES)

(f) Date	(g) Dollars Exchanged	(h) Exchange Rate	(i) Exchange Charge	(j) Local Currency Received

NOTE: Documents received from the banks or disbursing officers on exchange transactions must be furnished to NAS/BOSTID.

NAS/BOSTID GRANTEE EXPENDITURE REPORT

GRANT NO.: \_\_\_\_\_

GRANT PERIOD: \_\_\_\_\_

Page 3

B. EXPENDITURES -- (Please report expenditures in currency actually used; local accounting records should be maintained on same basis.)

Category	LOCAL CURRENCY		U.S. CURRENCY	
	This Period	To Date	This Period	To Date
Salaries				
Consultant Fees				
Travel International				
----- Domestic				
Equipment				
Material and Services				
Overhead				
TOTAL				

(k)

(l)

(k)

(l)

C. STATUS OF FUNDS

1. Amount available in this period:	Local Currency	US Dollars
(p) Bank balance at beginning of period:	_____	_____
(q) Petty Cash on Hand, beginning of period:	_____	_____
(r) Advances outstanding, beginning of period:	_____	_____
(s) Received during period:	_____	_____
(t) Total available in this period:	(p)+(q)+(r)+(s) _____	(p)+(q)+(r)+(s) _____
2. Amount spent in this period (k)	(k) _____	(k) _____
3. Total amount available end of period:	(t) - (k) _____	(t) - (k) _____
4. Amount available end of period:		
(u) Bank balance	_____	_____
(v) Petty Cash	_____	_____
(w) Advances outstanding	_____	_____
5. Total available end of period:	(u)+(v)+(w) _____	(u)+(v)+(w) _____

[Please explain any discrepancy between 5. and 3.]

D. SUPPORTING STATEMENTS

Please furnish with this report the detailed statement of all financial expenditures by category. Reconciled bank statements should be attached.

NAS/BOSTID GRANTEE EXPENDITURE REPORT

GRANT NO.: \_\_\_\_\_

GRANT PERIOD: \_\_\_\_\_

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CERTIFICATION

The undersigned hereby certify that all expenditures have been reported, are correct, and are in accordance with the Grant Purposes and Objectives, Budgets, Memorandum of Grant Provisions and any Amendments thereto.

Date Submitted to NAS/BOSTID: \_\_\_\_\_

Certified by: \_\_\_\_\_  
Name and Signature of Responsible Financial Officer                      Date

\_\_\_\_\_  
Name and Signature of Responsible Principal Investigator                      Date

Approved by: \_\_\_\_\_  
Name and Signature of National Program Administrator                      Date

\_\_\_\_\_  
Name and Signature of National Program Coordinator                      Date

NAS/BOSTID GRANTEE EXPENDITURE REPORT

GRANT NO.: \_\_\_\_\_

GRANT PERIOD: \_\_\_\_\_

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EXAMPLE

GRANTEE EXPENDITURE REPORT

Dates	Check Number	Vendors	Total	Salaries	Consul- tant Fees	-----Travel-----		Equipment	Materials & Supplies	Overhead
						Int'l	Domestic			
1/2/91	127	L&L Supply	20.00						20.00	
1/15/91	128	S. Smith	180.00	180.00						
1/15/91	129	R. Jones	250.00	250.00						
Total Expend. This Period			450.00	430.00					20.00	
Total Expenditures To Date			450.00	430.00						
Funds Received			2000.00	850.00	500.00		200.00	200.00	250.00	
Unexpended Funds			1550.00	420.00					230.00	

THIS IS A SAMPLE



NATIONAL ACADEMY OF SCIENCES  
 BOARD ON SCIENCE AND TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT  
 RESEARCH GRANTS PROGRAM

STATUS OF NAS ADMINISTERED BUDGET

Grant No.: Report on Payment No.:  
 Principal Investigator: Grant Period:  
 Institution:

This report shows the funds spent by category for the portion of the grant administered by NAS. All items have been completed by NAS, and are presented to confirm the amounts spent and remaining in this portion of the grant budget. Please retain this report for your records.

CATEGORY	(a) BUDGET	(b) EXPENDITURES From: To:	(c) TO DATE	(d) BALANCE
Domestic Travel				
International Travel				
Research Expenses				
Publications				
Equipment				
TOTAL				
-----				
Materials and Services				

**NATIONAL ACADEMY OF SCIENCES  
BOARD ON SCIENCE AND TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT  
PAKISTAN/BOSTID AGRICULTURAL RESEARCH GRANTS PROGRAM  
GRANT NO. \_\_\_\_\_**

NAS supplied funds for this Grant will be deposited to the following bank account:

\_\_\_\_\_  
Name in which the account is registered

\_\_\_\_\_  
Account Identification Number

\_\_\_\_\_  
Name and Branch of Bank

\_\_\_\_\_  
Address of Bank Office Holding the Account

\_\_\_\_\_  
Name(s) of Person(s) Authorized to Sign Checks on the Account

\_\_\_\_\_  
Name of U.S. Correspondent of Your Bank

This account is \_\_\_ interest bearing \_\_\_ non-interest bearing

NOTE: Grantee is responsible for securing any necessary clearances for receipt of funds.

Please return two copies of this completed form. Thank you.

ACTIVITY AND ANNUAL PROGRESS REPORTS  
SCHEDULE & FORMAT

The Grantee is required to submit two types of narrative reports: (a) Semi-Annual Activity Reports, and (b) Annual Progress (and a Final) Reports. Activity and Progress Reporting requirements are applicable to all Grant components, to include administration (Collaboration and Support) and research projects (Subgrants). Activity and Progress Reports will be prepared by individuals responsible for the respective (administrative or research) components of the Grant, and submitted to the NAS by the National Program Coordinator (P.I. of this Grant) or his designated alternate. Reporting periods apply universally to all components and activities under this Grant, regardless of the initiation date of individual components. As described below, the Activity and Progress reports differ from one another in reporting periods (frequency), purpose, length and content.

A. ACTIVITY REPORTS

Reporting Periods: Reporting periods cover six-month increments, the first such increment to begin on the date of this Grant award and to end on the last day of the sixth month of this Grant.

Due Date: Activity Reports (three copies) are due within one month of the termination of the reporting period.

Purpose: Activity Reports are intended to provide the NAS with timely information on actual activities which have been initiated or implemented with Grant support during the reporting period.

Content and Format: Activity Reports should briefly summarize significant activities supported under this Grant, to include but not limited to such information as:

- personnel actions [recruitment or changes of support staff and investigators],
- travel [List of all international (to include regional) travelers along with their positions, purposes, destinations and dates of travel],
- seminars, workshops or meetings,
- initiation of training programs,
- initiation of research project (Subgrant) or new activity (e.g., field trials, laboratory protocol) within research project,
- equipment ordered/procured, etc.

Activity Reports need not provide details of research objectives, methods, or results.

**B. ANNUAL PROGRESS AND FINAL REPORTS**

**Reporting Periods:** The first annual Progress Report covers the entire period up to the anniversary date of this Grant award. The second and subsequent reports cover similar 12-month increments.

**Due Date:** Progress Reports (three copies) are due within one month of the termination of the reporting period. In addition, a comprehensive final report is due 90 days after expiration of the Grant.

**Purpose:** Progress Reports are intended to provide detailed information regarding research objectives, methods, and results during the 12-month reporting period, and a brief description of objectives and activities planned for the coming year. Progress Reports should also reflect scientific collaboration with other participating institutions and countries. The Final Report will provide comprehensive information regarding research results over the life of the project, and implications for agriculture.

**Content and Format:** The narrative section of progress and final reports will be more detailed than that of the activity report, and will include the following items.

1. Background
  - 1-2 paragraphs summarizing origin and objectives of project.
  - 1-2 paragraphs summarizing resources used and work methods, to beginning date of this reporting period (if this is not the first progress report)
2. Progress
  - 2-5 pages summarizing work during this reporting period, including
    - scientific progress
    - problems encountered
    - achievements/research findings
    - regional and international linkages developed
    - manuscripts submitted and publications (attach reprints or copies of publications)
3. Plans for Next Annual Period [PROGRESS REPORTS ONLY]
  - 1-2 pages describing next steps in research, including
    - research objectives
    - revised work plan
    - anticipated findings
    - anticipated problems
    - planned regional and international linkages

**OR**

3. Implications for Agriculture and Future Research [FINAL REPORT]
  - 1-2 pages describing the implications and recommendations for agriculture on the basis of research findings, and related research questions which have yet to be addressed.

**NATIONAL ACADEMY OF SCIENCES**  
**Board on Science and Technology**  
**for International Development**  
**Pakistan-BOSTID Agricultural Research Grants Program**

**GENERAL RECORDKEEPING REQUIREMENTS**

The following are general requirements for NAS/OIA grantees.

**DOCUMENTATION:**

1. Staff, Goods and Services -- The Principal Investigator (PI) is required to approve all hiring or appointment of staff and the ordering of all goods and/or services (travel orders, purchase requisitions, consultant agreements) to be charged to the NAS/OIA grant funds.
2. All ordering documentation (Purchase Requisitions, Purchase Orders, Staff Requests, Consultant Agreements, Travel Orders, Petty Cash Funds, Advance Payments) should have the following information (IN ENGLISH) on them:
  - (a) Indication that it is to be charged to NAS/OIA funds,
  - (b) Identification of budget category to be charged,
  - (c) PI's initials, in addition to normal institutional approval procedure.
3. All receipts documentation (Payroll Sheets, Vendor's Invoices, Travel Vouchers, Petty Cash Reimbursement Slips) should have the following information (IN ENGLISH) on them:
  - (a) Identification that it is to be charged to NAS/OIA funds,
  - (b) Identification of budget category to be charged,
  - (c) From whom goods and/or services were received,
  - (d) Signature of person who received goods and/or services,
  - (e) Amount due,
  - (f) How paid (i) if by cash: date and amount of payment, signed by person who made payment, and person who received payment,  
(ii) if by check: check number and amount, date paid,
  - (g) PI's initials (this means the PI certifies that the goods and/or services have been received and that payment can be made since they are proper charges to the NAS/OIA funds.)
4. Filing -- All the above documentation should be filed separately in a manner that allows ready access by NAS/OIA auditors and program staff.

## **NAS/OIA GENERAL RECORDKEEPING REQUIREMENTS**

Page 2

### **RECORDS**

1. **Bank Statements** -- All bank statements should be reconciled monthly with the check stubs, and the formal accounting record of deposits and checks issued. The bank statements and cancelled checks should be maintained along with the monthly bank reconciliation. Copies of the monthly bank statement should accompany the quarterly financial reports submitted to the NAS.

2. **Accounting Records** -- There should be some formal accounting record of all financial activities on the NAS/OIA grant, as follows:

- (a) approved budget by category,
- (b) actual receipts by budget category,
- (c) actual expenditure (cash and check) by budget category
- (d) bank deposits and checks issued,
- (e) advances made and advances cleared,
- (f) petty cash received and petty cash paid out.

3. **Advances** (sums paid to individuals in anticipation of expenditures) -- There should be a formal record of each advance of NAS/OIA funds. It should contain the following:

- (a) Name and signature of person receiving advance,
- (b) Date and amount paid,
- (c) Why advanced (here you can refer to document or item),
- (d) PI's authorization of advance,
- (e) Date and amount paid back and/or amount of documentation supplied,
- (f) Amount still outstanding, usually a running balance.

There should be some policy for following up on any advance which is outstanding for more than 30 days, which includes withholding of salary payment, if necessary.

4. **Petty Cash** -- There should be a petty cash receipt book which has a minimum of two copies, one of which remains in the book. Any payment in cash should be recorded in this book. Each receipt should contain at least the following information (IN ENGLISH):

- (a) Name and signature of person receiving cash,
- (b) Date and amount paid,
- (c) Name or number of NAS/OIA project,
- (d) What budget category should be charged,
- (e) PI's approval,
- (f) Who made payment.

## **NAS/OIA GENERAL RECORDKEEPING REQUIREMENTS**

Page 3

5. Monthly Reconciliations -- At the end of each month the following reconciliations should be prepared:

- (a) Bank Reconciliation
- (b) Advances Reconciliation
- (c) Petty Cash Count and Reconciliation

### **CURRENCY CONVERSION REQUIREMENTS BOSTID-PARC RESEARCH PROGRAM**

The U.S. dollar checks sent as grantee payments must be converted on the legal market in Pakistan, at a Pakistan bank, and the transaction must be recorded with an official bank receipt that indicated the dollars exchanged, exchange rate used, and Pakistan rupees received.

**PARC-BOSTID Research Program  
Project Groups**

**Molecular Biology**

**CS-PB-1**

Transfer of B.t. genes to chickpeas for pod-borer resistance (F.M. Khan, Centre for Advanced Molecular Biology (CAMB), University of Punjab, Lahore)

**CS-PB-8**

Construction of a linkage map and identification of disease resistance genes in Brassica (A. Sohial, CAMB, University of Punjab, Lahore)

**AS-PB-9**

Control of hydropericardium syndrome (HPS) in poultry (A.H. Cheema, Animal Sciences Institute, NARC, Islamabad)

**CS-PB-20**

Development of protoplast technology for the genetic manipulation of indica rice (Y. Zafar, Nuclear Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad)

**Group Advisor:**

Dr. Peter Day, Rutgers University

**Stress Tolerance**

**CS-PB-6**

Tolerance of wheat to hypoxia and salinity (R.H. Qureshi, University of Agriculture, Faisalabad)

**CS-PB-7**

Development of salt tolerant varieties of wheat (S. Farooq, Nuclear Institute for Agriculture and Biology, Faisalabad)

**CS-PB-10**

Genetic improvement of sunflower crop for production under stress conditions (M.K. Hussain, University of Agriculture, Faisalabad)

**CS-SD-15**

Development of wheat and barley varieties with production technology for moisture deficient and saline soils in Sindh (M.R. Lodhi, Wheat Research Institute, Tandojam)

**CS-PB-19**

Contribution of biological nitrogen fixation to rice grown on salt-affected soils (K.A. Malik, NIBGE, Faisalabad)

**CS-NW-25**

Selection of cotton varieties tolerant to salinity (A.N. Khan, Gomal University, Dera Ismail Khan, NWFP)

**Group Advisor:**

Dr. William Rains, University of California, Davis

## **Integrated Pest Management**

**CS-PB-5**

Development of an integrated pest management system for cotton in Sindh (A.A. Baloch, Cotton Research Institute, Karachi)

**CS-NW-12**

Integrated insect pest management technology for muskmelon in stressed lands (G.A. Miana, Gomal University, Dera Ismail Khan, NWFP)

**CS-PB-14**

Biocontrol of chickpea pod-borer (B.A. Malik, Crop Sciences Institute, PARC, Islamabad)

**CS-SD-17**

Insect pest management in stored grain and rice crop using botanical products (G. Jilani, Tropical Agricultural Research Institute, PARC, Karachi)

**CS-NW-23**

Control strategies for Maydis leaf blight of maize (S. Ahmad, NWFP Agricultural University, Peshawar)

**Group Advisor:**

Dr. David Ferro, University of Massachusetts at Amherst

## **Water and Range Management**

**SS-BL-3**

Water-harvesting to enhance crop production in Highland Balochistan (B.R. Khan, AZRI (PARC), Quetta)

**AS-BL-4**

Improved management of indigenous breeds of sheep in highland Balochistan (S. Rafique, AZRI (PARC), Quetta)

**SS-PB-11**

Development of resource management strategies to raise productivity of eroded areas and watersheds (S. Ahmad, Natural Resources Institute, NARC, Islamabad)

**CS-SD-13**

Selection of mesquite for production of grazable biomass and fuelwood in stressed land (R. Ahmad, University of Karachi)

**CS-PB-26**

Manipulation of Dera Ghazi Khan rangeland to improve the productivity of local livestock (M.F.U. Khan, NARC, Islamabad)

**Group Advisor:**

Dr. Dean Anderson, New Mexico State University, Las Cruces

## Soil Fertility

SS-PB-2

Conjunctive use of water from varying quality sources on salt affected land (T. Hussain, University of Agriculture, Faisalabad)

SS-PB-16

Potassium and ammonium dynamics in soil and the implications for fertility management (M.S. Akhtar, Soil Mineralogy Laboratory, NARC, Islamabad)

SS-NW-21

Developing a fertility management system for eroded lands (A. Bhatti, NWFP Agricultural University, Peshawar)

CS-NW-22

Crop management practices for improving crop productivity and soil fertility on marginal lands (M. Hatam, NWFP Agricultural University, Peshawar)

CS-NW-27

Development and transfer of farming systems for the Rod-Kohi area (H.U. Khan, Gomal University, Dera Ismail Khan, NWFP)

Group Advisor:

Dr. James Oster, University of California, Riverside

## CONSULTANT AND GRANTEE RESEARCH VISITS

All projects were visited regularly by group advisors and BOSTID staff. In addition, many projects were visited by consultants with specific expertise, and most projects included at least one grantee research visit.

### GRANT #1

The following grantee visits were made:

- Dr. Riazuddin spends 2 months each year at the University of Washington, Seattle, where he has a rich collaboration;
- Dr. Tayyab Husnain visited Dr. Milton Gordon, Department of Biochemistry, University of Washington, Seattle (August 6-November 30, 1993).

### GRANT #2

There was a consultant visit by Dr. James Rhoades, Director, U.S. Salinity Laboratory, Riverside, California, to Faisalabad (February 8-17, 1994). There was also a grantee visit by Dr. Tahir Hussain to Water Management Laboratory (Dr. James Ayars), Fresno, California; Department of Soil and Environmental Sciences (Dr. James Oster), University of California, Riverside; the U.S. Salinity Laboratory (Dr. James Rhoades), Riverside; and the University of California (Dr. Steven Gratten), Davis (August 17-September 2, 1993).

### GRANT #3

There were consultant visits:

- Dr. B. A. Stewart, Dryland Agriculture Institute, Canyon, Texas, to AZRI, Quetta (February 21-26, 1993)
- Dr. John Stednick, Earth Resources Department, Colorado State University, Fort Collins, to AZRI, Quetta (January 2-15, 1994)

There was also a grantee visit by Dr. Zahid Ali Qureshi to Dryland Agriculture Institute (Dr. B.A. Stewart), West Texas A&M University, Canyon, and to the Biological and Irrigation Engineering Department (Dr. Lyman S. Willardson), Utah State University, Logan (January 25-February 2, 1994).

The researchers also collaborated in the collection of weather data (BOSTID-PARC Project #4) and in the measurements of runoffs (BOSTID-PARC Project #11).

### GRANT #4

There was a consultant visit by Dr. David Thomas, Department of Meat and Animal Science, University of Wisconsin, Madison, to AZRI, Quetta (November 14-24, 1992).

There were also two grantee visits:

- Dr. Shahid Rafique to the U.S. Sheep Experiment Station (Dr. James A. Fitzgerald), Dubois, Idaho (August 8-27, 1993)
- Dr. Inam-Ul Haq to Texas A&M University, San Angelo (Dr. Millard Calhoun, ARS/USDA); to the Department of Animal Sciences (Drs. John Glenn, Dan Brown, and Eric Bradford), University of California, Davis; and to the Hopland Research and Extension Center, University of California, Hopland, California (March 12-26, 1994)

### GRANT #5

Grantee visits were made by Drs. Ahmed Ali Baloch and Ali Mohammed Kalroo to (1) the Methods Development Laboratory of the Animal and Plant Health Inspection Service (Drs. Bob Staten and Fred Stewart) and the Insect Biological Control Research Laboratory, Western Cotton Research Center (Drs. Thomas J. Hennebury and Alan Cohen), U.S. Department of Agriculture in Phoenix, Arizona; (2) the Brawley USDA Irrigated Desert Research Station in El Centro, California; and (3) the APHIS cotton insects research and rearing teams in Weslaco and Mission, Texas (Drs. Edgar King and Ray Curruthers) (March 11-28, 1994).

### GRANT #6

There was a consultant visit by Dr. Michael Shannon, U.S. Salinity Laboratory, Riverside, California (April 13-24, 1993). A grantee visit was made by Dr. Shafqat Nawaz to the Department of Agronomy and Range Science (Dr. D. William Rains), University of California, Davis (October 24-November 5, 1993). Dr. Shafqat Nawaz also attended the American Society of Agronomy meeting, Cincinnati, Ohio (November 6-12, 1993).

#### **GRANT #7**

There was a consultant visit by Dr. Michael Shannon, U.S. Salinity Laboratory, Riverside, California (April 13-24, 1993). There was also a grantee visit by Mr. Tariq Mahmud Shah to the Department of Agronomy (Dr. Lane Rayburn), University of Illinois, Urbana (July 10-September 12, 1993). In addition, Dr. Shafqat Farooq attended the 17th International Congress of Genetics, Birmingham, England (August 13-29, 1993).

#### **GRANT #8**

There was a consultant visit by Dr. Vic Knauf, Calgene, Davis, California, to Lahore (October 21-November 2, 1992).

#### **GRANT #9**

There were two grantee visits:

- Dr. Khalid Naeem to the Diagnostic Virology Laboratory of Dr. B. Panigrahy at the National Veterinary Services Laboratories in Ames, Iowa (July 24-August 20, 1993).
- Dr. Ashiq Cheema to the Wiley Laboratory (Dr. Barrett S. Cowen), Department of Veterinary Science, The Pennsylvania State University, State College (August 29-September 26, 1993).

#### **GRANT #10**

There was a consultant visit by Dr. Michael Shannon, U.S. Salinity Laboratory, Riverside, California (April 13-24, 1993). There was also a grantee visit by Dr. Medhet Kamil Hussain to North Dakota State University (Dr. A. Schneider), Fargo, and the U.S. Salinity Laboratory (Dr. Michael Shannon), Riverside, California (November 27 - December 25, 1992).

#### **GRANT #11**

There was a consultant visits by Dr. John Stednick, Department of Earth Resources, Colorado State University, Fort Collins, to Islamabad (January 2-13, 1994). A grantee visit was made by Dr. Shahid Ahmad to the Earth Resources Research Center (Dr. John Stednick) of Colorado State University, Fort Collins; to The Center for Advanced Decision Support for Water and Environment Systems at the College of Engineering and Applied Science of the University of Colorado, Boulder; and to the U.S. Department of Agriculture's South West Watershed Research Laboratory (Dr. Dave Goodrich) in Tucson, Arizona (January 15-February 1, 1994).

#### **GRANT #12**

Two grantee visits were made:

- Dr. G. A. Miana to the Florist and Nursery Crops Laboratory (Dr. James C. Locke) and the Sustainable Systems Laboratory (Dr. Aref A. Badul Baki), U.S. Department of Agriculture (USDA), Beltsville, Maryland; and the Food and Feed Safety Research Laboratory (Dr. Deepak Bhatnagar) USDA, New Orleans, LA (March 12-26, 1994).
- Dr. Said Mir Khan to the University of Hawaii (Drs. Diane Ullman of the Department of Entomology and C.S. Tang of the Department of Environmental Biochemistry) and the USDA Tropical Fruit and Vegetable Research Laboratory on Hilo; and to the Department of Horticulture (Dr. Jules Janick and Dr. James Simon), Purdue University, Lafayette, Indiana, as well as the Indiana Muskmelon Extension Research Station (March 11-28, 1994).

#### **GRANT #13**

A consultant visit was made by Dr. Peter Felker of the Center for Semi-Arid Forest Resources, Texas A&I University, Kingsville, to the University of Karachi (October 8-11, 1992).

There were also several grantee visits:

- Dr. Rafiq Ahmad to the Center for Semi-Arid Forest Resources (Dr. Peter Felker), Texas A&I University, Kingsville (July 31-August 16, 1993)
- Dr. Shoaib Ismail to the U.S. Salinity Laboratory (Dr. James Poss), Riverside, California; the Water Management Research Laboratory (Drs. Gary Banuelos and Clarence Finch), U.S. Department of Agriculture, Fresno, California; the Department of Food and Agriculture (Dr. Vashek Cervinka), University of California, Davis; the Desert Legume Project (Drs. Matt Johnson and R. Phillip Upchurch) and San Pedro Mesquite Company, Tucson; the Department of Plant Sciences (Dr. James O'Leary) and Office of Arid Land Studies (Dr. Ken Foster), University of Arizona, Tucson; and Texas Kiln Products in Bastrop and Mesquite Products of Texas in Bulverde, Texas (April 17-May 2, 1994)

- Drs. Rafiq Ahmad and Shoaib Ismail to the Zayed Arid Zone and Environmental Research Centre (Dr. Ahmed Al-Masoum), Al-Ain University, and the Ministry of Agriculture and Fisheries (Dr. Hashim), Dubai, United Arab Emirates; the Arid Zone Research Centre (Dr. Shahta O. Al-Khatieb) of Gulf University and the Biology Department (Dr. Jameel Abbas) of Bahrain University, Bahrain; and the Ministry of Agriculture (Mr. Ali Hashim, Director, Soil and Water Section), Doha, Qatar (May 28-June 6, 1994)

In addition, Dr. Rafiq Ahmad attended the International Conference on Desert Development, Mexico City (July 22-30, 1993).

#### **GRANT #14**

A grantee visit was made by Dr. Khalique Ahmed to Dr. David Riley, Texas A&M University, Weslaco, Texas (November 2-22, 1993).

#### **GRANT #15**

This grant was visited regularly by the group advisor but additional travel was not funded.

#### **GRANT #16**

A grantee visit was made by Dr. M. Saleem Akhtar to the Department of Soil and Crop Sciences (Dr. Joe Dixon), Texas A&M University, College Station (December 4, 1993-January 13, 1994). In addition, Dr. M. Saleem Akhtar attended the 10th International Clay Conference, Adelaide, Australia (July 18-26, 1993).

The researchers also determined bulk density and moisture changes due to tillage treatments for Project #27.

#### **GRANT #17**

Two grantee visits were made:

- Dr. Noor Ullah to the University of Hawaii (Drs. Diane Ullman of the Department of Entomology and C.S. Tang of the Department of Environmental Biochemistry) and the U.S. Department of Agriculture (USDA) Tropical Fruit and Vegetable Research Laboratory on Hilo; and to the Department of Horticulture (Dr. Jules Janick and Dr. James Simon), Purdue University, Lafayette, Indiana (March 11-28, 1994).
- Dr. S.A.R. Kazmi to the Florist and Nursery Crops Laboratory (Dr. James C. Locke) and the Sustainable Systems Laboratory (Dr. Aref A. Badul Baki), USDA, Beltsville, Maryland; and the Food and Feed Safety Research Laboratory (Dr. Deepak Bhatnagar) USDA, New Orleans, Louisiana (March 12-27, 1994).

#### **GRANT #19**

Two grantee visits were also made:

- Dr. Kauser Malik to Washington State University (Dr. Thomas Lumpkin), Pullman, and Dr. Dwight Baker, Panlabs, Seattle (November 28-December 2, 1992); also to the Department of Agronomy and Range Science (Dr. D. William Rains), University of California, Davis (December 13-15, 1992)
- Mr. Sikander Ali to the Department of Natural Sciences (Dr. William Zimmerman), Michigan State University, Dearborn (May 28-July 29, 1993)

The following conferences were attended:

- Dr. Kauser Malik to the 9th International Congress on Nitrogen Fixation, Cancun, Mexico (December 3-12, 1992)
- Mr. Sikander Ali to the 6th International Symposium on Nitrogen Fixation with Non-Legumes, Ismailia, Egypt (September 6-10, 1993)

#### **GRANT #20**

Two grantee visits were made:

- Dr. Yusuf Zafar to the International Rice Research Institute, Los Banos, Philippines (February 6-11, 1993)
- Mr. Zahid Mukhtar to the International Rice Research Institute, Los Banos, Philippines (September 1993 to May 1994).

In addition, two conferences were attended:

- Dr. Yusuf Zafar to the 6th Annual Meeting of the Rockefeller International Program on Rice Biotechnology, in Chiang Mai, Thailand (February 1-5, 1993)

- Mr. Zahid Mukhtar to the 7th Annual Meeting of Rockefeller International Program on Rice Technology, in Bali, Indonesia (May 16-20, 1994).

#### **GRANT #21**

Dr. Amanullah Bhatti visited the Dryland Agriculture Institute Workshop at West Texas A&M University, Canyon, Texas (June 6-July 1, 1994), and then the Department of Soil Physics (Dr. David J. Mulla), Washington State University, Pullman (July 2-9, 1994).

#### **GRANT #22**

The following grantee visits were made:

- Dr. Mir Hatam to the International Center for Agricultural Research in Dry Areas (ICARDA) in Aleppo, Syria (April 21-28, 1993)
- Dr. Mir Hatam and Dr. Aslam Khan to the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) in Patancheru, Andhra Pradesh, India (December 8-16, 1993)

In addition, Dr. Mir Hatam attended the Dryland Agriculture Institute Workshop at West Texas A&M University, Canyon, Texas (June 6-July 1, 1994). Dr. Mir Hatam and Dr. Aslam Khan attended the International Symposium on Pulses in Kanpur, India (December 4-8, 1993).

#### **GRANT #23**

The following grantee visit was made: Dr. Shabeer Ahmad attended the Dryland Agriculture Institute Workshop at West Texas A&M University, Canyon, Texas (June 6-July 1, 1994), and then the Department of Plant Pathology (Dr. Charles A. Martinson), Iowa State University, Ames (July 2-9, 1994).

#### **GRANT #25**

This grant was visited regularly by the group advisor but additional travel was not funded.

#### **GRANT #26**

Because of this project's perceived importance, BOSTID advisors spent a great deal of time supporting its literature (of which there is little) and data needs. In addition, the BOSTID program awarded the principal investigator a non-project-funded workshop and grantee visit to the United States: Dr. M. Fatah Ullah Khan visited the Dryland Agriculture Institute Workshop at West Texas A&M University, Canyon, Texas (June 6-July 1, 1994), and then the U.S. Department of Agriculture's Jornada Experimental Range (Dr. Dean M. Anderson), Las Cruces, New Mexico (July 2-9, 1994).

#### **GRANT #27**

The following grantee visit was made: Dr. Hamid Ullah Khan to the Department of Soil and Environmental Sciences (Dr. James Oster), University of California, Riverside; the International Center for Arid and Semiarid Land Studies (Dr. Harold Dregne), Texas Tech University, Lubbock; the U.S. Department of Agriculture Conservation and Production Research Laboratory (Dr. B.A. Stewart), Bushland, Texas; Walnut Gulch Watershed (Dr. Ken Renard), Tucson, Arizona; and the University of California at Davis (August 12-28, 1993).

In addition, Dr. Hamid Ullah Khan attended the Dryland Agriculture Institute Workshop at West Texas A&M University, Canyon, Texas (June 6-July 1, 1994).

There was also good collaboration with BOSTID Project #21 (Dr. Bhatti), which should be encouraged and continued.

## PUBLICATIONS

The following papers have been prepared for publication, unless otherwise noted:

**GRANT #1**

"Use of *Bacillus thuringiensis* Pesticidal Genes in Breeding Plant Resistance." Other papers will be submitted for publication.

**GRANT #2**

"Conjunctive Use of Water from Good and Poor-Quality Sources to Extend Irrigated Area and Reduce Disposal Problem in Salt-Affected Soils."

The following dissertations have also been generated by this research:

- Akhtar, M.A. 1994. *Strategies for the Utilization of Brackish Groundwater for Crop Production*. Ph.D. Thesis (in preparation). Department of Soil Science, University of Agriculture, Faisalabad.
- Mahmood, A. 1994. *Cyclic vs. Blended Use of Canal and Brackish (Tube Well) Waters for Crop Production*. M.Sc. Thesis. Department of Soil Science, University of Agriculture, Faisalabad.
- Qaiser, M.A. 1994. *Effect of Cyclic Use of Brackish Water on the Yield and Quality of Sugarcane*. M.Sc. Thesis. Department of Soil Science, University of Agriculture, Faisalabad.
- Hussain, N. 1994. *Amelioration of Brackish Water through Organic and Chemical Amendments*. Ph.D. Thesis (in preparation). Department of Soil Science, University of Agriculture, Faisalabad.

**GRANT #3**

"Micro-catchment Water Harvesting to Increase Soil Moisture and Crop Production in Balochistan."

**GRANT #4**

- "Effect of Feeding Low and High Protein Rations on the Performance of Balochi Lambs under Intensive Feedlot Conditions"
- "Ewe and Lamb Performance as Influenced by Supplemental Feeding During Breeding, Late Gestation and Early Lactation in Highland Balochistan"
- "Monitoring of On-Farm Performance of Balochi and Harnai Sheep and Goats Raised under Traditional Management in Highland Balochistan"
- "Assessing the Fattening Potential, under Intensive Feedlot Conditions, of Balochi and Harnai Lambs Fed Two Energy Levels in Highland Balochistan"

**GRANT #5**

- "Integrated Pest Management in Cotton in Sindh, Pakistan: I. Natural Enemies of Insect Pests"
- "Development of Integrated Pest Management in Cotton in Sindh, Pakistan: II. Control by Management"

**GRANT #6**

- "Effect of Salinity and Hypoxia on Wheat Growth and Ionic Relations: A Greenhouse Study"
- "Comparative Physiology and Root Anatomy of Two Wheat Varieties Exhibiting Differential Growth Response to Salinity and Hypoxia"

**GRANT #7**

- "Production and Evaluation of Salt-Tolerant Wheat Germplasm Derived Through Crosses Between Wheat (*Triticum aestivum* L.) and *Aegilops cylindrica*. I. Production of Salt-Tolerant Wheat Germplasm"
- "Production of Salt-Tolerant Wheat Germplasm Through Crossing Cultivated Wheat with *Aegilops cylindrica*. II. Field Evaluation of Salt-Tolerant Germplasm"
- "Identification of Different Wheat Genotypes Through Polymorphism Based on Random Amplified Polymorphic DNA (RAPD)"

**GRANT #8**

"Integrated Pest Management in Brassica."

#### GRANT #9

- "Immunosuppressive Potential and Pathogenicity of an Avian Adenovirus Isolate Involved in Hydropericardium Syndrome in Broilers"
- "A Study on Lateral Spread of Aetiologic Agent(s) of Hydropericardium Syndrome in Broiler Chickens"

#### GRANT #10

The following papers have been published:

*Science International* 5(2):203-205, 1993:

- "Breeding Sunflower for Salt Tolerance: Genetic Variability for Seedling Vigor and Salt Tolerance in Sunflower (*Helianthus annuus* L.)"

*Proceedings*, All Pakistan Scientific Conference, 1992, Khanspur:

- "Breeding Sunflower for Salt Tolerance: Effect of Salinity on Growth and Development of Cultivated Sunflower (*Helianthus annuus* L.)"
- "Breeding Sunflower for Salt Tolerance: Genetic Variability for Yield and Yield Components for Salt Tolerance in Sunflower (*Helianthus annuus* L.)"

*Proceedings*, International Seminar on Seed, December 1992, Islamabad:

- "Breeding Sunflower for Salt Tolerance: Association of Seed Quality to Salt Tolerance in Sunflower (*Helianthus annuus* L.)"
- "Breeding Sunflower for Salt Tolerance: Physiological Basis for Salt Tolerance in Sunflower (*Helianthus annuus* L.) at Flower Initiation"

The following papers have been accepted for publication:

*Proceedings*, 2nd All Pakistan Scientific Conference, December 1993, Lahore:

- "Breeding Sunflower for Salt Tolerance: Physiogenetic Mechanism of Salt Tolerance in Sunflower (*Helianthus annuus* L.)"
- "Breeding Sunflower for Salt Tolerance: Association of Seedling Growth and Mature Plant Traits for Salt Tolerance in Cultivated Sunflower (*Helianthus annuus* L.)"

*Science International*:

- "Breeding Sunflower for Salt Tolerance: Physiological Basis for Salt Tolerance in Sunflower (*Helianthus annuus* L.) at Seedling Stage"

#### GRANT #11

"Reducing Water Seepage from Earthen Ponds: A Few Options."

The following paper has been published: Shafiz, M., A. Hassan, and S. Ahmad. 1994. "Soil Physical Properties as Influenced by Induced Compaction under Laboratory and Field Conditions." *Soil and Tillage Research* 29:13-22.

#### GRANT #12

"Population Dynamics and Control of Melon Fruit Flies at Dera Ismail Khan."

#### GRANT #13

- "Effect of Salinity on Growth of *Rhizobium* spp., Nodulation and Height of *Prosopis* Species"
- "Screening of Mesquites (*Prosopis* spp.) for Biomass Production in Barren Sandy Areas Using Highly Saline Water for Irrigation"

#### GRANT #14

- "Modified Artificial Diet for Mass Rearing of Chickpea Pod Borer, *Helicoverpa (Heliothis) armigera* (Hübner)"
- "Susceptibility of Larval Instars of *Helicoverpa (Heliothis) armigera* (Hübner) to HD-1-S-1980 and Relative Toxicities of Commercial *Bacillus thuringiensis* Berliner"

There have also been a large number of papers prepared for PARC.

#### GRANT #15

The following paper has been prepared for publication but will require additional seasons of data: "Development of Wheat and Barley Varieties for Rotation with Rice in Moisture-Deficient and Saline Soils of Sindh."

#### GRANT #16

- "Potassium Release Characteristics of Sand and Silt in Relation to Mineralogy: I. Selected Mollisols, Vertisols, and Inceptisols"
- "Potassium Release Characteristics of Sand and Silt in Relation to Mineralogy: II. Selected Alfisols and Aridisols"
- "Clay Mineral Composition and Characteristics of Soils in Relation to Potassium Chemistry: I. Mollisols and Vertisols"

#### GRANT #17

- "Repellency and Growth Inhibitory Effects of Indigenous Plant/Marine Animal Extracts Against Red Flour Beetle, *Tribolium castaneum* (Herbst) Coleoptera: Tenebrionidae"
- "Evaluation of Some Plant Extracts/Products Against White-Backed Plant Hopper, *Sogatella furcifera* (Horvath) Infestation on Rice"
- "Farm-Level Evaluation of Some Botanical Products as Protectants of Stored Rice Against Insect Attack"

#### GRANT #19

"Role of N<sub>2</sub>-Fixing and Growth Hormone-Producing Bacteria in Improving Growth of Wheat and Rice."

In addition, research presentations were made at the following conferences:

- International Congress on Nitrogen Fixation, Cancun, Mexico, December 1992
- 6th International Symposium on Nitrogen Fixation with Non-Legumes, Ismailia, Egypt, September 1993
- International Symposium on Biotechnology for Sustainable Development, Faisalabad, Pakistan, December 1993

#### GRANT #20

The project resulted in the following publications and presentations:

- "Transgenic Rice--A reality within reach" (abstract)
- "Establishment of Regeneration of Calli and Cell Suspension Line of Basmati Rice (*Oryza sativa* L. cv B.370)," in *Pakistan Journal of Botany*
- "In-vitro studies of wild rice: Development of cell and protoplast cultures of *Oryza glaberrima* Stend.," paper presented at the 3rd National Meeting of Plant Tissue Culture, August 2-5, 1993, Baragali, Pakistan
- "Development of In-Vitro Techniques for the Improvement of Local Indica Rice," *Proceedings of the International Symposium on New Genetical Approaches to Crop Improvement* (in press)
- "Micro Calli from Basmati 370 (*Oryza sativa* L. cv. Basmati B.370) Protoplasts," *Pakistan Journal of Scientific and Industrial Research* (submitted)

#### GRANT #21

"Using Geostatistics in Soil Fertility Research on a Field Scale."

#### GRANT #22

"Response of Wheat and Chickpea to Organic and Inorganic Manures in Rainfed Agriculture."

#### GRANT #23

"Synergistic Effect of Cultivar Type and Fungicide on Southern Leaf Blight and Yield in Corn."

#### GRANT #25

"Selection of Cotton Varieties Tolerant to Salinity."

#### GRANT #26

"Manipulation of a Highly Degraded Rangeland To Improve the Production of Forage and Livestock." Once more seasons of data have been analyzed, the group will submit this paper for publication in a referred journal, such as the *Journal of Range Management* or *Journal of Arid Environments*, as well as in Pakistani journals.

#### GRANT #27

"Pre-flooding Tillage Influences on Wheat and Chickpea Production in a Semi-arid Climate of Pakistan."

**EQUIPMENT PURCHASED BY BOSTID**  
(Major equipment items individually valued at more than \$1,000)

**GRANT #1**

- Beckman Instruments, Inc., rotor assemblies for centrifuge (3)
- New Brunswick Scientific Co. gyrotory shaker with accessories

**GRANT #2**

- Perkin-Elmer International atomic absorption spectrometer (with accessories and software)
- AST Research, Inc. computer with software and mouse
- Lexmark laser printer

**GRANT #3**

- Sentry depth moisture gauge with accessories
- Ohaus Scale Corporation balance

**GRANT #4**

- Labconco Corporation crude fiber apparatus
- Isotemp oven with shelf
- Fisher Scientific balance

**GRANT #5**

- AST Research, Inc., computer with software and mouse
- Lexmark laser printer with warranty

**GRANT #6**

- Energy Beam Sciences rotary microtome
- Energy Beam Sciences plastic sectioning kit for rotary microtome
- Energy Beam Sciences knife holder for rotary microtome

**GRANT #7**

- Stratagene still video system
- Hotpack growth chamber
- Jouan, Inc. refrigerated centrifuge
- Fisher Scientific analytical balance with interface
- VWR Scientific refrigerated circulating bath
- Stratagene transilluminator for still video system

**GRANT #8**

- The Baker Company vertical laminar flow hood with Class II safety cabinet
- Hoefer Scientific Instruments fluorometer with accessories
- Bio-Rad Laboratories Trans-Blot semi-dry cell system with power supply
- Bio-Rad Laboratories power supplies for Bio-Rad equipment (2)

**GRANT #9**

- Miles Inc. cryostat with microtome
- Jouan, Inc. refrigerated centrifuge
- Hoefer Scientific Instruments power supply for electrophoresis unit
- Shelton Scientific, Inc. microcentrifuge with rotor
- Fotodyne Incorporated photophoresis documentation station

**GRANT #10**

- Li-Cor Inc. portable leaf area meter
- Buchler digital chloridometer
- Buck Scientific, Inc. flame photometer
- Standard Industries, Inc. sunflower thresher
- Isotemp oven with additional shelves

**GRANT #11**

- AST Research, Inc. computer Premium Server 4/33
- Houston Instruments plotter
- Universal Automation Systems universal positioning system (UPS) w/standard peripherals and software
- Compucom external hard drive for computer
- Lexmark laser printer with warranty
- Epson scanner with adapter kit
- Connor tape drive for computer
- Heinrich plate tamper soil compactor

**GRANT #12**

- Perkin-Elmer International HPLC liquid chromatograph
- Perkin-Elmer International HPLC liquid chromatograph accessories kit
- Perkin-Elmer International HPLC liquid chromatograph detector
- Hotpack environmental chamber
- Labline environmental chambers (3)
- Advance American Technologies computer 486/66
- Cole-Parmer Instrument Company analytical balance
- Forestry Suppliers, Inc. insect drawers (24)

**GRANT #13**

- Geonics Limited ground conductivity (salinity) meter
- Li-Cor Inc. portable leaf-area meter
- Precision Systems micro-osmometer
- Li-Cor Inc. transparent conveyor belt
- AIRMAD plant water potential apparatus

**GRANT #14**

- Hotpack environmental chamber
- AST Research, Inc. computer with software and mouse
- Lab-Line Instruments plant growth chamber
- Lexmark laser printer with warranty
- Waring blender/stirrer

**GRANT #15**

No equipment was purchased for this project.

**GRANT #16**

- Labconco Corporation freeze-dry system
- Branson cell disruptor
- Lexmark laser printer with memory upgrade, software & warranty
- Fisher Scientific ion-selective electrodes (Ca & Mg, K, Na, Cl, and Reference)
- VWR Scientific vacuum pump for freeze dryer system
- Beckman thermocouple for infrared spectrophotometer

**GRANT #17**

- Jouan, Inc. refrigerated centrifuge
- Labconco Corporation freeze-dry system
- Welch vacuum pump for freeze-dry systems (2)

**GRANT #19**

- Leica, Inc. microtome with quick-release clamp
- Labconco Corporation still
- Wheaton autostill
- AST Research, Inc. computer with software and mouse
- Cole-Parmer Instrument Company shaker bath
- Cole-Parmer Instrument Company spectrophotometer
- Hewlett-Packard scanner

- Cole-Parmer Instrument Company one channel recorder
- VWR Scientific pH meter
- Lab-Line Instruments orbital shaker

**GRANT #20**

- BTX Inc. electroporation system
- Eberbach Corporation rotary shaker

**GRANT #21**

- Advance American Technologies computer 486/66

**GRANT #22**

- Advance American Technologies computer 486/66

**GRANT #23**

- Advance American Technologies computer 486/66

**GRANT #25**

- Buck Scientific, Inc. flame photometer with filter
- Buck Scientific, Inc. air compressors (2)

**GRANT #26**

- Advance American Technologies computer 486/66

**GRANT #27**

No equipment was purchased for this project.