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**PLANT BREEDING RESEARCH AND TEACHING
AT
SINDH AGRICULTURAL UNIVERSITY**

A Consultancy Report

by

Gurdev S. Khush

March, 1990

PARC • USAID • MART • WINROCK

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Head Division of Plant Breeding, Genetics
and Biochemistry
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A

The MART (Management of Agricultural Research and Technology) Project is funded by the United States Agency for International Development (USAID). The MART Project's chief link to the Government of Pakistan is through the Pakistan Agricultural Research Council (PARC). A MART Project Coordination Committee composed of federal, provincial, and university representatives coordinates and guides project activities. Its purpose is to assist the Pakistani agricultural research system to strengthen its research management capabilities, and to improve communications, training, farming systems research, arid zone research, and research in the rural social sciences. Winrock International, through a contract with USAID, has responsibilities to assist with the first four of these tasks. Two international agricultural research centers, the international maize and wheat improvement center (CIMMYT) and the International Center for Agricultural Research in Dry Areas (ICARDA), are responsible for the other two tasks.

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CONTENTS

	<u>Page</u>
Introduction	1
Establishment of Institute of Plant Breeding	1
Research Projects of Teacher's in Plant Breeding	3
Teaching program of Plant Breeding and Genetics	3
Research Projects of Students	4
Rice Improvement for Lower Sindh	4
Raising the Teaching and Research Standards	5
Establishment of Linkages Between SAU, Rice Research Institute, Dokri and IRRI	5
Appendix I	7
Appendix II	8
Appendix III	10

INTRODUCTION

I was invited for a week's consultancy trip to Sindh Agriculture University by Vice Chancellor, Dr. I.M. Bhatti. The terms of reference for the consultancy trip are given in Appendix I.

I was received warmly by the Vice Chancellor, his senior administrative colleagues and member of various faculties of the university. I also had the opportunity to visit Agriculture Research Institute and Atomic Energy Agriculture Research Center which are located nearby. I had in depth discussions about the objectives and organization of the proposed Institute of Plant Breeding with the staff of department of Genetics and Plant Breeding. I reviewed the research and academic programs of the department of Genetics and Plant Breeding and met with several graduate students. I was glad to have the opportunity of visiting Rice Research Station Thatta which is located in the middle of the rice growing area of lower Sindh. It was a great honor to meet the acting Governor of Sindh province Justice Sajjad Ali Shah on the last day of my visit.

I am grateful to the Vice Chancellor and his staff for all the courtesies extended to me during my stay and for fine hospitality. My special thanks go to Dr. Mohammad Ishaque A. Memon, Professor of Plant Breeding and Genetics and Dr. Rahim Bux Mirbahar, Professor of Plant Physiology, who were with me throughout the trip and for their memorable company. The itinerary of my trip is given in Appendix II and the persons met during the trip are listed in Appendix III.

1. Establishment of Institute of Plant Breeding

Sindh is predominantly an agricultural province and more than 70% of its population is engaged in agriculture. It is endowed with rich agricultural resources. It has fertile alluvial soils, abundant resources of irrigation water from river Indus, year round growing season and very hardworking people. Yet average yields of most crops are much below the average world yields. For example, average yield of rice in Sindh is only 2.3 tons/ha as compared to 3 tons/ha world average and over 6 tons/ha in Egypt, Japan, Korea and Australia. The average yield of wheat in Sindh is 2.0 tons/ha as compared to 2.5 tons/ha world average. Vegetable oils and pulses are important items in the daily diet of Sindhi people, yet the province is deficient in these commodities and huge sums are spent upon importation of these items. A wealth of vegetable crops are grown in the province but the seeds are imported from Japan and other countries. Well organized research programs for the improvement of pulses, oil seeds, vegetable crops and fodder crops do not exist in the province.

Recent success of green revolution in raising the productivity of wheat and rice worldwide shows that well organized research

programs on crop improvement and management can lead to major breakthroughs in increasing the crop yields.

Sindh Agriculture University, Tandojam has a well trained and young staff in department of Plant Breeding and Genetics. Most of them have been trained abroad and have higher degrees from world's premier universities. The main responsibilities of the staff are the teaching of the undergraduate and graduate courses in Plant Breeding and Genetics. Facilities for research are limited. Thus, the talents of highly trained staff are not fully utilized. On the other hand, research on crop improvement is neglected. The establishment of Institute of Plant Breeding will help remedy the situation. It will (1) help optimize the use of talents of trained staff, (2) stimulate research on crop improvement, (3) will lead to the development of laboratories and facilities for high caliber research, (4) will provide opportunities for the training of large number of graduate students, and (5) will help establish a center of excellence on crop improvement. Thus, I strongly endorse the proposal for the establishment of Institute of Plant Breeding.

I have gone through the document PC-1 for the establishment of Institute of Plant Breeding carefully. The document is well prepared. I have the following suggestions.

- i. The organization of various divisions into departments gives the impression of fragmentation and unwieldy management. The divisions should have sections on a particular crop not the separate departments. For example Division of Vegetable Breeding should have sections on solanaceous vegetables, cucurbitaceous vegetable and liliaceous and maluaceous vegetables. Each division should be headed by a strong leader.
- ii. In addition to the proposed divisions, I strongly recommend addition of a Division of Genetic Research. Genetic resources are the backbone of any crop improvement program. Breeding programs are initiated with the collection, introduction, evaluation and hybridization of landraces or crop varieties. Each year new introductions and breeding lines are added. Maintenance of the germplasm of each crop by individual breeders become a cumbersome job and over time valuable materials are lost. The division of Genetic Resources should be given the responsibility of conservation of germplasm of all crops and appropriate facilities for short, medium and long term storage of germplasm comparable to modern gene banks should be developed. With the addition of division of Genetic Resources, need for division of Economic Botany becomes redundant. Collection, cataloguing, evaluation and selection of medicinal and aromatic plants and spices and condiments can be handled by the division of Genetic Resources.

- iii. The proposed institute should also have a division of Crop Physiology. Modern crop improvement programs draw heavily upon the knowledge of crop physiology. For Example in selecting more productive and efficient plant types, a knowledge of crop ideotypes developed by plant physiologists is essential.
- iv. I propose that a division of Publications and Communications be added. This division should assume responsibility for preparing publications, bulletins and newsletters on crop varieties and management practices and disseminate the publications to the farmers all over the state.

2. Research Projects of Teacher's in Plant Breeding

I had the privilege of discussing with several staff members of the department of Plant Breeding and Genetics, the research projects being pursued by them. I have also gone through document on Research and Academic Programs of department of Plant Breeding and Genetics which lists a few of the research projects of staff members. In general, the research projects are well thought of and address the crop improvement problem of the state. However, I feel that emphasis should be put on the more basic aspects of crop improvement. For example, drought and salinity are the two serious problems in the state. Projects aimed at understanding the mechanisms of resistance, genetic of resistance and breeding and selection procedures for salinity and drought would generate useful knowledge for crop improvement.

3. Teaching program of Plant Breeding and Genetics

I have gone through the document research and academic programs of department of Plant Breeding and Genetics with pleasure. It lists the undergraduate and graduate courses taught by the staff of the department. There is an excellent coverage of the subject matter by different courses. Only area which is not covered is crop evolution. A 3 unit course on principles of plant evolution including origin of cultivated plant would be a useful course to add.

There are two courses (introductory genetics and breeding I and introductory genetics and plant breeding II) which cover a mixture of topics on genetics and plant breeding. In place of these two courses it would be advisable to have two courses; one on introductory genetics and the other on introductory plant breeding. For example, linkage, polyploidy, chromosomal aberrations, changes in chromosome number, aneuploidy, DNA structure and function, etc. should be combined with the subject matter of introductory course on genetics. Breeding methods etc. should be covered in the introductory course on plant breeding.

I do not see any difference in the subject matter covered by elementary (PBG 501) and plant biotechnology (PBG 603). Perhaps these two courses should be combined into one course or the subject matter of PGB 603 should be modified to include principles of recombinant DNA technology and plant transformation.

Generally a course on cytology is considered a prerequisite to course on cytogenetics. Here cytology (PBG 701) is a higher numbered course than cytogenetics in crop improvement (PBF 507 and PBG 508). Rationale for this is not clear.

I also feel that course on breeding of individual crops such as breeding of tobacco and oil seed crops (PBG 604) or breeding for cereal crops (PBG 606) etc. are not necessary. Principles of breeding are applicable to all crops. What is needed are high caliber courses on principles of genetics and plant breeding, biometry, population genetics, cytogenetics and biotechnology. Armed with this knowledge, the students can read the literature dealing with improvement of individual crops themselves. Elimination of crop specific breeding course would help free the time of staff members for more fundamental research.

4. Research Projects of Students

I have gone through the synopses of thesis projects of Ph.D students listed in the document Research and Academic Programs, of department of Plant Breeding and Genetics. All of them are on field oriented research and a very high proportion are on quantitative genetics, particularly on diallele analysis. A few of them are on mutation breeding. The caliber of the research projects is high. However, it would be good idea if some students are trained in cytogenetics and tissue culture. I recommend that laboratories for teaching and research on cytogenetics and tissue culture be established as soon as possible. More emphasis should be put on developing thesis projects on genetics of disease and insect resistance and stress tolerance.

5. Rice Improvement for Lower Sindh

Lower Sindh comprising districts of Badin, Thatta and Hyderabad is an important rice growing area. Of the total area of 1.8 million acres planted to rice in Sindh, 30% or 0.6 million acres is in lower Sindh. This region is characterized by comparatively mild temperatures, longer growing period, brackish sub-soil water, water logging and high level of salinity. The average yield of rice (1.8 ton/ha) is much lower than state average of 2.3 tons/ha. Since the rice growing problems of this region are quite different than those of middle and upper Sindh, the Government of Sindh took a very wise initiative to establish the Rice Research Station at Thatta under the overall supervision of Rice Research Institute Dokri. I was glad to visit the new station and discussed the rice growing problems of the area with Dr. G. M. Avesi, Deputy Director

cum Economist Botanist of the station and his staff. High yielding varieties, with salinity tolerance, short stature, good grain quality and resistance to stemborers are badly needed. Some promising lines with yield potential of more than 6 tons/ha have been identified on the basis of replicated yield trials conducted during last 3 years. Moreover, this area is highly suitable for growing two crops of rice a year, if short duration varieties with salinity tolerance become available.

IRRI has a collaborative network involving several national programs for developing rice varieties with tolerance to problem soils including salinity. Under this program early generation materials developed for salinity tolerance are evaluated at key sites in national programs. Arrangements were discussed with Deputy Director, Rice Research Station, Thatta, for sharing and evaluation of early generation breeding materials and fixed lines at Thatta. Hopefully, this collaboration will result in the identification of high yielding and salinity tolerant rice varieties suitable for lower Sindh.

6. Raising the Teaching and Research Standards

I had the ample opportunity to interact with the staff members of the department of plant breeding and genetics to determine the difficulties faced by them in further improving the teaching and research standards. It was obvious to me that the staff is well trained and highly motivated. However, laboratory facilities and equipment for research are wholly inadequate. Therefore, immediate attention should be paid to develop teaching and research laboratories for cytogenetic, tissue culture, molecular genetics and service laboratories for determining the quality of crop products. Establishment of institute of plant breeding should help alleviate this problem. Opportunities should be provided to the staff of the department for short term visits to the well reputed research institutes and universities abroad either to undergo a short term training or to attend international conferences or workshops. Sindh Agricultural University should try to establish linkages and closer working relationships with crop specific institutes within the CGIAR system such as IRRI, CIMMYT, ICRISAT, ICARDA, CIP and IITA or non CGIAR centers such as AVRDC.

7. Establishment of Linkages Between SAU, Rice Research Institute, Dokri and IRRI

The stated goal of IRRI is "improved well being of present and future generations of rice farmers and consumers, particularly those with low income". To meet this goal IRRI generates and disseminates rice-related knowledge and technology of short and long term environmental, social and economic benefit and to help enhance national rice research systems. IRRI insures the relevance

of research and complementarity of international and national research efforts through close collaboration with national programs.

Pakistan and IRRI have a long history of collaboration on rice research. Rice Research Institutes at Dokri and Kala Shah Kaku have exchanged the genetic materials with IRRI for the last 25 years and have released the improved materials emanating for this collaboration to rice farmers in Pakistan. Many scientists from Pakistan have received training at IRRI and others have participated in conferences, workshops and monitoring tours. To-date the collaboration in rice research in Sindh has been primarily through Rice Research Institute (RRI), Dokri. To enhance this collaboration further, it is suggested that a closer trilateral linkages be established between SAU, RRI Dokri, and IRRI. Such linkages would be particularly important for improving the quality of fundamental research on rice and in the area of training. For the latter purpose arrangement may be made whereby graduate students complete the course work for M.Sc. or a Ph.D. degree at SAU Tandojam and come to IRRI for thesis research. IRRI has similar arrangements with several universities in rice growing countries. It is recommended that Vice Chancellor of SAU visit IRRI along with a couple of his senior colleagues to discuss trilateral collaboration between SAU Tandojam, RRI Dokri and IRRI, with IRRI administration.

TERMS OF REFERENCE OF DR. G.S. KHUSH
CONSULTANT DURING HIS VISIT
(FROM 21st MARCH TO 26th MARCH 1990)
TO SINDH AGRICULTURE UNIVERSITY TANDOJAM, PAKISTAN

1. Review plan for the establishment of Institute of Plant Breeding, Sindh Agriculture University Tandojam. Suggest improvement in its structure, material and technical requirements.
2. Review research projects of the teachers in plant breeding and provide guidance for further refinements.
3. Review the entire area of teaching in plant breeding at Sindh Agriculture University Tandojam and suggest ways to strengthen the teaching to an international level.
4. Evaluate research projects of students, particularly Ph.D. scholarship and suggest improvement so as the Ph.D. degree acquires credibility within the international scientific community.
5. The consultant, along with teacher's will visit rice growing area in the province to identify on-farm problems to be solved through breeding effort.
6. Consult with faculty members regarding their research/teaching work and suggest training program as well as appropriate institutions so as to raise the teaching and research program to an international level.
7. Explore and suggest ways for the establishment of viable trilateral linkage between; IRRI, Philippines; IRRI, Dokri and Sindh Agriculture University Tandojam for conducting fundamental and applied research to boost rice production in Sindh.

ITINERARY

March 21, 1990 A.M.

Arrival Quaid-e-Azam International Airport, Karachi, 2:15 p.m.

Arrival Sindh Agricultural University, Tandojam, 5:00 a.m.

Called upon Vice Chancellor I.M. Bhatti and held discussions with the Vice Chancellor and his senior administrative colleagues.

Meeting with staff members of the department of Plant Breeding and Genetics and visits to the laboratories of the department.

March 21, 1990 P.M.

Visited the farmer's fields around Tandojam and the Tomb of Hazarat Shah Abdul Latif Bhattae at the nearby Hala town.

March 22, 1990 A.M.

Visited University library
Visited departments of Soil Science, Entomology and Plant Pathology.

March 22, 1990 P.M.

Visited departments of Social Sciences, Islamiyat, English, Agroecconomics, Rural Science, Statistics and Computer Center.

March 23, 1990

Visited Rice Research Station Thatta and held discussions with the Rice Botanist cum Director and his staff regarding the rice growing and improvement problems of the region and finalized arrangements for the exchange of rice breeding materials. Visited historical mausoleums in the vicinity of Thatta town. Returned to Tandojam in the evening.

March 24, 1990 A.M.

Discussions with staff members of the department of Plant Breeding and Genetics regarding the proposal for the establishment of Institute of Plant Breeding, research projects of individual staff members, syllabus of the department and research projects of graduate students.

March 24, 1990, P.M.

Visited the faculties of Agricultural Engineering and Animal Husbandry and Veterinary Medicine. Also visited the laboratories and fields of Agricultural Research Institute, Tandojam and the University farm.

March 25, 1990, A.M.

Delivered a seminar on the Rice Improvement Program of IRRI and held discussions with the seminar participants.

March 25, 1990 Noon

Lunch hosted by Vice Chancellor I.M. Bhatti at his residence followed by discussion with senior officials of the university.

March 25, 1990 P.M.

Visited laboratories of Atomic Energy Agriculture Research Center, Tandojam.

March 25, 1990 Evening

Official dinner hosted by the Vice Chancellor with the senior officials of Sindh Agricultural University, Agricultural Research Institute and Atomic Energy Agricultural Research Center.

March 26, 1990

Departure for Karachi 8 A.M.
Called upon the Acting Governor, Sindh Province and the Chancellor of Sindh Agriculture University, Tandojam.
Visited the Mausoleum of Quaid-e-Azam.
Departed for Manila at 6:45 P.M. via PK-760.

ADMINISTRATORS AND SCIENTISTS MET

Karachi

Justice Sajjad Ali Shah, Acting Governor, Sindh and Chancellor SAU, Tandojam

Sindh Agriculture University, Tandojam

- Dr. I.M. Bhatti, Vice Chancellor
 Dr. Noor Nabi Ansari, Director of Research and Advanced Studies
 Dr. Mohammad Ali Chang, Registrar
 Mr. Din Mohammad Soomro, Director Finance
 Dr. Umed Ali Buriro, Director, Planning and Development
 Dr. Shah Mohammad Burero, Dean, Faculty of Animal Husbandry and Veterinary Science
 Dr. Iman Bux Koondhar, Dean, Faculty of Agricultural Engineering
 Dr. Gularm Rasool Solangi, Dean, Faculty of Crop Production
 Dr. Rajab Ali Memon, Dean, Faculty of Social Sciences
 Mr. Shumusddin Soomro, Chairman, Department of Plant Breeding and Genetics
 Dr. Mohammad I. Memon, Professor or Plant Breeding and Genetics
 Dr. Rahim Bux Mirbahar, Professor of Plant Physiology
 Dr. Moula Bux Kumbar, Assistant Professor, Plant Breeding and Genetics
 Dr. Haji Khan Abro, Associate Professor, Plant Breeding and Genetics
 Dr. Mir Mohammad Rajpur, Assistant Professor, Plant Breeding and Genetics
 Dr. Noor Mohammad Shahani, Assistant professor, Plant Breeding and Genetics
 Dr. Abdul Jabbar Malik, Assistant Professor, Plant Breeding and Genetics
 Dr. Khuda Bux Mir Bahar, Chairman, Department of Animal Husbandry
 Mr. Mohammad Kalwar, Lecturer, Plant Breeding and Genetics
 Mr. Abdul Majid Khushk, Assistant Professor, Plant Breeding and Genetics
 Mr. Bashir Ahmad Ansari, Lecturer, Plant Breeding and Genetics
 Mr. Mohammad Khokhar, Librarian
 Dr. Gulam Hussain Memon, Chairman, Department of Soil Science
 Dr. Mohammad Yusuf Panhwar, Chairman, Department of Plant Pathology
 Mr. Mohammad Hanif Arain, Assistant Professor, Plant Pathology
 Dr. Mohammad Hashim Bhatti, Associate Professor, Plant Pathology
 Mr. Mumtaz Hussain Pathan, Assistant Professor, Plant Pathology
 Dr. Abdul Haque Soomro, Chairman, Department of Entomology
 Dr. Shafi Mohammad Nizamani, Chairman, Department of Plant Protection
 Mr. Ghulam Mohammad Baloch, Professor of Plant Protection
 Dr. Nazir Ahmađ Choudhry, Chairman, Department of Statistics

Mr. Sharafuddin Shah, Project Director
Mr. Khalid Ahmad, Project Engineer
Dr. Nazir Ahmad Leghari, Incharge, Farm Machinery Institute
Mr. Ghulam Mustafa Memon, Research Officer, Farm Machinery
Institute

Staff of Rice Research Institute, Dokri

Mr. Ghulam Abass Khohro, Director
Mr. Arbab Ali Soomro, Rice Breeder
Mr. M.R. Hakro, Entomologist

Rice Research Station, Thatta

Dr. Ghulam Mustafa Avesi, Deputy Director
Mr. Ghulam Hyder Issani, Deputy Director Extension, Thatta District
Mr. Ghulam Sarwar Soomro, Price Commission, Islamabad

Atomic Energy Agriculture Research Center, Tandojam

Dr. A. R. Azumi, Director
Dr. S. Naqvi, Head, Plant Physiology Division
Dr. G. M. Shah, Principal Scientific Officer, Plant Breeding
Dr. S. Ghafoor, Senior Scientific Officer, Plant Breeding
Mr. Mohammad Afzal Arain, Senior Scientific Officer, Plant Breeding
Mr. Shamimul Hassan, Incharge, Tissue Culture Program
Dr. A.R. Bughio, Entomologist

Agriculture Research Institute Tandojam

Mr. Altaf Hussain Choudhary, Director