PD-ABG-402
83333

MID-TERM EVALUATION REPORT

PLANT GENETIC RESOURCES (PGR) PROJECT

PROJECT No: 386-0513

IQC Contract No. PDC-1406-I-00-0034-00
Delivery Order No. 14

Prepared for USAID/India

Prepared by:

Dr. Peter H. Van Schaik, Team Leader
Dr. Ken Rachie
Dr. J.S. Kanwar
Dr. N.G.P. Rao

International Resources Group Ltd.
1400 I Street, N.W., Suite 700
Washington, D.C. 20005

June 1993

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 1
- 1.1 The Project 1
- 1.2 Project Purpose 1
- 1.3 Evaluation Purpose 1
- 1.4 Evaluation Methodology 2
- 1.5 Findings and Conclusions 2
- 1.6 Principal Recommendations 4

2. BACKGROUND 6
- 2.1 The Need 6
- 2.2 The PGR Project 7

3. EVALUATION OUTCOMES 10
- 3.1 Gene Bank and Related Activities 10
  - 3.1.1 Findings 10
    - 3.1.1.1 Exploration, Collection and Characterization 10
    - 3.1.1.2 Germplasm Introduction and Exchange 11
    - 3.1.1.3 Plant Quarantine 12
    - 3.1.1.4 Conservation of Germplasm: Construction of National Gene Bank/NBPGR Headquarters Building 12
    - 3.1.1.5 Germ Plasm Evaluation and Utilization 13
    - 3.1.1.6 National Facility for Plant Tissue Culture Repository (NFPTCR) 13
    - 3.1.1.7 Collaborative Research 14
    - 3.1.1.8 Training/Professional Development 15
    - 3.1.1.9 Technical Assistance 16
    - 3.1.1.10 Data Base Management 16
    - 3.1.1.11 Germplasm Advisory Committees 17
    - 3.1.1.12 Recommendations 17
- 3.2 Plant Quarantine Stations and Greenhouse/Screenhouse Facilities 21
  - 3.2.1 Present Status and Plans 21
  - 3.2.2 Findings and Recommendations 22
- 3.3 Equipment 25
  - 3.3.1 Present Status 25
  - 3.3.2 Findings and Recommendations 27
- 3.4 Operational Considerations 28
- 3.5 Financial 30

4. ATTACHMENTS

4.1 Logical Framework
4.2 Scope of Work
4.3 Methodology
4.4 Team Members
4.5 Places and Persons Visited
4.6 NBPGR, Map of all locations of the Indian PGR system
4.7 NBPGR, Organizational Chart
4.8 NBPGR, Functional and Crop Responsibilities by Location
4.9 NBPGR, List of Crops and stations
4.10 NBPGR, Germplasm Explorations and Collections
4.11 NBPGR, Germplasm Exchange
4.12 NBPGR, Plant Quarantine Inspection
4.13 NBPGR, Active Germplasm Holdings
4.14 NBPGR, Current Holdings of 30 Crops by Location
4.15 NBPGR, Germplasm Accessions in Long-term Storage
4.16 NBPGR, Germplasm Accessions Supplied, by Crops
4.17 NBPGR, Training Programs Organized in India
4.18 NBPGR, Scientists Trained in U.S.A.
4.19 NBPGR, U.S. Consultants to India
4.20 Some Thoughts on Germplasm Policies and Procedures
4.21 NBPGR, Lists of Tranche I, II and III Equipment
4.22 NBPGR, Equipment Support to Cooperating Centers
4.23 PGR Project, Expenditures as of March 31, 1993
4.24 PGR Project, Summary of Project Costs
4.25 Documentation

PREFACE

It was extremely fortunate and timely that the Indo-U.S. Sub-commission on Agriculture identified Plant Germplasm Resources Conservation as a high priority subject for collaboration between two countries which have major interests in plant biodiversity.

Major steps have been taken in this joint effort to establish in India a fully functional infrastructure to enable it to collect, preserve and make available for worldwide use its rich biodiversity of many crops and their wild relatives.

Much remains to be done. This mid-term review was done to evaluate progress to-date and recommend some future actions.

The evaluation team commends the GOI and USAID for their activities; also USDA-OICD and Winrock International for considerable dedication and contribution.

The team is particularly indebted to Dr. R.S. Rana, Director, NBPGR, for his enthusiastic and capable leadership, his hospitality and informative guidance and the comprehensive Status Report he prepared for our use.

The team also gratefully acknowledges the courtesies and hospitalities extended at the locations we were able to visit.

P.V.S
K.O.R.
J.S.K.
N.G.P.R.

ACRONYMS

INDIAN INSTITUTIONS

CAC	Crop Advisory Committees
CARI	Central Agricultural Research Institute
CPRI	Central Potato Research Institute
CPWD	Central Public Works Department
CRRI	Central Rice Research Institute
DARE	Department of Agricultural Research and Education
GAC	Germplasm Advisory Committee
GOI	Government of India
ICAR	Indian Council of Agricultural Research
IARI	Indian Agricultural Research Institute
NBPGR	National Bureau of Plant Genetic Resources
NFFTCR	National Facility for Tissue Culture Research
NGAB	National Germplasm Advisory Board

U.S. INSTITUTIONS

APHIS	Animal and Plant Health Inspection Service
ARS	Agricultural Research Service (USDA)
FAR	Federal Acquisition Regulations
FERRO	Far East Regional Research Office (USDA)
GRIN	Genetic Resource Information Network
NPGRS	National Plant Genetic Resource System
NSSL	National Seed Storage Laboratory
OICD	Office of International Cooperation and Development (USDA)
USAID	United States Agency for International Development, India
USDA	United States Department of Agriculture

INTERNATIONAL AGENCIES

CGIAR*	Consultative Group on International Agricultural Research
IARC	International Agricultural Research Centers
IBPGR	International Board of Plant Genetic Resources
SAARL	South Asian Association for Regional Cooperation
TAC	Technical Advisory Committee of CGIAR
WINROCK	Winrock International Institute for Agricultural Development

*CGIAR centers include: IRRI, CIMMYT, CIAT, CIP, ICRISAT, ICARDA, ILRAD, ILCA, ISNAR, IFPRI, IBPGR, and WARDA.

GENERAL

AICCIP	All-India Coordinated Crop Improvement Project
ARP	Agricultural Research Project
CRI	Commodity Research Institute
MSS	Management Support Services
NMIC	Not Manufactured in India Certificate
NRC	National Research Center
PACD	Project Assistance Completion Date
PASA	Participating Agency Service Agreement
PIU	Project Implementation Unit
PSC	Personal Services Contract
SAU	State Agricultural University

PLANT QUARANTINE GREENHOUSES

GH-PP-EC	Greenhouse-Plant Propagation-Evaporation Cooling
GH-VI-EC	Greenhouse-Virus Indexing-Evaporation Cooling
GH-AC-EC	Greenhouse-Aircondition-Evaporation Cooling
GH-GO-EC	Greenhouse-Growout-Evaporation Cooling
PEQ	Post Entry Quarantine

PROJECT IDENTIFICATION DATA

1. **Country** INDIA

2. **Project Title** Indo-U.S. Plant Genetic Resources Project

3. **Project Number** 386-0513

4. **Project Dates** August 31, 1988 - September 30, 1995

5. **Project Funding**

a.	USAID Bilateral Funding (grant)	U.S.$14.70 million
b.	Host-Country Counterpart Funds	U.S.$ 9.25 million
	Total:	**U.S.$23.95 million**

6. **Mode of Implementation** Host country with Management Support Services Contract with Winrock International and PASA with USDA-OICD

7. **Project Designer** Government of India (ICAR) and USAID/India

8. **Responsible Mission Officials**

a.	Mission Director	Walter G. Bollinger
	Deputy Director	Steven Mintz
b.	Project Officer	D.R. Arora

9. **Previous Evaluation** None

1. EXECUTIVE SUMMARY

1.1 The Project

The Indo-US Plant Genetic Resources Project was officially initiated on August 31, 1988 with the signing of Project Documents between the Government of India, Department of Economic Affairs (DEA), Ministry of Finance and the U.S. Agency for International Development (USAID). This occurred after many earlier activities since 1984 when the Indo-US Sub-Commission on Agriculture identified plant resource conservation as a high priority area for joint collaboration. These activities included pre-project implementation under the Agricultural Research Project (ARP) with $200,000 funding for some training, technical consultations and project design work.

Due to many delays, some avoidable, some unavoidable, little was accomplished until 1991. Two notable actions were taken however which have served to accelerate activities from then on. One was the establishment of a Participating Agency Service Agreement (PASA) between USAID and the US Department of Agriculture, Office for International Cooperation and Development (USDA, OICD) to arrange for training of Indian scientists in the U.S. The other action was the Management Services Contract between USAID and Winrock International to provide technical support, oversight, and control for the design, specifications and construction of plant quarantine facilities in India and the procurement of imported scientific equipment.

The Project is to run for seven years until September 1995. Total Project support is $23.95 million, of which USAID provides $14.70 million and the Government of India $9.25 million in Rupee equivalent.

1.2 Project Purpose

The Project's purpose is to assist the GOI in establishing a fully functional infrastructure of physical facilities, trained administrative and technical staff, and equipment. The ultimate goal is to have in India a National Plant Germplasm Resources system which manages all aspects of plant germplasm exploration, collection, evaluation and preservation to preserve India's rich plant genetic diversity and to enhance India's role as a major global and regional partner in the international efforts of plant genetic resource conservation and utilization.

1.3 Evaluation Purpose

The purpose of this mid-term evaluation as outlined to the review team in the Scope of Work was to review the progress, assess the relevance and effectiveness of activities carried out, identify problems, examine the validity of the project design and assumptions made, estimate if time and resources are sufficient to achieve project

objectives, and make recommendations for mid-course corrections and for future actions to sustain the system.

A number of issues were identified in the Scope of Work related to the implementation, progress, and future actions. These have been dealt with in detail in appropriate sections of the report.

The team considers it important to note in this summary, that although the required 56 months of the project's life have passed, certainly 56 months of productive project activities have not occurred. In reality about one-half of this period lapsed due to technical problems and bureaucratic processes in the U.S. as well as within the Indian Government, causing active project implementation to be delayed until 1991.

1.4 Evaluation Methodology

The mid-term evaluation was done by a joint US/India team of four scientists (see Attachment 4.4). Extensive experience in agricultural research, plant germplasm exploration, evaluation and management as well as administration and management was evident among the team's members.

No formal methodology or approach was followed. The team used review of documents, informal discussions and interviews, visits to U.S. Institutions in Washington, DC, to NBPGR's headquarters in New Delhi and to several outlying locations in India to assess the current situation. Additionally, an Issues and Questions memorandum was sent to NBPGR Centers asking for brief notes on several of the major issues of the evaluation (see Attachment 4.3).

The report is the accumulation of all this information and the team's assessment of it.

1.5 Findings and Conclusions

The Project's goal to have in India a functioning National Plant Germplasm Resources System will, at least in principle, be achieved. This is partially due to the fact that, through the activities of the National Bureau of Plant Genetic Resources (NBPGR) and its affiliated Regional Centers and Base Stations under the direction of its dynamic Director, Dr. R.S. Rana, a basic functional system is already in place. In addition a great deal has been achieved since 1991 when project activities really got underway.

Gene Bank. The Gene Bank's construction was started in September, 1992 and barring unforseen delays should be completed by December, 1994. The team is concerned, however, that insufficient planning and design work is being done for the interior layout of furnishings with properly designed and fitted laboratory benches, storage cabinets, fixtures, outlets for power, gas, water, etc. Without this being done

advance CPWD and the Contractors will deliver buildings which will take a long time to furnish and which will not be effectively and efficiently utilized.

Greenhouses - Screenhouses - Quarantine. A contract for these facilities at three locations (New Delhi, Hyderabad, Bhowali) has been approved by the GOI and USAID and should be signed shortly by Winrock International and Donn Sharp and Son, the Contractor.

The GOI is having second thoughts about the fourth location, agreed on and planned for the Andaman Islands. After much discussion and thought, the team concluded that the GOI should accept the Andaman location. An off-shore quarantine location is of considerable importance and is critical to the PGR system's success, and the opportunity to develop good research facilities for ICAR on Andaman may be lost if the USAID assistance under the present contract is not accepted. The team did agree that the Andaman facilities may be scaled down and that if at all possible USAID should agree to the construction of some greenhouse - screenhouse facilities in Kanpur.

Equipment. There is considerable equipment to be procured, both within India and through importation. This equipment will serve to support work at the new facilities as well as at other existing locations of the NBPGR system. The team found good planning and preparation but a lack of action in procurement and delivery. An example is in the 18 planned Medium-Term Seed Storage Units and related seed handling and drying equipment. Many locations with germplasm collections have no facilities for storage at present but could accommodate the equipment. The team, therefore, urges NBPGR to proceed as quickly as possible to get this equipment in place.

The cost of all equipment items needed exceeds the allotted budget and it is hoped that additional funds can be found to meet the program's needs.

Training. After some initial problems in getting appropriate clearances for Indian scientists to go as scheduled were overcome, the U.S. training program under the USDA/PASA has proceeded smoothly and successfully, and should be completed as planned. The team has concerns about training needs beyond the PASA termination date.

In-Country Training. A number of training programs have been conducted in India in the form of workshops dealing with germplasm collection, evaluation, and maintenance and computer-based information management. A regional training program was also held in 1991 with participants from 10 countries. In-country training, both formal and hands-on, will be a significant component of the NBPGR program after physical and operational facilities are fully functional. This will involve training activities for Indian scientists and technicians as well as for participants from other countries to fulfill India's leading role in the international PGR programs.

Program Operations. The NBPGR's operational program of collection, evaluation, documentation and storage is difficult, complex and because of its size a long term undertaking. The team found a high level of ambition, enthusiasm, and progress. Collections of several crops have been rejuvenated, samples sent to NBPGR's long-term storage, and catalogs prepared. For the long-term continuity of the program the team urges NBPGR to establish active Crop Advisory Committees to develop protocols and procedures for the collection, evaluation, and documentation for all crops in the system.

Sustainability. The team concluded that NBPGR has the capability to operate a successful national germplasm system as long as the program is developed as planned, sustained GOI support is maintained for all components of the system and the NBPGR is staffed with leadership of the caliber and quality it presently enjoys. Serious consideration should be given to Dr. R. S. Rana's successor as Director as his tenure is limited to just a few more years. Because of the status of NBPGR as a center of national importance, the team suggests that the GOI consider its elevation to the status of the National Research Institutes.

Operationally, the Project's progress timetable is no longer synchronized with USAID's time frame because of delays in the early years (1988-91). Because of this, USAID's support is scheduled to terminate at the very beginning of the operational phase. USAID should therefore consider extending the PGR Project by several years during the initial years of the operational phase to protect its investments in the system, and to assure that all systems are in place and operational.

Several additional collaborative explorations and research projects have been suggested. These should be approved and funded.

1.6 Principal Recommendations

That USAID, with the concurrence of GOI, extend the PGR Project a minimum of two years, including extension of Winrock International's contract for technical assistance and management services, and USDA-OICD's PASA for training, collaborative collection and research.

That USAID and ICAR agree to proceed with construction of Greenhouse-Screenhouse-Quarantine facilities at the ICAR Station on Andaman Islands albeit on a somewhat reduced scale and that one grow-out greenhouse facility be provided at Kanpur.

That NBPGR, with technical assistance from Winrock International and using professional services, proceed as rapidly as possible with the design of interior spaces for its new facilities so that installations can take place when laboratories and offices are ready.

That NBPGR develop specific protocols and procedures for collection, evaluation and documentation for all crops in the system. The NBPGR should also categorize collections and accessions according to type: e.g. (i) collected landraces; (ii) improved varieties; (iii) wild and weedy relatives; (iv) germplasm pools (particularly for outcrossed species); and (v) special genetic stocks. Moreover, the source and type of germplasm requests should be noted to aid future strategy planning.

That NBPGR take immediate steps to procure, deliver, and install medium-term seed storage units and related seed handling equipment at all locations where such facilities are needed and can be accommodated.

That proposals for several more collaborative explorations and research projects be developed and funded particularly for medicinal crops and under-utilized crops.

Because the team's recommendations for the completion of already committed and essential facilities as well as for operational needs beyond the LOP will require considerable additional funds, the team recommends that USAID and GOI begin discussions at an early date to provide these needed resources.

That GOI seriously consider elevating the NBPGR to the status and prestige of the National Research Institutes. This will recognize its function as a truly national, coordinating and leading institution.

Details of the above recommendations and additional ones are made in specific sections of the report.

2. BACKGROUND

2.1 The Need

A rapidly growing conviction that India has a major stake in plant germplasm acquisition, conservation and development became obvious as a consequence of sporadic famines during the first half of this century and chronic shortages of cereal grains early in the second half of the 1900's. Only massive imports of food grains during the 1950's and 1960's averted a major catastrophe; but agriculture scientists, administrators and politicians recognized that India could not afford continued infusions of basic food commodities. This conviction was bolstered by intensive agricultural research which, by the mid-1960's conclusively demonstrated that improved technology properly applied could almost immediately increase productivity by up to three-fold. Extensive promotion and demonstration trials of improved technology were carried out while supplies of essential inputs were built up including improved seeds, irrigation, fertilizers and agricultural chemicals. The enthusiastic and dedicated efforts by farmers, scientists, administrators and others including foreign assistance resulted in doubling national grain production from the low-to-mid 70 million tons of the 1950's to near 180 million tons annually by the early 1990's. Unfortunately, population growth has more than kept pace with increased food production and is expected to reach or exceed 900 million by the end of 1993 or early 1994.

The present dilemma in India is that population is growing rapidly, while food production increases tend to plateau at ever diminishing increments depending on major advances in research and/or expansion of irrigation and land development schemes. In order to ensure continuing productivity increases of major crops and to create new agro-horticultural industries, there must be a continuing flow of new crops and improved germplasm into India. Recognizing this important concept, the Indian Council of Agricultural Research (ICAR) created a new institution, the National Bureau of Plant Genetic Resources (NBPGR) in 1976 with headquarters at the Indian Agricultural Research Institute (IARI), New Delhi. The NBPGR is charged with India-wide responsibilities for planning, promoting, implementing and coordinating all activities concerning plant exploration and collection, germplasm import and export, plant quarantine, evaluation and documentation of collections; and for the safe conservation of both indigenous and introduced genetic variability in crop plants and their wild relatives.

The Indian sub-continent is a primary center of origin and genetic diversity for more than 20 major economic plants, including rice, some Asian pulses, sugarcane, citrus, mango, banana, yams and several common vegetables and spices. It is also very rich in numerous medicinal and aromatic plants. It is estimated that nearly 140 domesticated species of economic importance, about 350 species of their wild relatives and over 800 species of ethnobotanical interest are native to this region and constitute

an invaluable reservoir of genetic materials needed by plant scientists for study and development, not only in India but worldwide.

2.2 The PGR Project

The new NBPGR was built on a strong foundation of the Plant Introduction Services initiated at the IARI in 1946. The NBPGR was established in 1976 with quarantine and coordinating headquarters at IARI, a 40 ha. experimental farm at Issapur (45 km west of Delhi), and a network of 12 regional centers representing the major agro-ecological environments in the country. It also has forged strong linkages with the leading Commodity Research Institutes (CRIs), National Research Centers (NRCs), All-India Coordinated Crop Improvement Projects (AICCIPs), and State Agricultural Universities (SAUs) functioning as National Active Germplasm Sites (NAGS). The NBPGR also works in close collaboration with International Agricultural Research Centers (IARC) like ICRISAT, CIMMYT, ICARDA, IRRI, IITA and the IPGRI. A particularly close linkage has been established with the International Plant Genetic Research Institute (IPGRI) which has its principal office for south and south-eastern Asia on the NBPGR campus.

The NBPGR functions through its five main divisions including: (i) Plant Exploration and Collection; (ii) Germplasm Exchange; (iii) Plant Quarantine; (iv) Germplasm Evaluation; and (v) Germplasm Conservation. The Director (at Delhi) has overall responsibility for administration, research management, and coordination. Regional Stations/Base Centers are each headed by a scientist and located at Shimla, Bhowali, Shillong, Jodhpur, Akola, Amravati, Hyderabad, Trichur, Srinagar, Ranchi and Cuttack. An additional off-shore plant quarantine station has been planned for the Andamans (Port Blair). The NBPGR has also established the National Facility for Plant Tissue Culture Repository (NFPTCR) and Cryopreservation Unit and houses three All-India Coordinated Research Projects: (i) Medicinal and Aromatic Plants; (ii) Under-utilized Plants; and (iii) Arid Legumes. The total sanctioned staff strength is 542 including 146 scientist positions (MSc/Ph.D qualifications).

Although the basic structure of the new NBPGR was installed, several aspects of its operations could not be implemented for lack of facilities. For this reason and because of mutual interest in these activities, the Indo-U.S. Sub-commission on Agriculture selected plant genetic resources conservation as a top priority area in 1984 for joint collaboration between India and the U.S.A. At the request of the Government of India, the development of a Project Paper was initiated in 1985. This was followed by nominating two design teams of American and Indian scientists to prepare project proposal documents.

The PGR Project was implemented initially as a sub-project of the joint Agricultural Research Project (ARP), but on recommendation of the ICAR and the design teams, it was decided to implement it as an independent project. In order to initiate some important activities during the long lead-time often required to complete all procedural

some important activities during the long lead-time often required to complete all procedural formalities of the two governments, an initial grant of $200,000 was provided from ARP resources to fund key project activities prior to the main implementation phase. A project grant agreement between GOI and the USAID was finally executed on 31 August, 1988 providing a fully-funded joint project with a seven-year LOP from 31 August, 1988 to 30 September, 1995. It has a $23.95 million budget jointly funded by USAID and GOI, of which USAID is underwriting approximately $15 million (up from $13.0 million originally proposed). Much of the U.S. contribution will be utilized for constructing of the National Gene Bank in New Delhi, four special quarantine greenhouses (Delhi, Bhowali, Hyderabad and Andamans) for providing equipment and cryopreservation facilities and for consultation, training and joint germplasm exploration and research projects (See Attachment 4.24). When these facilities are in place and fully operational by the end of the project it will be possible to store up to 800,000 accessions in the system. Although inevitable startup problems delayed the project timetable by about two years, considerable progress is now being made on construction, personnel appointments and acquisition of equipment at all centers. The exception is the Andamans where questions of purpose and sizing remain to be determined.

National Gene Bank. The Indian National Gene Bank was established to conserve both local and introduced germplasm collections in the form of seeds, vegetative propagules, tissue/cell cultures, embryos and germinal tissues. The first built-in cold storage vault was obtained from the U.K. in 1983. Based on the experience obtained and external support from Canada, four more modules (two units of 100 m^3 and two units of 176 m^3 capacity) have been installed at NBPGR headquarters for long term storage of crops in laminated aluminum/plastic pouches at -20°C after drying them to 5% moisture content. The electric supply is backed up by a standby diesel generator. Vegetatively propagated and recalcitrant species are being maintained in the field and as in vitro conservation and cryopreservation to the extent possible with present facilities. For the 17-year period 1976 - 1992, a total of 138,911 germplasm accessions were available in storage or maintained in the field. Moreover, a total of 1,097,775 samples had been imported "according to procedure', and 129,390 samples had been appropriately processed for export.

When completed, furnished, equipped, and operational in 1995, the National Gene Bank will represent a state-of-the-art and the finest such facility in the world. It is indeed fitting that India with such a rich heritage of economic plant germplasm spanning the tropical to temperate and subalpine environments, and with a long, proud history of agricultural research achievements have facilities appropriate to its needs. Such a facility will also be key to training of young scientists from both India and abroad.

Training and Professional Development. Eight training courses on various aspects of plant genetic resources were organized by NBPGR during 1989-93. A total of 107 participants from 31 different institutes and centers were benefitted in terms of

the NBPGR providing an opportunity to 37 participants from 19 countries to upgrade their skills and technical capabilities.

Professional development training is organized and managed jointly with OICD (Washington) and FERRO (New Delhi) under a PASA with USDA executed on 12 February, 1990. The original agreement was for one year and subsequently extended to 20 August, 1994. Under the PGR Project, 65 Indian scientists have received training in the areas of germplasm exchange, plant quarantine, exploration, collection, characterization, documentation and plant tissue culture in several USDA laboratories and U.S. universities. This includes 11 scientists who visited the U.S.A. under the $200,000 pre-project grant and nine Indian scientists currently in the United States.

Joint Explorations. Three joint explorations have been carried out: (i) sunflower exploration in the U.S.A. on 3-8 September, 1992 produced 144 accessions of nine different species; (ii) collection of jojoba in the southwest U.S.A. on 10-22 August, 1992 yielded 75 accessions; and (iii) Cucumis spp. in north central and western India on 16 October to 10 November, 1992 produced 658 accessions of several species of cucumber and melons.

Collaborative Research. Four areas for collaborative research were identified by the NPGS of the U.S. and NBPGR of India. These six-month projects are being carried out in the U.S.A. starting on March 12, 1993 and include: (i) egg plant taxonomy and evolution; (ii) characterization of Musa spp. using RAPD analysis of DNA; (iii) role of lipoxygenase and deterioration of soybean seeds; and (iv) efficient detection of virus in Prunus and Citrus budwoods to begin about July-September, 1993.

The latter two collaborative activities are particularly interesting, gratifying and productive for both India and the U.S.A. researchers. Therefore, continuing support for these joint efforts should be considered beyond the LOP.

3. EVALUATION OUTCOMES

3.1 Gene Bank and Related Activities

The function and management of gene banks include: exploration, collection and characterization of germplasm; **in situ** and **ex situ** conservation and regeneration; evaluation and pre-breeding for genetic enhancement; and documentation and germplasm resource information network.

The National Bureau of Plant Genetic Resources (NBPGR) with its eight regional stations, two exploratory base centers and 30 crop specific cooperating institutions constitutes a comprehensive network charged with the responsibility of developing a well organized national plant genetic resources system (Attachments 4.6, 4.7, 4.8 and 4.9). It is in a unique position to play a very useful and significant role in conserving biodiversity of global germplasm for crop improvement programs at the national, regional and global levels. The purpose of the Indo-US PGR Project is to strengthen the Bureau's capabilities in this direction.

3.1.1 Findings

3.1.1.1 Exploration, Collection and Characterization

Three joint explorations were undertaken under the PGR project.

i) **Exploration and collection of Jojoba germplasm in USA (August 10-22, 1992).** Dr. S. Kochar (NBPGR), Dr. I.P. Ting and Mr. H.H. Naqvi (University of California) participated. A total of 75 accessions of **Jojoba** were collected from S.E. California and S.W. Arizona.

ii) **Collection of Wild Sunflower species in USA (September 3-8, 1992).** Dr. S.S. Duhoon (NBPGR), Dr. G.J. Seiler (North Dakota), Dr. R. Marinkovic (Yugoslavia) and Ms. C. Staffer (Ames, Iowa) participated. The exploration covered the great plains region covering the States of North Dakota, South Dakota, Nebraska, Kansas, Montana, Wyoming and Colorado. A total of 144 accessions covering nine species were collected.

iii) **Exploration and Collection of Cucumbers and Melons in India (October 16-November 10, 1992).** Dr. M.N. Koppar and Dr. V.C. Srivastava (NBPGR), Dr. J.E. Staub (USDA/ARS, Wisconsin) and Dr. J. McCreight (USDA/ARA, California) participated. Explorations were undertaken in the States of Rajasthan, Madhya Pradesh and Uttar Pradesh. The following accessions were collected:

Cucumber	(Cucumis sativus)	194
Snap melons	(Cucumis melo var. momordica)	236
	(Cucumis callosus)	156
Snake cucumber	(Cucumis melo var. utilissimus)	24
Other cucumber species and vegetable crops		48
	TOTAL	658

Excellent reports with passport data have been developed and the materials are available for evaluation.

iv) NBPGR continues to make collections in India. Between 1989-90 to 1992-93, a total of 220 explorations were conducted and 33,571 accessions of different agri-horticultural crops were collected. The details are given in Attachment 4.10.

v) The NBPGR has been publishing crop inventories and germplasm catalogues of various crop plants. So far, the Bureau has published 45 catalogues. Between 1989 and 1993, it has published 8 catalogues:

International wheat/triticale materials		(1989-90)
Indigenous and exotic maize germplasm		(1991)
Evaluation of forage sorghum germplasm	- Part I	(1991)
Catalogue on okra germplasm	- Part II	(1991)
Evaluation of forage sorghum germplasm	- Part II	(1992)
Evaluation of pearl millet germplasm	- Part I	(1993)
Catalogue on okra germplasm	- Part III	(1993)

3.1.1.2 Germplasm Introduction and Exchange

Germplasm exchange activities have considerably increased during the past four years. A total of 10,400 accessions were sent abroad and 58,154 accessions distributed within the country during 1989-90 to 1992-93. Details are given in Attachment 4.11 which reflects the increased activity in this area.

Apart from introducing genetic resources of crop plants with specific attributes like biotic and abiotic stresses, there is growing tendency to lay greater emphasis on germplasm resources of crops that contribute to export promotion, fruit plants, energy yielding and medicinal plants and crops with processing attributes.

3.1.1.3 Plant Quarantine

During the four-year period (1989-90 to 1992-93) 516,878 samples were processed for quarantine clearance. The number of samples found infested with pests and weeds were 10,043 out of which 428 samples were rejected and 9,615 samples were salvaged. The details are given in Attachment 4.12.

The quarantine division has identified several plant pathogens and major insect and mite pests of quarantine importance and the techniques of their detection. Information is also available on pathogens and pests intercepted during quarantine rendering great service to the safety of the country's agriculture. In virus detection, difficulties were encountered in procuring antisera for certain viruses not found in India.

3.1.1.4 Conservation of Germplasm: Construction of National Gene Bank / NBPGR Headquarters Building

The status (March 31, 1993) of germplasm accessions in long term/medium term storage and the <u>in vitro</u> conservation program at NBPGR is given in Attachments 4.13, 4.14, 4.15.

3.1.1.4.1 <u>The National Gene Bank</u>. The National Gene Bank for long-term storage of over 800,000 samples and the Headquarters building is under construction. The building complex has four blocks - D, A, B and C. The D Block will house an underground gene bank. Construction work has progressed quite well and the shuttering of the roof is about to be completed. Block A is also underground and has two parts. One part will house the liquid nitrogen plant and the other the tissue culture and computer facilities. Work is expected to be completed soon. Block B is the machine room. Block C has no basement and will house the administrative offices.

Construction activities are on schedule. They are reviewed every month with concerned officials of NBPGR, CPWD, USAID and Winrock. The gene bank construction is expected to be completed by December 31, 1994 and the new building fully operational by end 1995.

When completed, the National Gene Bank and Headquarters building will have the following components:

I. <u>National Gene Bank</u>

i)	Seed Repository	(storage at -20°c.)
ii)	Cryo Bank	(storage at -196°c.)
iii)	Tissue Culture Repository	(10-25°c.)

II. **Laboratories and Administrative Complex**

i) Orthodox Seed National Conservation Block
ii) Tissue Culture and Cryopreservation Block
iii) Germplasm Exchange Block
iv) Plant Quarantine Block
v) Computerized PGR Data Base
vi) Director's office and common support facilities

It will have a total covered area (all floors) of 13553.84 sq.m. and has been well designed.

3.1.1.4.2 **Medium Term Storage Facilities**. Additionally, medium-term storage facilities will be augmented at various co-operating and regional stations for active collections. Plans and specifications are being developed for issuance under an Invitation for Bid (IFB) for the construction of the facilities.

3.1.1.5 Germ Plasm Evaluation and Utilization

Multi-site evaluation of germplasm through collaborative efforts with the regional and cooperating centers has been initiated and the information catalogued. Much of the evaluation data are with the crop specific centers and it will be necessary to collect the information and document it to facilitate effective use.

During the year 1992-93, a total of 1377 germplasm accessions in different crop species were supplied to 79 indentors (Attachment 4.16) out of which 24 are private sources, largely for vegetable germplasm.

Evaluation catalogues of forage sorghum and pearl millet have been published.

3.1.1.6 National Facility for Plant Tissue Culture Repository (NFPTCR)

The NFPTCR has been functioning from 1986 with support from the Department of Biotechnology. Major research areas are:

a) **In vitro** conservation of economic plants (emphasis on spices, plantation, industrial, horticultural, medicinal, aromatic and tuberous plants and wild and endangered species)

b) cryopreservation of seeds, pollen and **In vitro** cultures and studies on their genetic stability and

c) Biosystematic and evolutionary studies on plant species of Indian origin.

Useful results have been reported. The NFPTCR also trains scientists in the biotechnological approaches such as tissue culture, micropropagation, molecular approaches to germplasm enhancement and cryopreservation.

3.1.1.7 Collaborative Research

Four areas for collaborative research with National Plant Germplasm System (NPGS) of USDA, the USDA/ARS and U.S. universities have been identified. Three NBPGR scientists left India on March 12, 1993 to start collaborative research in the U.S. for a period of six months. The three areas in which collaborative research has begun include :

I) Collaborative Studies of Egg Plant Taxonomy and Evolution

U.S. Principal Investigator - Dr. L.D. Gottleib, Professor of Genetics, University of California, Davis, CA 95616

Indian Principal Investigator - Dr. J.L. Karihaloo, Senior Scientist, NBPGR, New Delhi

II) Use of Random Amplified Polymorphic DNA (RAPDs) for Characterization of *Musa* Germplasm Diversity and Stability

U.S. Principal Investigator - Dr. R.L. Jarret, Southern Regional Plant Introduction Station, Griffith, Georgia

Indian Principal Investigator - Dr. K.V. Bhatt, Scientist, NBPGR, New Delhi

III. Physiological and Chemical Attributes of Deterioration in Soybean Seeds with and without the Enzyme Lipoxygenase

U.S. Principal Investigators - Dr. Eric E. Roos and Dr. Christina W. Vetuccii, USDA-ARS, NSSL, Fort Collins, Colorado

Indian Principal Investigator - Dr. Kalyani Srinivasan, Plant Physiologist, NBPGR, New Delhi

The duration of each project will be one year. After working together for six months on the project, each of the two collaborating scientists will work in their respective laboratories for additional six months before the preparation of the final report.

Technical program for the fourth collaborative project "Efficient detection of viruses and therapeutic treatments relevant to ***Citrus*** and ***Prunus*** budwoods" has been drawn up by NBPGR. Dr. D.B. Parakh, Scientist, NBPGR has been identified as the Indian Principal Investigator. The U.S. Principal Investigator is being identified. The collaborative research is likely to begin during July-September 1993.

3.1.1.8 Training/Professional Development

3.1.1.8.1 Training within the Country

a. National Level. Between 1989-93, eight training courses were organized: one on exploration, evaluation and conservation; one on germplasm exchange and plant quarantine; and six on documentation and information management. A total of 107 participants benefitted from these programs.

b. International Level. The following three programs with international participation were held:

- International Workshop on Okra Genetic Resources;
- FAO/IBPGR Regional Training Course on Crop Resources of Local Importance in South Asia and Indo-China;
- On-job Training Program on Long Term Conservation.

A total of 37 participants took part. Details are given in Attachment 4.17.

3.1.1.8.2 Training in U.S.A.

Under the Participating Agency Service Agreement (PASA), professional training in the U.S.A. was organized by the Far Eastern Regional Research Office (FERRO) in New Delhi and the USDA's Office of International Cooperation and Development (OICD) in Washington.

The initial agreement which was for one year was extended to one more year and subsequently for two more years. The PASA is due to expire on August 20, 1994. Prior to the execution of PASA, limited professional development training/study tours were provided by Winrock International under ARP for pre-project activities of the PGR Project.

The areas of training in the U.S.A. included: germplasm exchange, plant quarantine, exploration, collection, characterization, documentation

and plant tissue culture in various U.S. universities and USDA laboratories. The training periods varied from three weeks for senior personnel to three months for working scientists.

Details of scientists trained in the U.S.A. are given in Attachment 4.18. Training schedules for ten more scientists have been finalized and their training is to be completed before November 1993.

3.1.1.9 Technical Assistance

The technical assistance activities of the PGR Project were organized by OICD under PASA with USAID. Dr. Norman James has been appointed as the leading consultant by OICD. Thirteen U.S. scientists visited the project as short-term consultants on different aspects including:

- Plant Genetic Resources Conservation and Use
- Design of National Gene Bank/NBPGR Headquarters Building
- Plant Quarantine Greenhouses / Screenhouses
- National Plant Tissue Culture Repository
- National Data Base Management and Automation Needs of the Plant Germplasm System

Their visits and advice have helped considerably in planning and implementing the PGR Project. The details of consultants are given in Attachment 4.19.

3.1.1.10 Data Base Management

The data processing capabilities have been strengthened at the NBPGR Headquarters and its Sub-stations. Twelve cooperating centers have been equipped with micro-computers. Through courses on "PGR Documentation and Information Management", 74 scientists have been trained. Data bases on gene bank storage, germplasm characterization and evaluation data are being created for storage and retrieval of information.

The printing of gene bank labels by conventional methods has been replaced by Barcode labels making use of thermal transfer technology. By this, all the information regarding specific accessions conserved in the National Gene Bank is depicted in Barcodes which are scanable with the help of laser scanners and displayed on a computer screen. It will also be displayed in a human readable form.

3.1.1.11 Germplasm Advisory Committees

With a view to gain rich experience of eminent scientists and experts having specific specialization in different fields, the Bureau has invited them to join Germplasm Advisory Committees that are being set up for specific crops or groups of crops. These committees advise the Bureau and will help in identifying gaps/short comings in collection, characterization, evaluation, documentation and conservation of genetic variability available in indigenous germplasm of relevant crops and will suggest suitable remedial actions: in updating the descriptors and descriptor traits used for evaluation of germplasm collections; in prioritizing categories of materials to be kept in long-term storage, to eliminate possible duplication and explore feasibility of developing core collections; for acquisition of promising materials from abroad through introductions and joint exploration; and in prioritizing research and training needs concerning germplasm.

So far NBPGR has set up the following five committees :

1. Germplasm Advisory Committee for Pulses
2. Germplasm Advisory Committee for Rice
3. Germplasm Advisory Committee for Oilseeds
4. Germplasm Advisory Committee for Wheat
5. Germplasm Advisory Committee for Sorghum, Millets and Maize

These committees are meeting regularly either at NBPGR, New Delhi or at one of the germplasm activity sites to meet the above objectivas effectively. It is also proposed to constitute a National Germplasm Advisory Board (NGAB) which will be comprised of all the Chairmen of different GACs and other leading experts.

An endeavor is being made to hold these Germplasm Advisory Committee meetings during their respective Annual Workshops so that the participating scientists are apprised of the recommendations.

In most cases, the germplasm committees met twice so far and their recommendations are being implemented.

3.1.1.12 Recommendations

1. Biological diversity is the basis for a sustainable agricultural resource base. Recognizing the dangers of development activities resulting in genetic erosion, genetic vulnerability and genetic wipe out, both

Government of India (GOI) and USAID attach prime importance for conservation of biodiversity. The purpose of the PGR Project is to build a comprehensive National Genetic Resource System (NGRS) which will strengthen, enhance and coordinate facilities and research activities required for collecting, evaluating and exchanging plant genetic resources for use in crop improvement programs. The second purpose is to enhance India's role in the global exchange network including the operation of a safe and efficient germplasm quarantine system. The mid-term evaluation reveals that the progress of various activities are moving satisfactorily and the team is of the opinion that long-term planning, financial and administrative support from both GOI and USAID are essential for the project to play its rightful role in the conservation and utilization of biodiversity in the national, regional and global contexts.

2. The goal of the genetic resources management system is to preserve the complete genetic diversity and maximize its use in crop improvement. It should be recognized that while the natural populations are in a dynamic state of evolution, collections are statically maintained and cannot capture all useful alleles. Rational germplasm conservation, therefore, requires continued eco-geographic surveys, particularly, in the centers of diversity and both ***in situ*** and ***ex situ*** conservation methods. While seeds are largely conserved in ***ex situ*** storage under suitable conditions, ***in situ*** conservation methods have advantages for wild species and perennial and woody species and vegetatively held materials. Fruits, nuts, plantation crops, and medicinal plants are better managed ***in situ*** near their natural habitats. The team recommends continued joint exploration beyond the project period in third countries as well under joint participation. ***In situ*** conservation should be encouraged with appropriate species.

3. The NBPGR is responsible to maintain available plant germplasm as a base collection under long term storage. A set of policy guidelines developed for the National Seed Storage Laboratory at Fort Collins are relevant for the NBPGR's National Gene Bank. The team recommends that NBPGR study those policy guidelines and develop suitable measures for the efficient management of the National Gene Bank.

4. Active gene banks bridge conservation and use. To-date, only a small fraction of the germplasm has been sampled and included in present day cultivars and this is true even with an extensively worked crop like rice. Linking the genetic resource system with conventional breeding programs for evaluation in crop specific environments would provide for a better evaluation mechanism. The NBPGR with 30 crop specific cooperating centers, which in turn have hot spot locations under them, is ideally suited for germplasm regeneration and evaluation.

The present evaluation catalogues do not seem to reflect a comprehensive effort at evaluation. The team therefore recommends that the NBPGR, in consultation with the concerned crop specific centers, develop a multi-location/multi-year evaluation of attributes conferring resistances to biotic and abiotic stresses and other characters of economic value. Comprehensive catalogues may be developed after such evaluation.

The team further recommends that based on data available in the NBPGR, in the cooperating stations and in international institutes, the germplasm accessions may be grouped as Improved varieties under cultivation, obsolete cultivars, primitive cultivars/land races, special genetic stocks and others (probably of no immediate value). This classification will be useful in utilization.

The team further recommends that at all active germplasm sites, modern medium storage facilities be provided.

5. Active development of collections (germplasm enhancement/pre-breeding) involves coordination of genetic dynamics of natural population with the needs of evolving breeding populations and is very much a part of rational germplasm conservation. Pre-breeding involving some form of mating and selection for increasing diversity and utility is useful. In the Indian context, germplasm pools of even cross fertilized species are not available in gene banks. The transference of genes that control desirable traits from the wild germplasm to adapted genetic backgrounds is also part of genetic enhancement. Since the crop specific coordinating centers have senior scientists in charge of germplasm, the team recommends that programs of germplasm enhancement be initiated and maintained. Such breeding populations contain more genetic diversity and have greater utility. A write-up on some thoughts on germplasm policies and procedures is presented in Attachment 4.20.

6. Conservation by micropropagation techniques of clonally propagated species has become important. Molecular biology has a significant role in genetic enhancement of germplasm. DNA collections are being planned and synthesis of molecules from DNA sequences are being researched. The NBPGR should keep pace with the contemporary developments in the field of biotechnology in relation to germplasm resources. The team recommends that the area of research in biotechnology in relation to genetic resources be further strengthened through training and collaborative research.

7. The team is of the firm opinion that continued collaborative research between NBPGR and scientists from USA can render the PGR activity contemporary and mutually beneficial and recommends continuation of collaborative research beyond the project period. Some possible areas for collaborative research are:

- methodologies in biodiversity research including survey, measurement, characterization and monitoring health of the ecosystem and conservation methods;
- attributes related to adaptational aspects, processing characters and special traits;
- biotechnology - molecular diagnostics, recombinant DNA technology for germplasm enhancement, ***In vitro*** conservation; and
- native biological sources, ethnobotany, preservation of human knowledge.

8. The NBPGR has a service function and a research function. The service function should largely be carried out by well trained technicians of various categories for whom on-the-job/hands-on training programs should be organized in the various departments.

The team was informed that USDA/OICD is continuing the employment of Dr. B.P. Shrivastava at the FERRO Office. This is fortunate since Dr. Shrivastava, a former USAID employee, has intimate knowledge of the Project. The team recommends that no more 3-week training tours be planned and that all future U.S. training plans be for working scientists and for a minimum of 12 weeks. Training of active scientists abroad should involve a research project in their respective areas of research.

Each training program for scientists in India should have a well-structured syllabus and practical content. Development of manuals for training and operational protocols are recommended.

9. The data management systems have been strengthened under the PGR project. The team recommends that, as visualised, the germplasm information system be fully developed along the lines of Germplasm Resources Information Network (GRIN) in the U.S.A. to provide complete and standardized information of the genetic resources held in the gene bank and enable its use by plant breeders.

10. The team observed that there were difficulties in obtaining some antisera for virus work and certain enzymes and other biologicals for biotechnology research and plant quarantine procedures. Since such biologicals are not yet available in India, the team recommends that funds

for import and rapid delivery of such materials. Since these chemicals deteriorate rapidly, no import and/or customs delays can be tolerated.

3.2 Plant Quarantine Stations and Greenhouse/Screenhouse Facilities

3.2.1 Present Status and Plans

An important component of the PGR Project is the development of four plant quarantine stations and creation of necessary greenhouse and screenhouse facilities for NBPGR in a range of agroclimatic regions of India. These facilities will be used for growing out and inspection of plant material, imported or exported under quarantine conditions. The locations, institutions and ecological environments they represent are as follows:

1. NBPGR Headquarters, New Delhi. It is the national genebank and is supported by a number of regional stations. Its special focus is on crops of subtropical origin. It has plant quarantine responsibility for all germplasm imported or exported. This capability is proposed to be strengthened and modernized to bring it to the level of international standards. It will develop similar quarantine facilities at three sub-stations at Hyderabad (semi-arid tropics), Bhowali (temperate zone) and Andamans (humid tropics) to provide for special needs of different agroecological regions and crops.

2. Regional Center, Hyderabad (A.P.). A NBPGR substation with focus on crops of the semi-arid tropics and special mandate to meet the quarantine demands of the International Crops Research Institute for Semi Arid Tropics (ICRISAT), and All India Directorates for Rice, Sorghum and Oilseeds, all located in Hyderabad. Its PEQ facilities are being strengthened under the PGR Project.

3. Bhowali (U.P.). A NBPGR substation with focus on crops of the temperate and sub-temperate climatic origin and special responsibility for temperate zone horticultural crops. Its PEQ facilities are being developed under the PGR.

4. Andaman Islands (Port Blair). This is a new center aimed at creation of PEQ Greenhouse complex facilities on an off-shore island in the humid tropics. Its special focus will be on plantation crops, spices and commodities relevant to humid tropics.

The total budget provision for all the PEQ Greenhouse complexes at four places was 1.15 million US dollars but due to inordinate delay in implementation of the project, price escalation and modern sophisticated design to meet the needs of each environment the cost estimates have considerably exceeded the budget provision. However USAID and Government of India have agreed to shift some of the provision under line items such as contingency, project operations ($220,000), support costs

($317,000) and allowance for inflation ($500,000) thus bringing the budget allocation for this purpose to 2.187 million US dollars. This is reported to be adequate to fully meet the cost of 3 PEQ Greenhouse complexes and facilities at New Delhi, Bhowali and Hyderabad but still falls short by some US dollars 800,000 required for the creation of off-shore facilities at Andamans.

The PEQ Greenhouse facilities are to be fabricated, erected and commissioned by the sub-contractor with the guidance of Winrock International under the Management Support Services (MSS) Contract of the Project. The sub-contractor, M/s. Donn Sharp and Sons have submitted a contract for fabrication, erection and handing over the facility on a turn-key basis to NBPGR. They are also obliged to provide after care service for a 12-months warranty period after the facilities are handed over to the NBPGR. The team understands that provision of spare parts and repairs have also been made which is an essential requirement in a developing country like India. The team is convinced that it is a well conceived and well planned project designed by leading U.S. experts, Drs. Robert F. Kahn and David Mears aimed at providing a sound base for future development of Indian agriculture through strengthening the PEQ Greenhouse complex facilities in different agroecological environments of India. It is designed to meet the international standards for import and export of plant germplasm and minimizing the risk of introduction of diseases and pests.

Recognizing the long-term value of this project and its unique features, the team is convinced that an additional grant for this purpose is fully justified and means should be found to provide it. The team hardly needs to stress that this will be a sound investment for the future of expanding, protecting, and making available India's rich resources of plant biodiversity.

3.2.2 Findings and Recommendations

1. The sites at New Delhi, Bhowali and Hyderabad have been selected but land levelling and erection of structures has not commenced. Greater difficulty is expected at Bhowali because of lack of easy accessibility to the proposed site. Strengthening of the present limited, unsatisfactory road and bridge facility across the rivulet across which the site lies is necessary specially for the transfer of prefabricated structures for PEQ, and subsequent access between this facility and the station's offices and laboratories.

2. The provision of electric power and water is the responsibility of the NBPGR and it is understood that the concerned officers/scientists are confident that even at Bhowali they will have no problem for providing this facility as the electricity department is committed to set up a power grid station close to the site. However, it is suggested that this should not be left to chance and immediate steps should be taken to ensure timely availability of energy and power.

3. The team is concerned that the plans for the PEQ Greenhouse facility for Andaman Island (Port Blair), an off-shore facility for plantation crops and commodities adapted to humid tropics is progressing rather too slowly. We understand the probable alternate sites at Port Blair have been visited by the Director, NBPGR and Director General, ICAR. However, no firm decision seems to have been conveyed to the contractor. Some alternative suggestions have been given because the authorities have apprehensions about maintaining a core of technical staff in an isolated environment.

After critically examining the various aspects of Andamans (Port Blair) site, the review team would like to stress that a PEQ Greenhouse complex in an off-shore site like Andamans (Port Blair) in the humid tropics is an essential and integral part of the entire system proposed for India and should not be allowed to suffer for any administrative or financial reasons. Its main importance is as an off-shore location away from the mainland in the humid tropics for introduction, evaluation and conservation of germplasm of plantation crops, spices and other tropical plants with minimum danger of inadvertent introduction of diseases and pests of such valuable crops in mainland India. We are convinced that a PEQ Greenhouse facility in this region will go a long way toward enriching Indian agriculture. In fact it can be a useful facility for international collaboration in germplasm conservation and exchange between Asian countries and other parts of the world.

The problem of staff and sustainability of the operation has been of some concern to ICAR, but this problem is not unique to this far off land and is evident even at Bhowali and other ICAR centers in the North East region. ICAR has the Central Agricultural Research Institute (CARI) in Port Blair and it can provide the necessary linkage for the NBPGR activity. Calcutta, the nearest big city can provide back-stopping support. The problem is not insurmountable and provision of certain incentives and adoption of suitable administrative measures can certainly help in inducing scientists to work under these environments. The long-term vision for development of the Andamans is bright and this facility could make a significant contribution.

From discussions and communications of NBPGR and DARE two types of alternatives emerge:

a. Shift the Andamans site to Kanpur at the Pulse Directorate Center.

b. Bifurcate the facility, retaining quarantine related greenhouse complex facilities in Andamans and shift some grow-out facilities to Kanpur.

The team does not support the first alternative. It is convinced that this defeats the very purpose of an off-shore island and humid tropical zone facility for quarantine. Secondly, the team believes that the quarantine related activities of pulses can be done easily at NBPGR, New Delhi and Hyderabad and its location at Kanpur will unnecessarily create a greater hazard of introducing pests and diseases, especially virus diseases, in the major pulse area of India in which Kanpur is located.

However, the team recognizes the need for creation of grow out facilities at Kanpur so that the plant material screened at Delhi and Hyderabad can be propagated and evaluated for use in the national program. Moreover the medium-term seed storage facility for pulses germplasm has to be at Kanpur and it will facilitate the process of rejuvenation and utilization of the plant material. The team, therefore, strongly supports the second alternative of bifurcation retaining at Andamans the main PEQ Greenhouse complex facility consisting of Plant Propagation Unit (GH.PP.EC), Virus Indexing Unit (GH.VI.EC), Quarantine Glasshouse Unit (GH.AC.EC) and Headhouse Unit along with one unit of Grow Out facility (GH.GO.EC). One grow-out facility at Andamans is recommended as the minimum needed against two planned by the U.S. consultants. The second Grow Out Unit (GH.GO.EC) planned for Andamans can be located in Kanpur (see attached sketch). Thus through this split arrangement, a self contained quarantine facility can be built in Andamans and a reasonable size grow out facility (30ft x 96ft) can also be provided at Kanpur. ICAR can add more such units if the need arises.

The containment laboratory in Andaman Island will provide an excellent facility for quarantine, post quarantine and research activities related to plantation crops, spices and other important crops of humid tropics. It will also be an excellent facility for research studies on exotic pathogens/pests with the least risk possibility. The component at Kanpur on the other hand will provide NBPGR an additional small facility for grow out of pulses under post quarantine conditions, of the pulses germplasm screened at Delhi.

The team stresses, that the decision for development of a quarantine greenhouse complex facility in Andamans should not be postponed or dropped for any financial, administrative or logistic consideration. Both India and USA can take pride in this unique facility and in providing a linkage in germplasm exploration, introduction, evaluation and exchange from an off-shore site to users in the humid tropics. It will also help India in playing its global role more efficiently, especially in SAARC countries and South East Asia.

4. We also suggest that a quarantine facility should not be considered only as a routine service center. Rather it should include a reasonable research component to develop reliable methods for detection of infested germplasm

accessions, safe, rapid and effective methods of destroying pathogens, insects in all life cycle stages, viruses, plant nematodes, and weeds. Research on improved technology for rescuing the germplasm involved and getting it quickly to the requesting scientists should form an important agenda of its research program.

5. Since with the completion of the Project there will become available modern facilities of quarantine at four stations, it will be, therefore, necessary to critically define the responsibility and accountability of each station for specific crops and commodities so as to make the best use of the facilities. We realize that some thinking in this direction has been done but further refinement is necessary.

3.3 Equipment

3.3.1 Present Status

Purpose. The first objective of the PGR Project is to develop for NBPGR headquarters a National Gene Bank building which will contain a fully equipped modern plant genetic resources data base management system, modern laboratories with sophisticated equipment and facilities for training scientists and technicians to update their knowledge in respective disciplines to carry out the mandate of the organization for collection, introduction, evaluation, conservation and exchange of germplasm in India and abroad. The second objective is to equip suitably its 4 quarantine stations at New Delhi, Bhowali, Hyderabad and Andaman (Port Blair). When completed, these centres will be able to provide an efficient and quick service to screen incoming and outgoing germplasm material to the user agencies. It also aims at strengthening the NBPGR regional centres and 30 base and crop research centres actively involved in medium-term storage of germplasm accessions and crop improvement research and maintenance of working collections of germplasm.

Implementation. The need for modernization of facilities for the main, regional and cooperating centres was well appreciated and highlighted in the PGR Project and a budget provision of 4.5 million U.S. dollars was made. Dr. Philip Stanwood, a U.S. consultant assisted NBPGR in selecting and prioritizing the lists of equipment to be procured from abroad and within India. These lists of equipment to be imported have been divided into 3 groups namely, TRANCHE I, II and III. A total of 76 items of equipment were identified for import. (See Attachment 4.21). These have been approved by ICAR/DARE and are at various stages of procurement. The procurement status of these items and number of pieces to be imported is shown in the following page.

Procurement Status as of 31 March, 1993

	Item	Units	Specifications Preparation	Approval/ Requisition Issued	Purchase Order Issued	Items in Warehouse in U.S.A.
Tranche I	7	43	-	2 (5)*	3 (15)*	2 (23)*
Tranche II	36	128	7 (43)*	15 (56)*	6 (17)*	8 (13)*
Tranche III	33	96	-	-	-	-
	76	267	7 (43)*	17 (61)*	9 (32)*	10 (36)*

* units per item

As of March 31, 1993, out of 7 items of Tranche I, two items comprising 23 units are ready for shipment from warehouses in the U.S.A. and purchase orders for 3 items comprising 15 units have been issued and are underway for the remaining 2 items. A total of 36 items under Tranche II are at various stages of procurement. As far as the items of Tranche III are concerned, their prioritization and processing remains to be done. The total cost estimate of imported equipment under the three Tranches exceeds budget provisions by about one million dollars. Thus, unless additional funds are made available further delay in procurement will occur. Since Tranche III equipment is mostly building dependent and needs to be prioritized, its procurement and installation will depend on and will be determined by the completion of the Gene Bank buildings. Thus, it is very likely that the procurement of equipment under this Tranche may not be completed by the end of the Winrock MSS Contract. Recognizing the importance of the equipment for strengthening the capability of the NBPGR system and also the anticipated unavoidable delay in the procurement, it is the recommendation of the review team that the MSS Contract be extended and an additional amount of 1 million U.S. dollars be provided to meet the minimum equipment needs.

The team did not see any consolidated approved list of endogenously procured equipment, but from the list in Attachment 4.22, we understand that this equipment has not yet been procured and distributed but is at various stages of procurement and distribution. The stations likely to be benefitted by this equipment, imported and endogenously procured, are indicated in this list. It does not include the NBPGR main centre which is the major recipient of this assistance.

The team also understands that the total amount of 0.5 million U.S. dollars provided for endogenously manufactured equipment has not been fully utilized and

The team also understands that the total amount of 0.5 million U.S. dollars provided for endogenously manufactured equipment has not been fully utilized and NBPGR is preparing new lists and is concerned that it will exceed the budget provision. GOI and USAID may have to consider some additional grant for this purpose.

One serious deficiency in the budget provision is the omission of the item of locally unavailable chemicals for molecular biology and tissue culture research and antisera for the use of quarantine laboratories. This is a critical and high priority item and should be included in approved lists of import items (See also Recommendation 10, Section 3.1.1.12).

Distribution of Equipment. The distribution of equipment imported and procured locally has been done by NBPGR. The regional stations of Akola, Trichur, Bhowali, Shillong and Jodhpur have been allotted 5 items each. They are seed drying cabinets, medium-term storage modules, digital moisture meters, field data recorder and a camera. The Shimla Centre of NBPGR has not been provided medium-term storage as it already has acquired it under another program. The Central Potato Research Institute, Shimla (CPRI), also has not been provided any equipment because it already has good modern facilities. However, the team feels that because of its importance and excellent research capability, CPRI could benefit from some specific equipment items. Likewise the indigenous equipment consisting of seed germinator, drying oven, personal computer and hygrographic thermograph has been provided to each of these stations. A photocopier, deep freeze, and air conditioner have been allotted to Bhowali, Shimla and Jodhpur Centres. The Cuttack and Ranchi Centres have been allotted less items based on their needs. The Hyderabad Station has been allotted special equipment comprising of 12 imported and 5 locally purchased items to accommodate its new facility.

Besides the NBPGR regional centres, 16 crop research institutes/directorates or coordinating centres for Cotton, Forages, Sugarcane, Horticulture, Rice, Wheat, Maize, Pulses, Oil seeds, Sorghum, Minor Millets, Soybean, Rape and Mustard and Groundnut have been allotted four imported and four endogenously procured pieces of equipment each. The most important pieces of imported equipment allotted to all of them is medium-term storage modules, besides a seed drying cabinet, continuous seed blower and digital moisture tester. The locally procured items such as seed germinator, drying oven, personal computers and hygro thermographs are provided to each station. Thus the capability of each important base crop germplasm centre is proposed to be upgraded for medium term storage and seed handling.

3.3.2 Findings and Recommendations

1. The team was impressed with the keen enthusiasm and interest of NBPGR and Winrock International in providing essential equipment for modernizing NBPGR's laboratories. However, judging from the progress of procurement of equipment it seems that the process will not be completed by the end of the MSS contract

and may even continue till the end of the period of the project and beyond. It needs the provision of additional funds and speeding up the process at all levels, so as to meet the target dates of the project completion.

2. The review team feels that it is necessary to provide for stations involved in medium-term seed storage and germplasm conservation, modules of such sophisticated storage facilities to enable them to maintain material at internationally acceptable standards of temperature and moisture. Some of these stations need seed drying cabinets also to reduce the moisture for long-term storage. These are costly but absolutely essential.

3. The team noted that specific provision of critical items for seed storage modules such as module shelving system, efficient durable and space saving seed containers such as metal cans, laminated foils, glass jars, etc. are not specifically included in the lists of equipment purchase of Tranche III. These essential items should not get omitted due to oversight.

4. It is not enough to procure the equipment. It is equally necessary to install it suitably and use it efficiently. Training of staff to handle the equipment is also necessary. The team suggests local arrangements for installing the equipment and for training to be made with the help of U.S. consultants. Need is also felt for providing servicing facilities and spare parts. For this, appropriate arrangements must be made in advance.

5. The team expressed concern that though quarantine facilities in Andaman (Port Blair) are included in the Project, no equipment for that location has been earmarked. The team trusts that NBPGR is going to spare such equipment from its headquarter base, as it has reserved a larger allocation for itself. In case our assumption is not correct, even now it is not too late to include the essential items of equipment for the Andaman Island facility.

6. In visits to different stations, it was observed that some of them are very poorly equipped. Even in regional stations like Trichur where construction of a building is in progress, the furniture required to make it a modern and efficient laboratory is not being designed specifically for the purpose, as is the case in Hyderabad. This is a serious concern as without properly designed furniture and fixtures in the laboratories and offices they cannot become functionally efficient facilities. USAID and ICAR may need to critically examine this situation and consider using services of local consultants to correct it.

3.4 Operational Considerations

The PGR Project is operated and managed by the NBPGR. The Director, NBPGR has full administrative and technical responsibility for the system's headquarters and all

the Project Implementation Unit (P.I.U.). The P.I.U. was planned with 10 positions which have been filled.

In addition to the P.I.U., Project operational implementation is aided by two contracts: (1) a Management Support Service (MSS) contract with Winrock International for Plant Quarantine facility design and construction, Equipment specifications, selection, procurement and delivery, and information systems design and installation; and (2) a PASA with USDA agencies to provide for US training of Indian personnel and provisions for U.S. consultants to India. Details of the activities of these contracts are described in appropriate sections of the report.

The team was impressed with the enthusiasm and efficiency of all levels of the Project's operations. There is much and obvious evidence of a great deal of activity and much coordination and cooperation among all agencies, USAID, GOI/DARE, ICAR, NBPGR, GOI/CPWD, Winrock International and USDA/OICD and FERRO.

The monthly meetings of the NBPGR, USAID, CPWD Review Committee with M/s. Paragon (the Contractor for the Gene Bank construction), at which construction progress, status, and problems are discussed, is a good example of this cooperative spirit.

The review team has no specific recommendations in this area other than to encourage this approach to be continued.

3.5 Financial

While the mid-term evaluation did not include a financial analysis and the team made no effort to look into financial management per see, there were no indications of financial management problems.

Attachments 4.23 and 4.24 show total Project expenditures and Project costs, respectively, up to March 31, 1993. It is interesting to draw attention to the footnote in Attachment 4.24 regarding the exchange rate of Indian to US currency at time of Project Signing. This should have an effect on the availability of L.C. funds for Project activities.

During discussions and review of Project documents it became clear to the team that in order to complete the Project as planned more assistance funds, both U.S. dollar and L.C. will need to be committed. Recommendations for this have been made in appropriate sections of the report.

4. ATTACHMENTS

LOGICAL FRAMEWORK

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Sector Goal To preserve India's rich sources of biological diversity for use in sustaining advances in agriculture	Measures of Goal Achievement – Enhanced and expanded plant genetic resources collected, stored and used. – Expanded use of germplasm by plant breeders to develop improved agricultural varieties.	– GOI budget flows for genetic preservation. – Requests for plant genetic resources (seeds, clonal material)	(– GOI continues to support plant genetic resources as priority activity. (– System enhancement through PGR will in improvements in the agricultural and allied sectors.
Project Purpose I To assist India's efforts to fully develop the physical, administrative & technical resources of NBPGR so that it and the institutions it supports can manage professionally a national system which sustains all aspects of collection, preservation, evaluation and exchange of India's important plant genetic resources.	Conditions that will indicate purpose has been achieved. End of project status. – Headquarters including all 5 divisions functioning effectively. – Adequate staffing throughout system. – Regional stations functioning effectively with cold storage facilities and appropriate equipment. – Gene bank storage facility operations, housing base collections.	– Site visits. – Project evaluations, site visits. – NBPGR records, site visits, monitoring reports. – Through computerized info system, site visits.	(– All AID and GOI inputs arrive in timely manner. (– Construction is of good quality. (– International relations conducive for PGR exchange & collaborative ventures. (– GOI continued support through 7th and 8th five year plans.
Corollary Project Purpose To enhance India's regional and global role in plant genetic resource preservation & use.	– Fully operational program training Asian and S.Asian and international participants leading to regional collaborative initiatives. – Free and sate internastional exchange of germplasm. – India playing lead role in plant germplasm conferences and workshops at regional and global level. – Strengthened scientific links between U.S. and India.	– Site visits, Training Center publications. – Site visits, NBPGR records – Site visits, NBPGR records – Joint programs in research exploration, training.	(– India continues to support free exchange of germplasm & information concerning germplasm.

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Outputs 1. Stregthened NBPGR national/regional network.	**Magnitude of Outputs** – Inventory of 121 completed–working collections completed, 300,000 accessions stored under proper conditions. – Adequate staffing in the system. – Tissue culture storage techniques significantly improved.	– Through computerized info system. – Site visits – NBPGR records. – Project evaluations. – USAID reports.	– GOI continued support through 7th and 8th five year plans of recurring and incremental costs. – NBPGR and cooperating ICAR institutes adequately staffed. – India continues to support free exchange of germplasm.
2. Establish high quality National Gene Bank.	– Base collections – 500,000 accessions stored in genebank under proper conditions.	– do –	– do –
3. Strengthened NBPGR information system.	– Base collection storage capacity for 600,000 accessions in place. – Plans exploration – and additional 75,000 accessions collected & stored in genebank. – Information on 80% of stored accessions in national germplasm data base.	-- do –	– do –
4. Establish & strenghten quarantine stations for seed examination for pests & pathogens.	– 4 stations – Delhi, Hyderabad, Andaman & Nicobar Islands, Foothills operational.	– do –	– do –
5. Expanded human resources/scientists capable of training NBPGR staff and international participants.	– 50 trained scientists training more than 300 Indian locals & other international students.	– do –	– do –
6. Strengthened and more productive inter–action of India's PGR system with international PGR systems.	– Collaborative initiatives in researches, exchanges, exploration and training.	– do –	– do –

INPUTS	IMPLEMENTATION TARGET (GRANT INPUTS)				MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
		AID	GOI	TOTAL		
USAID – Grant $13.0 million – Staff Time	Construction	2,650	5,400	8,050	– AID invoice/documents – On–site verification – NBPGR documents – PIO/P and USDA/OICD/ITC document – Consultant reports	– Project is adequately funded and staffed – GOI processes "Non–manufactured in India Certificate" – GOI obtains customs clearance – Consultants available – GOI's timely processing of plans – USAID provides adequate implementation/administrative support
	Equipment	5,000	500	5,500		
	Training	800	100	900		
	T.A.	1,200	200	1,400		
	Admin. Support	1,300	1,400	2,700		
	Contingency and Inflation	1,800	1,010	2,810		
		13,000	8,660	21,660		
GOI – Incremental funds of $8.66 million – Management Assistance – Land for Headquarters						

ATTACHMENT 4.2

SCOPE OF WORK

1. About the Project

1.1 Stated Goal and Purpose:

The goal of the PGR project is to assist the conservation of India's rich and diverse plant genetic resources particularly for use in sustaining advances in agriculture. The purpose is to (i) assist India's efforts to fully develop the physical, administrative and technical resources of the National Bureau of Plant Genetic Resources (NBPGR) so that it and the institutions it supports can manage a national system which sustains all aspects of exploration, collection, preservation and exchange (nationally and internationally, public and private) of plant germplasm; and (ii) enhance India's regional and global capability in plant genetic resource conservation and use.

1.2 Implementing Agency:

NBPGR is implementing this project under the guidance and overall responsibility of Dr. R.S. Rana, Director, who is assisted by the Project Coordination Committee and the Project Implementation Unit.

1.3 Planned Inputs and Outputs:

NBPGR is charged with developing, operating and coordinating the Indian national PGR system. The project is designed to improve the capability of NBPGR for safe maintenance of germplasm collections so that it can effectively participate in global exchange of plant germplasm for crop improvement research. For this purpose, the GOI funding of $9.25 million and the USAID funding of $14.70 million (total $23.25 million) is provided for the construction of a gene bank and quarantine green houses, equipment, technical assistance, training, project operations, evaluation, monitoring, contingency and inflation as presented in Attachment "2".

As a result of these inputs the following accomplishments are expected during the Life of Project (LOP):

i. A comprehensive inventory of active germplasm collections dispersed throughout India;

ii. Upgradation of the quality of active collections;

iii. At least 60% of NBPGR's field station collections regenerated/recollected and about 100,000 accessions of NBPGR and non-NBPGR collections stored as base collection in NBPGR genebank;

iv. NBPGR plant exploration and collection program based on annually revised 5 year rolling workplans;

v. A computerized germplasm data base management system in place and in use at NBPGR headquarters and its selected regional centers as well as at the Indian council of Agricultural Research (ICAR) crop research institutes;

vi. Long-term storage facility for upto 600,000 accessions at the NBPGR gene bank;

vii. Enhanced exchange of plant germplasm for research purposes with scientists in both public and private sectors in India and abroad;

viii. Well equipped and staffed plant quarantine stations to facilitate exchange of germplasm at four sites;

ix. NBPGR playing a lead role in organizing the regional and global PGR conferences and workshops;

x. Strengthening of linkages between the U.S. and the Indian germplasm system particularly in the areas of collaborative research, joint exploration and germplasm exchange; and

xi. An international program in collaboration with International Board for Plant Genetic Resources (IBPGR) to train Indian, South, Southeast Asian and other international participants in tropical and subtropical germplasm exploration conservation and exchange.

1.4 Progress and Accomplishments:

All the accomplishments of the PGR project are expected to take place in three phases, i.e., Initiation Phase (0-2 years), Construction Phase (2-5 years) and Maturity Phase (5-7 years). Technically the project is already in its fifth year and the second phase should have been nearing completion by now. However, in reality due to many constraints the various project activities picked up the desired momentum only in 1991 and since then considerable progress has been made which is enumerated below under various major subheads.

i. Implementation and Administration Support:

For the procurement of professional development training of Indian scientists in the U.S.A. and technical assistance (long and short-term consultants, collaborative research and joint exploration) from the United States Department of Agriculture (USDA), a Participating Agency Service Agreement (PASA) was executed in February 1991 between USAID and USDA initially for a period of one year which has been further extended upto August 20, 1994.

The Management Support Service (MSS) contract with Winrock International became operational in January 1992 for the procurement/construction of four quarantine green house/screen house complexes, project equipment, and limited amount of training an technical assistance that are not available through PASA.

A Project Implementation Unit (PIU) has been established at NBPGR to support various project activities. It was strengthened in 1992 through additional provision of staff to help accelerate project implementation.

ii. Construction:

Genebank/NBPGR Headquarters: Foundation of the Genebank NBPGR Headquarters was laid in July 1992. However, actual construction work picked up in November 1992. The construction work under the supervision of the Central Public Works Department (CPWD) of the GOI is in full swing now and is expected to be completed by December 1994.

Quarantine Greenhouses: Conceptual designs for them at all the four identified locations (New Delhi, Hyderabad, Bhowali and Port Blair) were finalized by two U.S. consultants. These have to be constructed by Winrock International under the provisions of MSS contract. A RFP for them was finalized on August 20, 1992. The subcontract for the construction/fabrication is likely to be awarded by Winrock International by the end of March/beginning April 1993.

iii. Equipment:

All the imported equipment procurement has to be done by Winrock International under the MSS contract. Lists containing 44 items of building independent equipment have been finalized and the procurement of these items is underway. The list of building dependent equipment is being reviewed by NBPGR/DARE and is likely to be authorized for procurement soon.

Fifteen Centers/Divisions have been provided computers, seed germinators and ovens through local procurement for upgradation of their facilities.

36

iv. Professional development:

Training conducted in U.S.A.: Professional development training is handled by the Office of International Cooperation and Development (OICD) under the PASA with USDA. As of date 49 Indian scientists have received the required training in the areas of plant quarantine, exploration, collection, characterization, documentation and exchange in various USDA laboratories and U.S. Universities. Specific plans have been drawn out for the training of 24 more scientists during FY 93 while the training plans for subsequent period are under development.

Training Courses Organized in India: A regional training program was organized in September 1991 in which 15 participants from 10 countries of South Asia and Indo-China received training. Two training courses on Computer-based PGR Information Management have been conducted in 1992-93 by NBPGR for the benefit of scientists engaged in documentation and cataloguing work. One training program on germplasm collection, evaluation and conservation will be organized in March 1993.

v. Technical Assistance:

Most of the technical assistance is planned to be provided by OICD under a PASA with USDA.

Lead and short-term consultants : Dr. Norman James has been appointed as a lead consultant by OICD. As of date 14 U.S. scientists have visited India to advise on various aspects of plant genetic resources conservation and use, design of genebank and NBPGR headquarters building, quarantine greenhouses, and national tissue culture repository, plant quarantine procedures, national data base management and automation needs of plant germplasm system.

Joint explorations: As of date three joint explorations have been completed by the teams of USDA and NBPGR scientists. The two explorations conducted in U.S.A. were on Sunflower (September 3-18, 1991-92) and *Jojoba* (August 10-22, 1992) while the third on *Cucumis* (October 16 - November 10, 1992) was conducted in India.

Collaborative research: NBPGR/ICAR have identified four areas for collaborative research with National Plant Germplasm System (NPGS) of USDA and University of California, Davis. Three of these (Use of Random Amplified Polymorphic DNA (RAPDS) for characterization of *Musa* Germplasm Diversity and Stability; Collaborative Studies on Eggplant Taxonomy and characterization at Biochemical and Molecular Levels; and Physiological and Chemical Attributes

of Deterioration in Soybean Seeds under storage) have been designed and will commence in March 1993. The fourth collaborative research activity is under development.

2. About the Evaluation

2.1 Purpose:

This mid-term evaluation will take place 56 months after signing of the Project Agreement. The purpose of this evaluation is to review the progress, assess the relevance and effectiveness of activities carried out, identify implementation problems, examine the validity of the assumptions made during the project design, correctly estimate the time and resources required to successfully achieve the project objectives, make practical recommendations, suggest mid-courses corrections and provide new directions for the project in future.

2.2 Issues:

The key issues/questions to be examined by the evaluation team are listed below:

A. Implementation Problems:

i. Has the Project Implementation Unit (PIU) been established with sufficient staff and financial resources to provide appropriate inputs to the project at the right time as required?

ii. Are the Project monitoring and review mechanisms well established to suggest corrective measures and take the necessary follow-up actions on a regular basis?

iii. Is the flow of USAID and GOI inputs/resources sufficient and timely to produce the desired outputs as envisaged?

iv. Are the contingency and inflation allowances sufficiently incorporated into the financial plans of USAID and GOI to meet the basic expectations of the overall implementation of the project?

v. Are the project implementation mechanisms in the form of MSS and PASA adequate and functioning satisfactorily to achieve the project objectives during the life of project?

38

vi. What are the major problems affecting the process of implementation of various project activities?

vii. Are the local and overseas training components being implemented in conjunction with an institutional development plan that will ensure the achievement of project objectives?

viii. Will the construction be completed on schedule and within budget?

B. Progress/Accomplishments:

i. Has the NBPGR consolidated and upgraded working collections of its field stations and cooperating institutions?

ii. How satisfactory are the efforts made by the NBPGR to improve exploration and collection and encourage wider use of assembled germplasm through participation of public and private sector?

iii. How well coordinated and focused are the overseas and in-country training programs and technical assistance from U.S. scientists on the key areas of PGR system?

iv. How well planned, coordinated and satisfactory is the progress made so far on the construction work and procurement of equipments related to the project?

v. What are the most significant accomplishments and prospects of other achievements of this project?

vi. What are the key factors responsible for time and cost over runs at initiation and construction stages of the project?

vii. What are the corrective actions that are required to expedite the progress of this project and ensure success?

C. Future Actions:

i. How sufficient is the remaining LOP and the inputs from USAID and GOI to compete all activities of the construction phase and maturity phase and thereby achieve the stated project purpose and goal of establishing the sound PGR system successfully?

39

ii. What are the time and cost implications of completing all activities successfully as per the project design and specific recommendations arising out of them?

iii. How valid are the assumptions of the project design and how realistic are the expected outputs from the project?

iv. How can the project measure its impact at purpose and goal levels both during implementation and after project completion?

v. What are the specific suggestions and practical recommendations which must be acted upon by all those who are responsible for planning and implementation of various activities of this project to meet its stated goals and objectives?

vi. What are the other issues which need to be addressed and resolved in order to complete activities according to the phased project design successfully?

2.3 Strategy:

A four member team consisting of two U.S. and two Indian experts will examine the evaluation issues/questions listed above. Relevant qualifications and experience in Agriculture/Plant germplasm conservation and exchange is necessary and experience of evaluation of AID and other donor assisted projects is desirable for all members. One of the senior U.S. experts will act as a team leader and will be responsible to coordinate evaluation activities and submit the final report to USAID.

The evaluation team will review the available documents, interview the persons concerned, visit the sites or locations of participating national, regional and local stations and other collaborating institutions as suggested below :

i. Documents:

- Project Paper
- Quarterly Reports
- Research and other publications
- Internal monitoring and review reports
- Any other relevant documents or records

ii. Interviews:

- USAID Staff
- GOI Staff
- NBPGR staff
- Staff at regional and local stations
- Staff at collaborating institutions
- Participating U.S. and Indian Scientists
- Management Services like OICD/USDA, Winrock and CPWD
- Interested people from public and private sectors

iii. Site Visits:

- NBPGR and other facilities in/around Delhi
- At least 3 out of 6 regional stations in India - Recommended visits include Hyderabad (A.P.), Shimla (H.P.) and Trichur (Kerala)
- At least 6 out of 30 local crop research stations may be selected
- Any other relevant similar site in India or U.S.A. for comparison or insights.

ATTACHMENT 4.3

PLANT GENETIC RESOURCES PROJECT

A. EVALUATION METHODOLOGY

The U.S. members of the evaluation team visited appropriate officials in Washington, DC in USDA-ARS, USDA-OICD, and Winrock International to become familiar with the Project's background and operational details.

Upon arrival in India the whole team spent several days reviewing Project documents, holding discussions with USAID, Winrock International, USDA-FERRO, and NBPGR staff.

A Questions and Issues Memorandum was prepared and sent to NBPGR Headquarters and Regional Centers asking for input on several of the major issues of the evaluation (see B. below).

Two major field trips were undertaken. One of five days to the North to visit NBPGR Centers and affiliated institutions at Bhowali, Shimla, and Karnal. The second of six days to the South to Hyderabad and Trichur. (See map of NBPGR Locations - Attachment 4.6)

Each evaluation team member assumed primary responsibility for specific aspects of the Project such as facilities, equipment, technical assistance, training, etc.

The final conclusions and recommendations are the result of joint discussions and consensus.

B. QUESTIONS AND ISSUES

Please prepare a brief note (no more than two pages) regarding your viewpoints of the following issues. Only address those issues you feel are appropriate for you.

I. Is the flow of USAID and GOI inputs/resources sufficient and timely to produce the desired outputs as envisaged?

II. What are the major problems affecting the process of implementation of various project activities?

III. Has the NBPGR consolidated and upgraded working collections of its field stations and cooperating institutions?

IV. What are the corrective actions that are required to expedite the progress of this project and ensure success?

V. How can the project measure its impact both during implementation and after project completion e.g., on collaborative research and germplasm exploration and exchange?

VI. What are the specific suggestions and practical recommendations which must be acted upon by all those who are responsible for planning and implementation of various activities of this project to meet its stated goals and objectives?

VII. Recommendations for future.

ATTACHMENT 4.4 EVALUATION TEAM MEMBERS

Dr. Peter H. Van Schaik - Team Leader

Dr. Van Schaik is an agronomist/plant breeder who has extensive experience as a researcher and research administrator both in the United States and in developing countries (including India from 1967-70). He holds a B.S. degree in Agronomy and Masters and Ph.D. degrees in Plant Breeding. His research has been in agronomy and varietal development of soybeans, cotton, peanuts and dry edible legumes. His administrative experience has been at the Area and Regional levels of USDA. He has held resident assignments in Iran and India, and has served on short-term consultancies in those countries and in Ethiopia, Kenya, Mali and Pakistan. He is the author of numerous technical articles on soybeans, cotton, peanuts and pulses. In 1992, Dr. Van Schaik served as Team Leader on the final evaluation of the Indo-U.S. Agricultural Research Project.

Dr. Kenneth O. Rachie

Dr. Rachie is an internationally known expert in plant genetic resources & conservation and plant breeding. He was awarded the B.S. degree in Agronomy, the M.S. degree in Agronomy and Plant Genetics, and the Ph.D. in Plant Genetics/Plant Breeding. He worked with the Rockefeller Foundation from 1954 through 1984 and served in Mexico (2 years), Uganda (3 years), Nigeria (5 years) with IITA on their grain legume program, Colombia (3.5 years) with CIAT as Deputy Director General for Research, Sumatra (2 years), and in India (1957-1967) where he focussed on genetic improvement of sorghum and millet. Since retirement from the Rockefeller Foundation, Dr. Rachie has consulted on three continents in the role of designer or evaluator of agricultural research projects and for the past five years has served as an external evaluator of the AID-funded Bean/Cowpea CRSP.

Dr. J.S. Kanwar

Dr. Kanwar is an internationally know research scientist and research administrator. He holds a B.S. degree in Agronomy/Soils and Masters and Ph.D. degrees in Soil Chemistry. From 1973 to 1988, as Director of Research and Deputy Director, he played a significant role in directing and coordinating research at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. This research covered sorghum, pearl millet, pigeonpea, chickpea, groundnut, and farming systems to improve the productivity and sustainability of dryland agriculture in the rainfed areas of the semi-arid tropics. He has served as a short-term consultant in numerous Asian countries and in Africa. In 1992, Dr. Kanwar served with Dr. Van Schaik on the evaluation of the above mentioned Indo-U.S. Agricultural Research Project.

Dr. N.G.P. Rao

Dr. Rao is well known in the international agricultural research community, especially for his work in sorghum breeding in India. He holds a B.S. degree in Agriculture, and M.S. and Ph.D. degrees in Plant Breeding. His experience encompasses both teaching and research in plant breeding and sorghum production. He has served over twenty years with the Indian Council for Agricultural Research, has served as a sorghum breeder in Nigeria (1980-83), and has served as the Vice Chancellor of the Marathwada Agricultural University (1984-87). He continues to serve as an external evaluator of various international collaborative research efforts.

ATTACHMENT 4.5

PLACES AND PERSONS VISITED

May 18 **Beltsville, Maryland**

U.S. Department of Agriculture, Agricultural Research Service, NPGS

Dr. Allan Stoner, Director, National Germplasm Resources Laboratory
Mr. Jimmie Mowry, GRIN Specialist
Dr. Ed Bird, GRIN Specialist
Mr. George Sterling, Plant Exploration Officer
Dr. Ahmed Hadidi, Scientist

May 19 **Washington, D.C.**

U.S. Department of Agriculture, Office of International Cooperation and Development and Agricultural Research Service

Dr. Dean Plowman, Administrator
Ms. Carol Wilson, International Affairs Specialist
Ms. Linda Lynch, OICD Coordinator, PGR Program Leader
Dr. David Kincaid

Winrock International

Dr. A. Colin McClung, U.S. Coordinator
Mrs. Surbhi Bhatt, Program Associate
Mr. P.S. Srinivasan, Admistrative Specialist. India Office (during his visit to D.C. Office)

May 20 **Beltsville, Maryland**

USDA, ARS

Dr. Henry Shands, Genetic Resources, National Program Staff

Washington, D.C.

International Resources Group

Mr. Robert A. Delemarre, Director
Dr. Norman James (by phone), USDA, OICD Consultant
Dr. Robert Kahn (by phone), Winrock Consultant

May 24 **New Delhi, India**

USAID

Mr. Walter Bollinger, Director
Mr. Steven Mintz, Deputy Director
Mr. John Grayzel, TDE
Dr. J.D. Tarter, PDI&T
Mrs. Andrea Yates, Special Projects
Mr. D.R. Arora, PGR Project Officer

USDA, FERRO
Dr. James Thomas, Director
Dr. B.P. Srivastava, Project Specialist

Winrock International
Dr. Harold E. Kauffman, India Coordinator, PGR Project
Dr. Surjan Singh, Project Specialist

May 25, 26, 27
National Bureau of Plant Genetic Resources
Dr. R.S. Rana, Director
Staff

May 29 **Bhowali, U.P.**
NBPGR, Regional Station
Dr. K.C. Negi, Econ. Botanist
Staff

Almora, U.P.
ICAR, Research Station

May 31 **Shimla, H.P.**
NBPGR, Plant Genetic Resources, Base Station
Dr. B.D. Joshi, Chief Scientist
Staff

ICAR, Central Potato Research Institute
Dr. J.S. Grewal, Director
Staff

ICAR, Regional Horticultural Research Station
Dr. Y.D. Sharma, Scientist
Staff

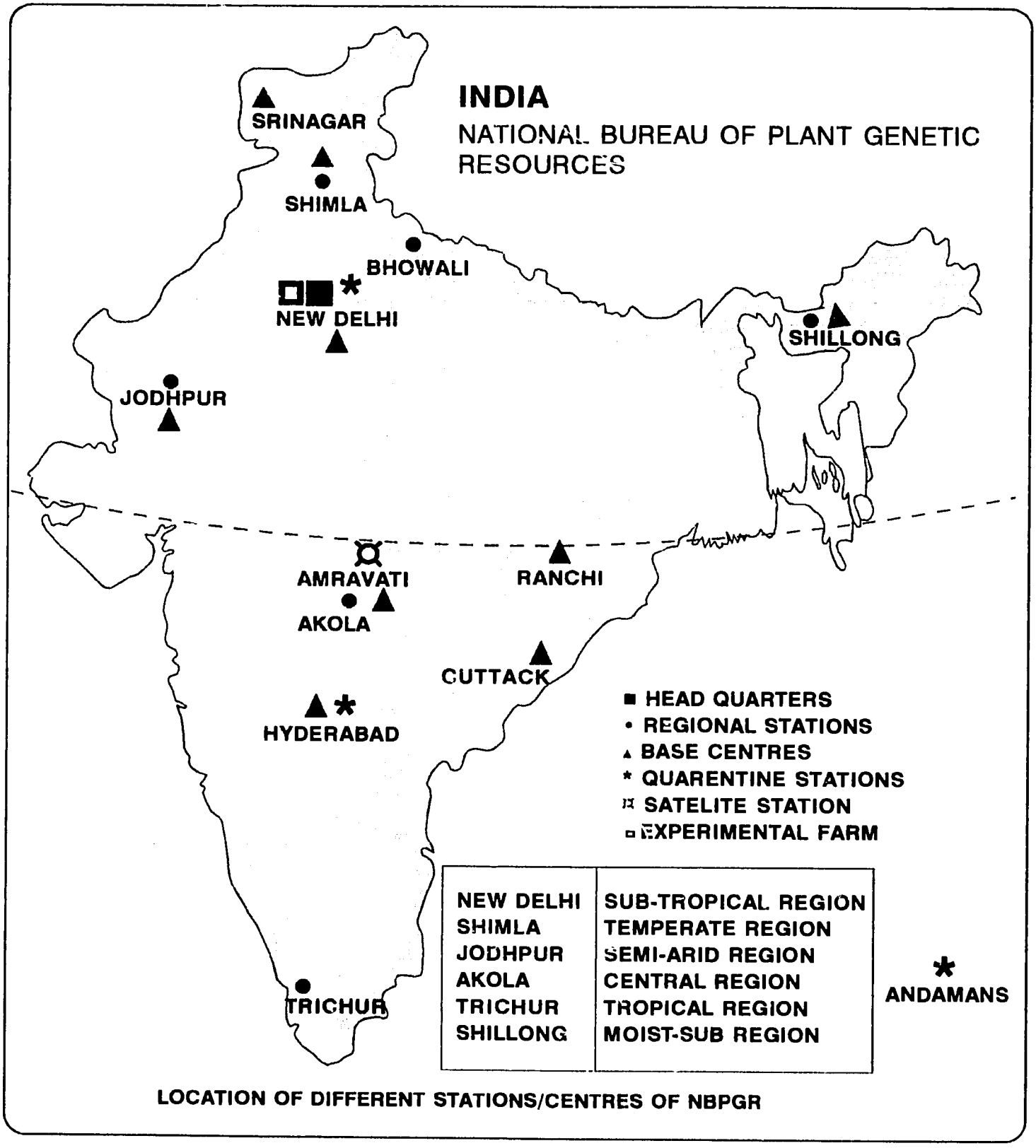
June 1 **Karnal, Haryana**
ICAR, Directorate of Wheat Research
Dr. L.B. Goel, Princ. Scientist
Dr. S.M.A. Naqvi, Sr. Scientist
Dr. S.K. Olithal, Princ. Scientist, NBPGR, New Delhi

June 3 **Hyderabad, A.P.**
NBPGR, Plant Quarantine Regional Station
Dr. K.S. Varaprasad, Chief Officer
Staff

47

ATTACHMENT 4.6

MAP OF NBPGR LOCATIONS



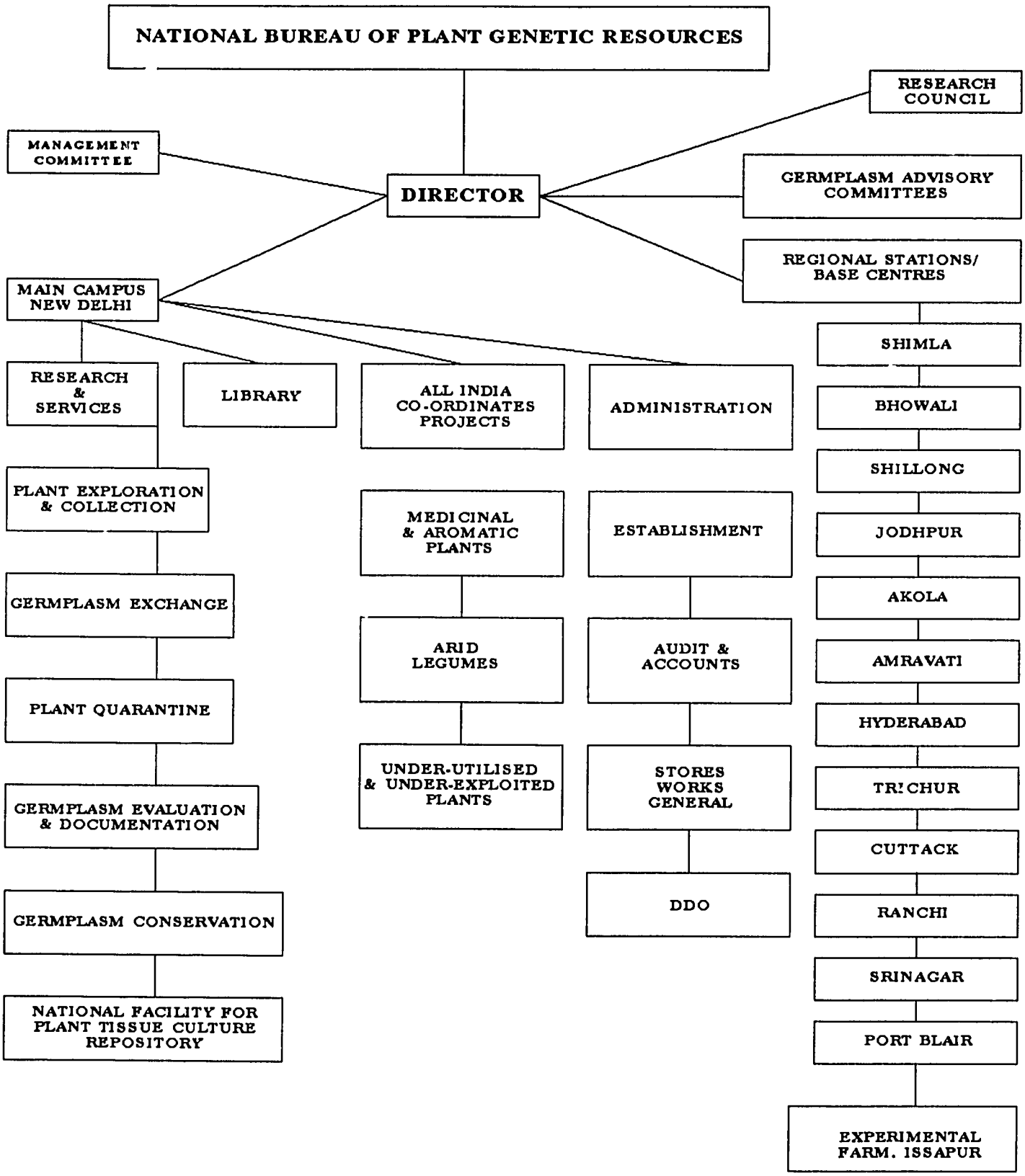
LOCATION OF DIFFERENT STATIONS/CENTRES OF NBPGR

Based upon Survey of India map with the permission of the Surveyor General of India.

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

ATTACHMENT 4.7

ORGANIZATIONAL CHART



ATTACHMENT 4.8

REGIONAL STATIONS, BASE CENTRES AND QUARANTINE STATIONS

Regional stations are mainly for evaluation, rejuvenation and maintenance of working collections of germplasm, while Base Centres are mainly oriented towards plant exploration and collection activities in the respective regions. Plant Quarantine Stations are to extend quarantine facilities nearer to sites of germplasm evaluation. The details of main stations and centres are as follows:

AKOLA
(MAHARASHTRA)

Location	:	Punjabrao Krishi Vidyapeeth Campus
Latitude/Longitude	:	23° 43'N, 77° 64'E
Altitude	:	281 m
Date of start	:	1977
Regional responsibility	:	Central peninsular
Crop responsibility	:	Oilseeds, legumes, pseudo cereals, millets, vegetables, fruits, fibre crops and industrial plants.
Accessions maintained	:	17,000
Farm area	:	20 ha
Satellite station	:	Amravati, 90 km (East). farm area - 5 ha

BHOWALI
(NAINITAL, UTTAR PRADESH)

Location	:	15 km. from Nainital
Latitude/Longitude	:	29° 20'N, 79° 30'E
Altitude	:	1460 m
Date of start	:	April, 1986
Regional responsibility	:	Temperate/sub-temperate northern Himalayas and foot hills.
Crop responsibility	:	Cereals, pulses, oilseeds, forages, horticultural, medicinal and aromatic plants.
Accessions maintained	:	600
Farm area	:	10 ha

CUTTACK
(ORISSA)

Location	:	Central Rice Research Institute Campus
Latitude/Longitude	:	20° 40'N, 85° 52'E
Altitude	:	132 m
Date of start	:	July, 1986
Regional responsibility	:	Eastern peninsular
Crop responsibility	:	Cereals, grain legumes, vegetables, fruits and tuberous crops
Accessions maintained	:	250
Farm area	:	2 ha

HYDERABAD
(ANDHRA PRADESH)

Location	:	Andhra Pradesh Agricultural University Campus
Latitude/Longitude	:	17° 19'N, 78° 23'E
Altitude	:	542 m
Date of start	:	April, 1986
Regional responsibility	:	Southern India
Crop responsibility	:	Quarantine clearance of paddy, mandate crops of ICRISAT and other crops of the region; collection of germplasm
Accessions cleared	:	7,500
Land	:	6.4 ha

JODHPUR
(RAJASTHAN)

Location	:	Central Arid Zone Research Institute Campus
Latitude/Longitude	:	26° 18'N, 73° E
Altitude	:	224 m
Date of start	:	1965
Regional responsibility	:	Western and north-western semi-arid and arid plains
Crop responsibility	:	Legumes, oilseeds, forages, vegetables, fruits and industrial crops
Accessions maintained	:	8,500
Farm area	:	6 ha

61

SHILLONG
(MEGHALAYA)

Location	:	ICAR Complex for North-Eastern Hill Region
Latitude/Longitude	:	25° 30'N, 90° 50'E
Altitude	:	1496 m
Date of start	:	1978
Regional responsibility	:	North-eastern humid temperate to humid sub-tropical
Crop responsibility	:	Paddy, maize, legumes, chillies, cucurbits and horticultural plants.
Accessions maintained	:	2,500
Farm area	:	1 ha

SHIMLA
(HIMACHAL PRADESH)

Location	:	Phagli
Latitude/Longitude	:	31°N, 77°E
Altitude	:	2076 m
Date of start	:	1961
Regional responsibility	:	Temperate/sub-temperate north-western Himalayas
Crop responsibility	:	Cereals, pseudo-cereals, millets, grain legumes, forages, vegetables, pome and stone fruits, nuts, ornamentals, tuber and medicinal crops.
Accessions maintained	:	10,000
Farm area	:	7 ha

TRICHUR
(KERALA)

Location	:	Kerala Agricultural University, Vellanikkara Campus
Latitude/Longitude	:	10° 50'N, 76° 20'E
Altitude	:	50 m
Date of start	:	1977
Regional responsibility	:	Southern tropical
Crop responsibility	:	Rhizomatous and tuberous crops, legumes, cereals, vegetables, fruits and spices.
Accessions maintained	:	7,000
Farm area	:	10.5 ha

62

ATTACHMENT 4.9

LIST OF CROPS AND STATIONS IN INDIA

Sl.	Crop	Station	Sl.	Crop	Station
1	Wheat	DOW (ICAR), Karnal	16	Vegetables	NBPGR, New Delhi
2	Rice	CRRI, Cuttack	17	Potato	CPRI, Shimla
3	Maize	IARI, New Delhi	18	Forages	IGFRI, Jhansi
4	Barley	IARI, Karnal	19	Spices	NRCS, Calicut
5	Sorghum	NRC, Hyderabad	20	Tobacco	CTRI, Rajahmundry
6	Pearl Millet	Agri. College, Pune	21	Plantation Crops	CPCRI, Kasaragod
7	Minor Millet	GKVKC, Bangalore	22	Medicinal and Aromatic Plants	AIC (M&AP) IP, New Delhi
8	Pulses	DPR (ICAR), Hyderabad	23	Agro - Forestry Plants	NRCA (IGFRI), Jhansi
9	Soybean	NRCS, Indore	24	Fruits (semi-arid)	HAU, Hisar
10	Oilseeds	DOR (ICAR), Hyderabad	25	Fruits (Subtrop. and Temp)	NBPGR, Shimla
11	Rapeseed and Mustard	HAU, Hisar	26	Fruits (tropical)	IIHR, Bangalore
12	Groundnut	NRCG, Junagadh	27	Citrus	NRCC, Nagpur
13	Sugarcane	SBI, Coimbalore and IISR, Lucknow	28	Fruits (Northern Plains)	CIHNP, Lucknow
14	Cotton	CICR, Nagpur	29	Tuber Crops	CTCRI, Trivandrum
15	Jute and Allied Fibres	CIJAF, Barrackpore	30	Pseudo-Cereals	NBPGR, Shimla

ATTACHMENT 4.10

NBPGR, GERMPLASM EXPLORATIONS AND COLLECTIONS

Year	No. of exploration conducted	No. of accessions collected
1989-90	59	13,436
1990-91	49	7,021
1991-92	57	7,002
1992-93	55	6,112
Total	**220**	**33,571**

ATTACHMENT 4.11

NBPGR, GERMPLASM EXCHANGE

Year	No. of accessions imported	No. of accessions sent abroad	No. of accessions distributed within country
1989-90	50,536	3,310	17,250
1990-91	49,521	1,195	12,680
1991-92	50,235	1,221	13,111
1992-93	52,160	4,674	15,113
Total	**202,452**	**10,400**	**58,154**

ATTACHMENT 4.12

NBPGR, PLANT QUARANTINE INSPECTION

Year	No. of samples processed	No. of samples found with and weeds	No. of samples salvaged	No. of samples rejected
1989-90	136,397	1,601	1,549	52
1990-91	122,850	3,175	3,028	147
1991-92	118,919	3,094	3,002	92
1992-93	138,712	2,173	2,036	137
Total	**516,878**	**10,043**	**9,615**	**428**

ATTACHMENT 4.13

NBPGR, ACTIVE GERMPLASM HOLDINGS AND AT ITS REGIONAL STATIONS (1993)

Sl.	Crop	Active Germplasm Holdings
1.	Cereals	12,670
2.	Pulses	39,034
3.	Millets and minor millets	11,190
4.	Oilseeds	19,375
5.	Vegetables	12,899
6.	Pseudo Cereals	4,931
7.	Forage Crops	1,906
8.	Tuber Crops/Spices	2,053
9.	Horticultural/Ornamental	2,253
10.	M & AP	870
	Total	**1,07,181**

ATTACHMENT 4.14

INDIAN NATIONAL PLANT GENETIC RESOURCES SYSTEM
Nodal Organization: NBPGR (Base Collections)
Current Holdings of National Active Germplasm Sites

Sr. No.	Crop	National Active Germplasm Sites	No. of Accessions Currently Available
1.	Wheat	Directorate of Wheat Research Indian Agricultural Research Institute New Delhi - 110 012	17,000
2.	Rice	Central Rice Research Institute Cuttack - 753 006 (Orissa)	20,000
3.	Maize	All India Coordinated Maize Improvement Project Indian Agricultural Research Institute New Delhi - 110 012	25,000
4.	Barley	All India Coordinated Barley Improvement Project IARI Regional Station Karnal - 132 001 (Haryana)	-
5.	Sorghum	National Research Centre (Sorghum) Rajendranagar Hyderabad - 500 030 (Andhra Pradesh)	2,767
6.	Pearl Millet	All India Coordinated Pearl Millet Improvement Project College of Agriculture, Shivaji Nagar Pune - 411 005 (Maharashtra)	-
7.	Minor Millets	All India Coordinated Minor Millets Project University of Agricultural Sciences Gandhi Krishi Vigyan Kendra Campus Bangalore - 560 065	8,572
8.	Pulses	Directorate of Pulses Research (ICAR), Kanpur - 208 024 (Madhya Pradesh)	9,310

9.	Soybean	National Research Centre for Soybean Bhawerkua Farm, Khandwa Road Indore - 452 001 (Madhya Pradesh)	2,500
10.	Oilseeds	Directorate of Oilseeds Research (ICAR) Rajendranagar Hyderabad - 500 030 (Andhra Pradesh)	15,629
11.	Rapeseed & Mustard	All India Coordinated Crop Improvement Project (Rapeseed and Mustard) Haryana Agricultural University Hisar - 124 004 (Haryana)	15,082
12.	Groundnut	National Research Centre for Groundnut Timbawadi P.O. Dist. Junagadh - 362 015 (Gujarat)	6,432
13.	Sugarcane	Sugarcane Breeding Institute Coimbatore - 641 007 (Tamil Nadu)	3,979
14.	Cotton	Central Institute for Cotton Research Panjori Farm, Wardha Road P.B. No. 125 G.P.O. Nagpur Nagpur - 440 001 (Maharashtra)	6,896
15.	Jute & Allied Fibres	Central Institute of Jute and Allied Fibres Barrackpore - 743 101 (West Bengal)	3,226
16.	Vegetables	National Bureau of Plant Genetic Resources Pusa Campus, New Delhi - 110 012	16,139
17.	Potato	Central Potato Research Institute Shimla - 171 001 (Himachal Pradesh)	2,375
18.	Forages	Indian Grassland & Fodder Research Institute (Forage Crops), Gwalior-Jhansi Road Jhansi - 284 003 (Uttar Pradesh)	6,267
19.	Spices	National Research Centre for Spices Marikunnu, Calicut - 673 012 (Kerala)	2,847

20.	Tobacco	Central Tobacco Research Institute Rajahmundry - 533 105 (Andhra Pradesh)	1,500
21.	Plantation Crops	Central Plantation Crops Research Institute Kasaragod - 671 024 (Kerala)	307
22.	Medicinal and Aromatic Plants	All India Coordinated (M & AP) Improvement Project Pusa Campus, New Delhi - 110 012	375
23.	Agro-Forestry Plants	National Research Centre for Agro-Forestry Indian Grassland & Fodder Research Institute Jhansi - 284 003 (Uttar Pradesh)	40
24.	Fruits (Semi-aird)	All India Coordinated Project (Semi-arid Fruits) Haryana Agricultural University Hisar - 125 004 (Haryana)	541
25.	Fruits (Subtropical and Temperate)	NBPGR Regional Station Phagli, Shimla - 171 004 (Himachal Pradesh)	454
26.	Fruits (Tropical)	Indian Institute of Horticultural Research 255 Upper Palace Orchards Bangalore - 560 080 (Karnataka)	13,118
27.	Citrus	National Research Centre for Citrus Seminary Hills, Nagpur - 440 006 (Maharashtra)	51
28.	Fruits (Northern Plains)	Central Institute of Horticulture for Northern Plains B-117, Indira Nagar, Lucknow - 226 016 (Uttar Pradesh)	587
29.	Tuber Crops	Central Tuber Crops Research Institute Sreekariyam, Trivandrum - 695 017 (Kerala)	3,586
30.	Pseudo-Cereals	NBPGR Regional Station Shimla - 171 004 (Himachal Pradesh)	3,682

ATTACHMENT 4.15

NUMBER A GERMPLASM ACCESSIONS STORED IN LONG–TERM/MEDIUM–TERM STORAGE BASE COLLECTIONS IN NATIONAL GENEBANK AT NBPGR (as of March 31, 1993

Crop Groups	No. of Accessions
LONG-TERM STORAGE (-20 DEG C)	
Cerals	50,456
Pulses	23,994
Millets and Minor millets	14,559
Oilseeds	15,647
Vegetables	6,229
Fibre Crops	3,212
Narcotics	790
M. & A.P.	179
Pseudocerals	736
Improved varieties	904
MEDIUMM-TERM STORAGE (4 DEG C)	
Voucher specimens of Exotics	20,760
Ref. samples of Indigenous collection	35,581
TOTAL	173,098

STATUS OF IN-VITRO CONSERVATION PROGRAM AT NATIONAL FACILITY FOR PLANT TISSUE CULTURE REPOSITORY

Crop	No. of Accessions in culture	Storage Temperature Degrees C.	Optimum Sub-Culture Interval (Months)
Allium sativum	50	10,4	16-18
Allium species	9	10	12
Ipomoea batatas	205	25	12-16
Dioscorea species	28	25	12
Zingiber officinale	97	25	12
Curcuma species	3	25	8
Musa spp.	150	25,15	12-22
Citrus aurantifolia	2	25	10
Piper species	6	25	10-12
Rauvolfia serpentina	4	15	15
R. canescen	1	25	15
Saussurea lappa	1	4	13
Tydophora idica	1	10	12
Picrorrhiza Kurroa	1	10	16
Gentiana kurroa	1	4	11
Pogostemon patshouni	2	25	9-10
Coleus forskonlii	7	25	18

ATTACHMENT 4.16

NBPGR, GERMPLASM ACCESSIONS SUPPLIED, BY CROPS (1992-93)

Crop/Group of Crops	No. of samples	No. of indentors
Pulses	324	16
Cereals	24	1
Vegetables	688	33
Fibres	10	4
Millets	72	5
Oilseeds	110	16
Forage	139	3
Others	10	1
Total	**1377**	**79**

ATTACHMENT 4.17

NBPGR, TRAINING PROGRAMS ORGANIZED IN INDIA

Sl.	Training Course	Year	No. of Participants
A.	National Level		
1.	Training Course on PGR : Documentation and Information Management	1990	15
2.	Training Course on Germplasm Exchange and Plant Quarantine Inspection	1990	16
3.	Training Course on PGR : Documentation and Information Management	1991	5
4.	- do -	1991	10
5.	- do -	1992	14
6.	- do -	1992	15
7.	- do -	1993	14
8.	Training Program on Exploration, Evaluation and Conservation	1993	18
		Total	107
B.	International Level		
1.	International Workshop on Okra Genetic Resources (IBPGR)	1990	15
2.	FAO/IBPGR Regional Training Course on Crop Resources of Local Importance in South Asia and Indo-China	1991	20
3.	On-job Training Program on Long-term Conservation (IBPGR)	1992	2
		Total	37

ATTACHMENT 4.18

NBPGR, SCIENTISTS TRAINED IN U.S.A.

	Year	No. of scientists
A. Under Pre-Project		
	1988	6
	1989	5
B. Under the Main Project		
	1990	10
	1991	7
	1992	21
	1993	16
	Total	**65**

ATTACHMENT 4.19

NBPGR, US CONSULTANTS TO INDIA

St.	Name	Field	Period	Person weeks
1.	Dr. Phillip C. Stanwood	Data Documentation	Feb.28-Mar.13, 1988	2
2.	Dr. Jimmie Mowder	- do -	- do -	2
3.	Dr. O.L. Gamborg	Plant Tissue Culture	Nov.21-Dec.09, 1988	3
4.	Dr.Phillip C.Stanwood	Updating Euipment	Feb. 10 - 18, 1989	1
5.	Dr. T.T. Chang	Genebank Building Construction	Feb. 13 - 19, 1989	1
6.	Dr. S.A. Eberhart	- do -	Feb. 10 - 18, 1989	1
7.	Dr. David Mears	Greenhousescrawl Construction	Aug.10-Sept.6, 1989	4
8.	Dr. S.M. Dietz	Germplasm Evaluation	Oct.21-Nov.11, 1989	3
9.	Dr. S.A. Eberhart	Genebank Building Construction	Nov.27-Dec.04, 1989	1
10.	Dr. T.T. Chang	Geneballk Building Construction	Nov.27-Dec.04, 1989	1
11.	Dr. Roberi P. Kahn	Plant Quarantine	Ju1.20-Aug.10, 1990	3
12.	Dr. Jimmie D. Mowder	Data Documentation	Apr. 18-30, 1992	2
13.	Dr. Edward Bird	- do -	Apr.18-30, 1992	2

ATTACHMENT 4.20

SOME THOUGHTS ON GERMPLASM POLICIES AND PROCEDURES

By:
Dr. Kenneth O. Rachie
New Delhi/June 1993

PURPOSE AND PROBLEMS

The purpose of a germplasm system is to conserve and evaluate inclusive collections of economic crops and potentially important plants for the benefit of mankind. Although plant breeders and geneticists are considered the primary users of germplasm collections, many other scientists, academicians, commercial interests and farmers can study and utilize collections of germplasm. These facilities increase in importance every year as new-improved varieties replace original land races; and as natural habitats are being destroyed by deforestation, new settlements and other human activities.

The largest and most rapidly growing germplasm repositories are mainly focussed on acquisition, evaluation and information management. In fact, the status of such facilities is often based on numbers of accessions housed rather than on the quality and usefulness of germplasm maintained. Since the inward flow of "new" materials continues unabated, capacities of even the largest repositories will be reached rather sooner than later. Meanwhile, the sheer weight of numbers adds to the overwhelming task of evaluation, maintaining collections, information management, and distribution of germplasm. At present this problem appears open ended with no solution in sight.

Germplasm repositories strive to conserve all important genetic stocks representing new or different combinations of genetic characters. Unfortunately, virtually all repositories are replete with prodigious numbers of duplication or closely related stocks. These arise from having received the same set of materials from different sources (often renamed and renumbered); or because plant collectors in their enthusiasm over new collections prefer to err on the side of 'plenty' rather than to ensure true diversity or separate identity for each collection. Whatever the reasons for this inevitable duplication, genetic resources personnel have a major headache in determining which collections deserve nomination to "accession" status, which should be blended or bulked up with "near identicals", and which should be discarded.

RATIONALIZING THE SYSTEM

There are various ways to address the problem of accession overload. These can be considered from the outset or the problem can be deferred until the system is completely clotted up. From several standpoints it would seem desirable to address a

long-term strategy from the very inception of the program. If properly planned and carried, out all aspects of the system's functions and activities could be improved, particularly germplasm distribution.

One approach to rationalizing a germplasm system would consist of following a series of steps designed to control and integrate genetic diversity at each stage of the process. These might include:

1. Eliminating duplicates and near duplicates by discarding and bulking up.
2. Evaluating the germplasm at two or more contrasting environments.
3. Adopting a multi-tiered identification procedure.
4. Classifying germplasm according to both variant and invariant characters.
5. Selecting special purpose nurseries based on use and genetic attributes.
6. Distributing germplasm mainly as special purpose nurseries, which can be made up in advance.

The fundamental principle of this proposal is to identify and conserve "total" genetic diversity; although a modicum of heterogeneity may be tolerated and may even be desirable in an identifiable accession. On this basis, it should be possible to eliminate or bulk up duplicates based primarily on passport data and cursory examination of seeds or plants.

At the beginning and with each lot of new introductions and collections, extensive nursery grow outs should be made under two or more contrasting environments. Based on growth performance and certain invariant characters, a classification can be made and near identical lines can be detected. At a certain and pre-specified level of similarity, these near identicals can be bulked up according to an appropriate procedure. However, remnant seeds/plants could be preserved separately as very small amounts under the original "log-in" identity (these are not considered as germplasm accessions and would not normally be distributed).

In order to reduce the numbers of duplicates and near-identicals, it may be necessary to establish a protocol for nominating "raw" collections or introductions to accession status. This can be done by germplasm repository and crop commodity scientists keeping in mind that conservation space, record keeping and handling are inevitably limited. It is further suggested that the burden of proof for nominating new germplasm accession be dependent on careful study of passport data, collection information and field grow out evaluations from at least two contrasting environments. This procedure should also be applied to previous accessions not subjected to the protocol and rigorous evaluation.

After the minimum of two grow outs under contrasting environments, individual lines are classified according to their characters and growth performance (using protocols established by Crop Advisory Committees). Duplicates and near duplicates are bulked up and special purpose nurseries are selected. At this juncture "permanent" accessions numbers are assigned. All future seed distributions derive only from these

permanent accessions. Depending on the level of discrimination practiced, this procedure could greatly reduce the number of accessions maintained while retaining virtually all of the genetic diversity acquired. These multiple grow- outs offer an excellent opportunity to classify materials - preferably according to use or growth habit, and to select special purpose nurseries. At least three such nurseries based on total genetic diversity and special attributes will be needed.

1. **Inclusive Collection :** All accessions in the genus (or species).
2. **Representative Nursery :** This nursery is intended to represent total genetic diversity but not necessarily all permutations of genetic characters across the spectrum of diversity : eg. 500 to 1000 lines from large collections.
3. **Diverse Germplasm Group :** Similar to the Representative Nursery but comprises fewer accessions (eg. 100 - 200).
4. **Special Purpose Nurseries :** These may be formed from accessions representing special characteristics and uses, such as : stress response, season/environment adaptation, seed quality, product quality, pest/disease reaction (if appropriate), and others. Since most requests for germplasm can be fulfilled with one or more of these nurseries, several sets can be prepared at once to increase efficiency.

It should be noted that it is not necessary to discard collections on the basis of presumed duplication. Rather, blending or bulking up can be done to conserve undetected diversity, and a small remnant sample of each collection not nominated to accession status may be conserved indefinitely in cryopreservation/storage.

The multi-location grow outs, evaluations, classification, elimination of duplicates and selection of special purpose nurseries will require considerable effort by experienced and knowledgeable teams of scientists. Specific procedures to be followed for each crop should be established by the appropriate Crop Advisory Committee, some of whom might be co-opted for part of the job. However, it would also provide an excellent opportunity for crop scientists, particularly the younger set, to learn about their species.

GERMPLASM CONVERSION

A primary objective of germplasm conservation is to provide genetic materials for present an future use by plant scientists and others. However, it is often disappointing and puzzling why so little use is made of much preserved germplasm. In fact there does not seem to be good information on the type of germplasm requested - a study that might be recommended for gene banks. If, for example, it turns out that least use is being made of collections of unimproved land races, it may be prudent to consider alternatives to occupying large storage facilities with little used collections of germplasm that inevitably replace more useful stocks.

On the other hand, the reason that large blocks of genetically diverse materials are not used is because they are difficult to grow, will not flower under prevailing

conditions, carry too many undesirable traits, or because plant scientists are unfamiliar with their potential. This was the case of sorghum collections nearly 30 years ago before the Sorghum Conversion Program was brilliantly conceived by a USDA sorghum breeder, Joe Stevens at Plainview, Texas. The resulting project became a joint endeavor between USDA and Texas sorghum scientists working at Puerto Rico (short days) and in Texas (long days). The initial set of exotics had been selected from the world sorghum germplasm collection assembled and evaluated in India in the early 1960s. The objective was to convert tall-late exotics to dwarf-early lines through a backcrossing procedure designed to retain as much of the genetic character of the exotic as possible. However, the early derivatives of these manipulations (eg. after only 1-3 BC cycles) turned out to be so valuable, the segregating materials were quickly snapped up by public and private plant breeders and incorporated directly into their breeding programs.

By the l980's a worldwide sorghum "revolution" was underway based on the partially converted genetic stocks : yields were rising, stress tolerances increased, pest resistance were incorporated, and grain quality was being improved. From this program it had become possible to reach another plateau of performance in terms of resistance to leaf diseases, increased insect tolerances, improved grain qualities (like larger grain size, increased carotene, higher lysine, and special quality endosperms (yellow, sugary, waxy, high diastatic power) and other new and useful genetic materials.

This approach could and perhaps should be adopted for other crops where large, under-utilized collections are available. Obviously, each species would require on evaluation for desired conversion objectives. These might include day length sensitivity or insensitivity, major disease or pest resistances, stress tolerance, or seed qualities in addition to/rather than short stature and earliness.

It should be noted that germplasm conversion has not yet been mandated to the NBPGR.

Whether germplasm scientists or commodity breeders/scientists assume leadership and administrative responsibilities for conversion activities is secondary to the importance of representatives from both groups working together in a team effort. Indian scientists applying some of these new approaches to innovative plant germplasm enhancement would simultaneously forge ahead of other national germplasm programs and accelerate improvement of their major crops and economic plants.

ATTACHMENT 4.21

PGR PROJECT EQUIPMENT LISTS

TRANCHE I EQUIPMENT

SER NO.	EQUIPMENT	NOS.	EST.CIF COST (FOB+25%)	DELIVERY POINT (NBPGR)	INSTALL
1	ULTRACENTRIFUGE	1 1	207,576 207,576	NEW DELHI HYDERABAD	YES YES
2	MICROSPECTROPHOTOMETER	1	272,800	DROPPED	–
3	AUTOMATIC GLASSWARE WASHER	4	35,960	NEW DELHI	NO
4	AUTOMATIC MOISTURE TESTER	19	51,219	NEW DELHI	NO
5	ELISA INSTRUMENTATION KIT	2 1	45,468 22,734	NEW DELHI HYDERABAD	YES YES
6	PIPETTING MACHINE	2	5,997	NEW DELHI	NO
7	MECHANICAL HOMOGENIZER	2	18,977	NEW DELHI	NO
8	CONTINUOUS SEED BLOWER	11	97,662	NEW DELHI	NO
	TOTAL	**44**	**965,969**		

Source : Winrock International PGR Quarterly Report 1993, No. 5

TRANCHE II EQUIPMENT

SER NO.	EQUIPMENT	NOS.	EST. UNIT COST	EST. CIF COST (.25%)	DELIVERY POINT (NBPGR)	INSTALL
9	SEED DRYING CABINETS	25	200,000		NEW DELHI	NO
10	BAR CODE PRINTER AND SCANNER	1	15,000		NEW DELHI	NO
11	MICROSCOPE, TRINOCULAR	1	30,000		NEW DELHI	YES
12	FREEZE DRYER	1	20,000		NEW DELHI	YES
13	TEMPERATURE GRADIENT PLATE	1	12,000		NEW DELHI	YES
14	VACUUM HEAD SEED PLANTER	1	1,000	1,240	NEW DELHI	NO
15	SPECTROPHOTOMETER, DIODE ARRAY	1	36,300	58,261	NEW DELHI	YES
16	MICRO BALANCE	1	12,000		NEW DELHI	YES
17	PHOTO DOCUMENTATION SYSTEM	1	15,000	18,600	NEW DELHI	YES
18	MICROSCOPE, STEREO WITH CAMERA ATTACHMENTS	1	100,000		NEW DELHI	YES
19	MICROSCOPE, COMPOUND, TRINOCULAR	1	6,000		NEW DELHI	YES
20	FIELD DATA RECORDER	23	161,000	99,820	NEW DELHI	YES
21	CAMERA	14	28,000		NEW DELHI	NO
22	DEEP FREEZER	3	27,000	18,600	NEW DELHI	YES
23	SPECTROPHOTOMETER	2	25,000	52,558	NEW DELHI	YES
24	DENSITY GRADIENT FRACTIONATOR	2	36,000		NEW DELHI	YES
25	BALANCE, ANALYTICAL	2	5,000		BHOWALI	NO
26	ELISA KIT	1	2,000	22,734	NEW DELHI	YES
27	NITROCELLULOSE MEMBRANE	2	3,000	6,100	NEW DELHI	NO
28	LABORATORY JACKS	2	800	1,860	NEW DELHI	NO
29	MAGNETIC STIRRING BARS	2	1,000	1,860	NEW DELHI	NO
30	DIALYSIS TUBES	2	1,600	5,456	NEW DELHI	NO
31	PARAFILM WITH DISPENSER	2	900	868	NEW DELHI	NO
32	MULTI MAGNESTIR	2	3,000		NEW DELHI	NO
33	STIRRER, MICRO-PROCESSOR CONTROLLED	2	1,400		NEW DELHI	NO
34	DIGITAL APPENDORF PIPETTORS	1	2,500	3,760	NEW DELHI	NO
35	ELECTROPHORESIS SYSTEM	2	20,000		NEW DELHI	YES
36	MB – DISPENSER	12	9,000		NEW DELHI	NO
37	MULTIGAS DETECTOR	10	15,000		NEW DELHI	NO
38	AMBIENT AIR ANALYSER	1	5,000	27,983	NEW DELHI	YES
39	DIGITAL POLARIMETER	1	16,000		NEW DELHI	YES
40	GAS CHROMATOGRAPH	1	27,000		NEW DELHI	YES
41	ROTARY EVAPORATOR	1	3,400		NEW DELHI	YES
42	SCANNING CALORIMETER	1	34,000		NEW DELHI	YES
43	FREEZER, PROGRAMMABLE	1	26,000	19,964	NEW DELHI	YES
44	INCUBATOR SHAKER, GYRATORY	1	18,000	22,320	NEW DELHI	YES
	TOTALS	128	918,900	361,984		

TRANCHE III EQUIPMENT (Tentative)

SER. NO.	EQUIPMENT	NOS.	TOTAL COST (FOB) in US.$	DELIVERY POINT (NBPGR)
45	AUTO ANALYSER	1	20,000	NEW DELHI
46	BENCH TOP AGAR STERLIZER	1	10,000	NEW DELHI
47	COLOR GRAPHIC PLATTER	1	2,000	NEW DELHI
48	COLD STORAGE MODULE (for LONG-TERM)	2	100,000	NEW DELHI
49	COLD STORAGE MODULE (for MED-TERM)	18	500,000	NEW DELHI
50	COPENHAGEN TANKS	2	16,000	NEW DELHI
51	CRYOSTATE	1	15,000	NEW DELHI
52	CARYOVAT (CARYO CONTAINERS)	2	29,000	NEW DELHI
53	CRYOSTARFREEZER	1	8,000	NEW DELHI
54	CRYOMICROTONE	1	12,000	NEW DELHI
55	DOT MATRIX PRINTER	1	1,000	NEW DELHI
56	GAS CHROMATOGRAPH (HP-5890)	1	20,000	NEW DELHI
57	HIGHSPEED REFRIG. CENTRIFUGE	2	8,000	NEW DELHI
58	HPLC WATER ASSOCIATES	1	40,000	NEW DELHI
59	HPTLC INSTRUMENT	1	30,000	NEW DELHI
60	ICE FLASKES MACHINE	3	2,000	NEW DELHI
61	LYPHOLIZER	1	18,000	NEW DELHI
62	MILLIPORE WATER PURIFYING SYSTEM	1	8,000	NEW DELHI
63	MICRO COMPUTER AND PRINTER	1	12,000	NEW DELHI
64	AUTOMATIC POLARIMETER	1	15,000	NEW DELHI
65	ROTARY EVAPORATOR	1	3,000	NEW DELHI
66	SEED DRYER	3	4,500	NEW DELHI
67	SEED DRYING CABINET	21	105,000	NEW DELHI
68	SOFT X-RAY PLANT	2	16,000	NEW DELHI
69	STEREO BINOCULAR MICROSCOPE	20	40,000	NEW DELHI
70	STORAGE MODULE (for MED.TERM)	2	100,000	NEW DELHI
71	WALK-IN ROOM GERMINATOR	3	30,000	NEW DELHI
72	TRANSMISSION ELECTRON MICROSCOPE	2	400,000	NEW DELHI
73	UTLRA MICROTOME WITH ACCESSORIES	1	25,000	NEW DELHI
74	ULTRASOUND & COMPUTER VISION	1	20,000	NEW DELHI
75	VACCUM FUMIGATION PLANT - 1000 capacity	3	75,000	NEW DELHI
76	VACCUM FUMIGATION PLANT - 500 capacity	1	10,000	NEW DELHI
77	VAPOUR HEAT TREATMENT PLANT	1	30,000	NEW DELHI
	TOTAL	104	1,724,500	

ATTACHMENT 4.22

INDO-U.S. PGR PROJECT

EQUIPMENT SUPPORT TO COOPERATING CENTRES
(Tentative Allotment Based on Proposals)

Name of the Centre	Name of the Equipment	
	Imported	Indigenous
1. CICR, Nagpur	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph
2. IGFRI, Jhansi	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph
3. SBI, Coimbatore	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph
4. IIHR, Bangalore	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph
5. CRRI, Cuttack	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph
6. Directorate of Pulses Research, Kanpur	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph
7. Directorate of Wheat Research, Karnal	* 1. Continuous seed blower	# 1. Seed germinator
	* 2. Digital moisture tester	# 2. Drying oven
	3. Seed drying cabinet	# 3. Personal computer
	4. Medium term storage module	4. Hygro-thermograph

8. Proj.Coordinator (Minor Millets), Bangalore	* 1. Continuous seed blower * 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	# 1. Seed germinator # 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
9. Proj.Coordinator (Rape Seed & Mustasrd), Haryana	* 1. Continuous seed blower * 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	# 1. Seed germinator # 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
10. NRCG,Junagadh	* 1. Continuous seed blower * 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	# 1. Seed germinator # 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
11. NRCS, Indore	1. Continuous seed blower 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
12. VPKAS,Almora	1. Continuous seed blower 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
13. NRCS, Hyderabad	1. Continuous seed blower 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
14. Directorate of Oilseeds Research, Hyderabad	1. Continuous seed blower 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
15. Proj.Coordinator (Maize), New Delhi	1. Continuous seed blower 2. Digital moisture tester 3. Seed drying cabinet 4. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermograph
16. CPRI, Shimla	-	1. Deep freezer

*** Supply order placed by Winrock International**
 # Procured and supplied

INDO-U.S. PGR PROJECT

EQUIPMENT SUPPORT TO NBPGR STATIONS

Name of the Centre	Name of the Equipment	
	Imported	Indigenous
1. NBPGR Regional Station Akola	1. Seed drying cabinet 2. Digital moisture tester 3. Field data recorder 4. Camera 5. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermographer 5. Air conditioner
2. NBPGR Regional Station Trichur	1. Seed drying cabinet 2. Digital moisture tester 3. Field data recorder 4. Camera 5. Medium term storage module	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermographer 5. Air conditioner
3. NBPGR Regional Station Bhowali	1. Seed drying cabinet 2. Digital moisture tester 3. Field data recorder 4. Camera 5. Medium term storage module	1. Seed germinator 2. Drying oven 3. Personal computer 4. Hygro-thermographer
4. NBPGR Regional Station Shillong	1. Seed drying cabinet 2. Digital moisture tester 3. Field data recorder 4. Camera 5. Medium term storage module	1. Seed germinator 2. Drying oven 3. Personal computer 4. Hygro-thermographer 5. Photo copier
5. NBPGR Regional Station Shimla	1. Seed drying cabinet 2. Digital moisture tester 3. Field data recorder 4. Camera 5. Medium term storage module	1. Seed germinator 2. Drying oven 3. Personal computer 4. Hygro-thermographer
6. NBPGR Regional Station Johdpur	1. Seed drying cabinet 2. Digital moisture tester 3. Field data recorder 4. Camera 5. Medium term	1. Seed germinator 2. Drying oven 3. Personal computer 4. Hygro-thermographer 5. Air conditioner

	storage module	
7. NBPGR Exploration Base Centre, Cuttack	1. Seed drying cabinet 2. Field data recorder 3. Camera	1. Seed germinator 2. Drying oven 3. Personal computer 4. Hygro-thermographer
8. NBPGR Exploration Base Centre, Ranchi	1. Seed drying cabinet 2. Field data recorder 3. Camera	1. Seed germinator 2. Drying oven 3. Personal computer 4. Hygro-thermographer
9. NBPGR Plant Quarantine Station Hyderabad	1. Ultra centrifuge 2. Elisa kit 3. Spectrophotometer 4. Density gradient fractionator # 5. Analytical balance # 6. Nitro-cellulose membrane # 7. Laboratory jacks # 8. Magnetic stirring bars # 9. Dialysis tubes # 10. Parafilms with dispenser 11. Microprocessor controlled stirrer 12. Electrophoresis system	1. Seed germinator 2. Drying oven # 3. Personal computer 4. Hygro-thermograph 5. Air conditioner

Procured and supplied

ATTACHMENT 4.23

SUMMARY OF PGR PROJECT COSTS
(GOI CONTRIBUTIONS)

(In '000 Dollars)

Components		Budget provisions	Expenditure incurred upto March 31, 1993		
			In kind	In cash	Total
1.	Construction				
A.	Headquarters Gene Bank	3200	-	1967.2	1967.2
B.	Greenhouse/Screenhouse				
C.	Staff Housing				
D.	Construction contingency				
	(i) Contingency	600	-	-	-
	(ii) Inflation	1700	-	-	-
2.	Equipment	500	-	194.0	194.0
3.	In-country training	100	-	31.9	31.9
4.	Technical assistance, collaborative research and joint exploration	200	-	-	-
5.	Project operations, Implementation and Administrative Support Cost	1925	-	590.2	590.2
6.	Evaluation/monitoring/audit	15	-	-	-
7.	Land	-	4615.4	-	4615.4
8.	Contingency	90	-	-	-
9.	Allowances for inflation	720	-	-	-
	Total	**9250**	**4615.4**	**2783.3**	**7398.7**

India Plant Genetic Resources (PGR) Project
Total Project Expenditure as of March 31, 1993
(Information given by Winrock International/USAID)

	Element	Earmark	Committed	Cum.Exp. 12/31/92	Jan-Mar. Qtrs.	Total[1] 3/31/93
19	TA	1,229,975	1,229,875	635,361	168,669	804,030
20	Trng.	896,732	896,732	566,068	0	566,068
	MSS[2]	100,000	100,000	0	13,000	13,000
30	In-country Training	110,000	110,000	10,500	127	10,627
40	Commodities					
	MSS	1,800,000	1,800,000	33,018	86,982	120,000
	LC	400,000	400,000	150,000	23,284	173,284
50	Construction					
	MSS	600,000	600,000	0	0	0
	LC	1,950,000	1,950,000	540,000	359,184	900,000
60	Other Direct Costs					
	MSS	570,000	570,000	461,000	139,289	601,142
	LC	130,000	100,000	3,540	11,460	15,000
70	Contingencies	0	0	0	0	0
Total Costs ($)		7,777,707	7,747,707	2,401,156	801,995	3,203,151

Note : 1. Figures include actual expenditure plus estimated accruals.

2. Components under the Winrock MSS Contract

ATTACHMENT 4.24

ILLUSTRATIVE SUMMARY OF PROJECT COSTS UPTO AND INCLUDING THE FIFTH AMENDATORY AGREEMENT

Components	A.I.D. Contributions			GOI Contri-butions	Total Costs
	FX Costs	LC Costs	Sub-Total		
1. CONSTRUCTION					
A. Headquarters/Gene Bank	0	3,200	3,200	3,200	6,400
B. Greenhouse Screenhouse procurement/erection	1,150		1,150	0	0
C. Staff housing	0	0	0	0	0
D. Construction contingency and inflation allowances:					
(i) Contingency	0	0	0	60	600
(ii) Inflation	0	0	0	1,900	1,900
2. EQUIPMENT (Laboratory, field, office and vehicles)	4,500	500	5,000	500	5,500
3. TRAINING					
a) In India	0	110	110	100	210
b) Overseas	1,200	0	1,200	0	1,200
4. TECHNICAL ASSISTANT, COLLABORATIVE RESEARCH AND JOINT EXPLORATION	1,600	0	1,600	200	1,800
5. PROJECT OPERATIONS, IMPLEMENTATION AND ADMINISTRATIVE SUPPORT COSTS	1,525	100	1,625	1,925	3,550
6. EVALUATION/MONITORING AUDIT	95	0	95	15	110
7. SUBTOTAL	10,070	3,910	13,980	8,440	22,420
8. CONTINGENCY (Not Included Items 1 & 7)	0	220	220	90	310
9. ALLOWANCES FOR INFLATION (Not included items 1 & 7)	300	200	500	720	1,220
10. TOTAL	10,370	4,330	14,700	9,250	23,950

* For purpose of this agreement, the exchange rate for determining the amount of host contribution over the LOP is $1.00 = Rs. 14.30 which was prevalent on the date of signing of the original agreement.

ATTACHMENT 4.25 DOCUMENTATION

Project Paper, Plant Genetic Resources (PGR) Project. August 1988

Project Grant Agreement for Plant Genetics Resources. AID Project No.386-0513, August 31, 1988.

Contract No.386-0513-C-00-2007-00, USAID and Winrock International, Institute for International Development. November 22, 1991.

Participating Agency Service Agreement. USAID and US Department of Agriculture. February 21, 1990.

Indian Council of Agricultural Research, National Bureau of Plant Genetic Resources, Quarterly Report Nos. 1-5, July 30, 1992 - March 31, 1993.

Indo-US Plant Genetic Resources Project. Status Report for Mid-term Evaluation, NBPGR, May 1993.

NBPGR, Newsletters, Volume 8, Nos. 1-4, 1992.

NBPGR, Annual Report 1991-1992.

NBPGR Research Highlights, 1990-1991.

NBPGR Research Highlights, 1991-1992.

Winrock International, PGR Quarterly Reports, Nos. 1-5, June 1992-March 1993.

Plant Genetic Resources, Documentation and Information Management, NBPGR 1992.

Plant Genetic Resources, Indian Perspective and NBPGR Symposium Proceedings, March 1987.

Request for Proposal for the Supply, Construction, and Commissioning of Greenhouse Facilities. RFP No. PGR 2463, Winrock International, August 14, 1992.

Indo-US PGR Project. Fabrication/Erection of Plant Quarantine Greenhouse Off-Shore Facility, providing for two sites. Personal communication, R.S. Rana, May 28, 1993.

Indo-US PGR Project. Equipment Support to Cooperating Centers. Personal communication, R.S. Rana, May 28, 1993.

USDA.ARS. National Seed Storage Laboratory, Ft. Collins, Colorado, Policy Guidelines. Personal communication, May 25, 1993.