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MANANAGEMENT OF AGRICULTURAL RESEARCH AND TECHNOLOGY PROJECT
(MART)

END OF TOUR REPORT

by

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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.

The mission of Winrock International Institute for Agricultural Development is to help reduce poverty and hunger in the world through sustainable agricultural and rural development. Winrock International assists people of developing areas - in Asia, Africa and the Middle East, Latin America and the Caribbean, and the United States - to strengthen their agricultural institutions, develop their human resources, design sustainable agricultural systems and strategies, and improve policies for agricultural and rural development. As an autonomous, nonprofit organization, Winrock International provides services independently as well as in partnership with other public and private organizations. The institute is recognized as a private voluntary organization.

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EXECUTIVE SUMMARY

The major constraints common to both agricultural research institutes in Sindh and Baluchistan were identified. A work plan was developed which was compatible with the project objectives and the terms of reference for the PROS position.

The first constraint was the lack of clearly defined objectives in research. A comprehensive analysis of the research for each section was undertaken. This analysis included the assessment of two or more years research. Combined analyses were performed on experiments conducted over time or locations. The objective was to clarify what progress had been made and relate the research to farmers' needs. Progress was slow during the first stages because it was necessary to train the resident statisticians in the procedures. They will continue the work after my assignment terminates.

The second phase of the program was the examination of the structure of the research institute organization. The objective in this phase was to promote inter-disciplinary coordination. Progress was made at ARI Sariab in this area, but very little progress was made in Sindh Province.

The second constraint addressed was the lack of a systematic procedure for pre-testing promising interventions under farmers' conditions. Research workers were encouraged to take a more active part in the existing farming system research program. In Sindh Province the research workers planted wheat, cotton and sugarcane variety trials as an integral part of the FSR program. As a result, a promising wheat variety and a promising cotton variety have been identified and will be further tested in the next cycle.

A proposal has been initiated in the Sindh Agricultural University, Tandojam for a Master's Degree in Farming Systems Research. This is the result of the effort of the MART Project in the area.

The third constraint is the limited understanding of statistics and field plot technique by the research staff and

administrators of both institutes. An aggressive training program was conducted to address this need. Approximately 80 research scientists attended two-week, intensive courses on design, analysis, and interpretation of agricultural experiments.

Few of the research scientists at the provincial level have had the opportunity to become proficient in the use of computers. Their comprehension of statistics is also limited. Under these conditions the MSTAT Statistical Software is too advanced for them. Time is lost when the research worker sends his data to the statistics department. There is also an advantage for each worker to analyze his own data.

To address this issue I wrote a simple, user-friendly statistical software package. It is menu and screen prompt driven. It does not require computer literacy beyond knowing how to turn it on and use the keyboard. A basic understanding of the frequently used statistical designs is all that is required. The program can be learned in less than one hour. It is being used by the statistics department in both institutes and the FSR unit of Sindh Province.

Other activities included acting as field liaison for the MART Project and assisting the Islamabad-based team members where necessary. Contact has been maintained with some progressive individuals and organizations in the private sector. I have encouraged their active input into the research organization but have had only some success.

END OF TOUR REPORT

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MART PROJECT

I. INTRODUCTION.

My activities (Nov.3, 1989 - Sept. 23, 1991) were concentrated in the Agricultural Research Institute, Tandojam (ARI Tandojam), the Agricultural Research Institute, Sariab (ARI Sariab), and the Sindh Agricultural University (SAU Tandojam). I planned work with the Horticultural Research Institute, Mirpurkas and the Rice Research Institute, Dokri, but the deteriorating law and order situation made it inadvisable to continue traveling in these areas.

Discussions with the directors and the section leaders of each of the institutes and a review of all annual reports for the past three years revealed some of the major constraints to productive research . Inadequate operational funds was the first constraint. A more efficient research program would alleviate this problem .

The three major constraints to effective research found in both institutes are (1) lack of objectivity, (2) no systematic research continuum from research to client farmer, and (3) a limited understanding of statistics and field plot techniques among the scientists. The program developed to address these issues was compatible with both the objectives of the MART Project and the PROS Terms of Reference(Appendix A).

II CONSTRAINTS AND ACTIONS TAKEN.

CONSTRAINT #1. Programs lack clearly defined objectives.

This is evident at all levels of research management. At the institute level research is determined more by available funding from national and international institutions and individual

interests than by defined objectives. At the section level it appears in many cases that the main objective of research is the annual report. There is little or no awareness of the needs of the client farmers. Research is planned on a yearly basis. Some experiments are conducted over a three year period or at multiple locations, but these are never subjected to a combined analysis.

A study of the annual research reports for the past two or three years revealed a lack of focus and coordination within the sections and between sections within the research institute. It is difficult to determine the recommendations for a particular crop since they are scattered throughout the chapters of each annual report.

Action taken. In discussions with the two research institute directors a two-phase program was prepared. The first phase of this program was a comprehensive analysis of the past research for each section to assess the progress that had been made in research. This comprehensive study includes the combined analysis of any sets of data to which that type of analysis is applicable and a critical review of each experiment. The objective was to determine what recommendations could be tested at the farm level and the relationship of the research program with client farmers' needs.

The resident statisticians at both research institutes collaborated in developing this program. The analysis for one section within each of the two research institutes has been completed. The institute statisticians are now sufficiently trained to continue the analyses for the remaining sections. They will continue to use the EASYSTAT statistics software program developed by MART Project. An example of the analysis for the Agronomy Section, ARI Sariab is included as Appendix B.

The second phase of this program was to plan the long range research program which focused upon the needs of the client farmers. This plan would include the active participation of the research workers from the experiment station in the farming systems research program. This participation would enable them to become

more familiar with the farmers' problems and the factors limiting production.

Suggested follow-up action: 1) The statistics section at ARI Sariab is weak. I suggest that Mr. Abdul Akbani, the statistician at ARI Tandojam be contracted for one or two weeks each year over the next two years to assist and to train them in the procedures we have introduced as well as basic analytical procedures.

2) Dr. Bajoi, Director ARI Sariab, is now in a very good position to make some needed changes in the organization of ARI Sariab. We have discussed this and I prepared a position paper with my ideas (Appendix B). This should be followed up as the preliminary stage of the final master plan for Sariab.

CONSTRAINT #2. NO SYSTEMATIC PROCEDURE FOR TESTING AND ADJUSTING PROPOSED RECOMMENDATIONS UNDER CLIENT FARMERS' CONDITIONS BEFORE FORMULATING RECOMMENDATION.

Some production factor recommendations cannot be adequately researched within the confines of the research station. They require an intermediate stage at the farm level for final adjustment. Although this is the function of the Applied Research Section of the Department of Extension, extension activity in both Sindh and Baluchistan Provinces is minimal. Therefore it is essential that a procedure be developed which has this intermediate stage and which facilitates the two-way flow of information between research and the farmer. A farming systems research component in the research program is the most efficient way to accomplish these goals.

Active Farming Systems Research Units were functioning in both Sindh and Baluchistan Provinces when I arrived. The Sindh Unit is based at the Sindh Agricultural University (SAU), Tandojam. The coordinating committee consisted of staff members from the ARI, (Tandojam), the Atomic Energy Agricultural Research Center (AEARC), and the SAU. In reviewing the work which had been done in Sindh Province I found three areas which needed improvement.

The experimental designs being used were not the most efficient for answering the questions. The design used was the "plus and minus" design. In this design a set of farmers' practices and the complete package are used as reference points and treatments arranged by adding one or more improved practices to the farmers' practice and subtracting improved practices from the complete package. This design has some inherent problems for estimating interactions and treatments assignment can become confusing. A 2' factorial arrangement permits the estimation of all main effects and interactions. In comparing the design used with a factorial arrangement including the same factors the factorial would require only one additional experimental unit. Factorial arrangements are standard practice now.

The system concept of farming systems research was not fully understood by some members of the FSR Coordinating Committee. Cotton and wheat varieties and minimum tillage practices had been introduced into the system which permitted the cultivation of two crops per year. The function of these interventions in the system was understood. Research methodology for studying the long range effects of other cultural practices in the system, however, were not being considered. Concomitant to this the practice of using different fields each season negated the estimation of system effects over time. Jointly the two site coordinators and I developed a long range plan for estimating the system effect of new experimental factors such as fertilizer use. An example of this plan is shown in Appendix B.

Although both ARI Tandojam and AEARC named members to the FSR Coordination Committee the active participation of both institutes was minimal. During the past 18 months efforts have been made to involve more members of the ARI staff in the FSR activities. Variety trials in cotton, wheat and sugarcane have been planted at both sites by the respective ARI sections. As a result of this

collaboration a promising wheat variety has been identified (Mehran-89) and a promising cotton variety (CRIS-109). The first sugarcane harvest will take place in October, 1991.

As originally designed, the FSR program in Sindh was based in the Sindh Agricultural University. The coordinating committee consisted of members of the faculty and representatives from both ARI Tandojam and AEARC. Under the circumstances this was wise a decision. It was unavoidable that the majority of the members of the committee were from the SAU faculty. However, this arrangement created the feeling in both the ARI Tandojam and the AEARC that it was a university function and their participation was secondary. The committee also lacked the active participation and input from the private sector.

In collaboration with the coordinating committee I developed a position paper (Appendix C) proposing changes in the structure of the FSR Program. A joint meeting of all directors or research and the Vice Chancellor was called in November, 1990, to discuss the paper. The recommendations were accepted with minor changes. The committees were named and dates set for the first meetings. The catalytic force in moving this change was the Vice Chancellor. Unfortunately he left that position while I was in the US on emergency evacuation. When I returned, I found the effort had lost its momentum and I have been unable to regenerate that momentum although many people acknowledge the need and express interest.

In collaboration with members of the Faculty of Social Science, SAU, a proposal for a Masters' Degree in Farming Systems Research is being developed for presentation to and approval by the appropriate academic councils. Core subjects will include field plot technique, statistical analysis, on-farm survey methodology, farming systems research methodology, and agronomy. It was decided the program will be offered in the Faculty of Social Sciences because of its relative strengths and comparative advantages in many core subjects.

Suggested follow-up actions: 1) Continue encouraging the institutionalization of the Farming System Research Program. The concept of this program being financed by the participating institutions is not clearly understood or accepted. 2) Promote the participation of private sector representatives on the committees of the FSR program. 3) Assist SAU in the development of the FSR Graduate Degree program which is in the planning stages now.

CONSTRAINT #3. RESEARCHERS AND ADMINISTRATORS WITH A LIMITED UNDERSTANDING OF THE USE OF STATISTICS AND FIELD PLOT TECHNIQUES IN RESEARCH.

All research workers in both institutes have a fundamental knowledge of basic statistical design. They are familiar with randomized complete block and split-plot designs and are able to design experiments using these designs. Some understand factorial designs. They are limited, however, in their understanding of the proper interpretation of the results of experiments. Some also have little understanding of the relationship of field plot techniques and the reliability of the research results.

Action taken. With the assistance of the Training and Extension Department and the Statistics Department of SAU a two-week course in planning, analysis, and interpretation of agricultural experiments was developed. The course, with modifications, was presented twice at SAU Tandojam and once at ARI Sariab.

The objective of the course was to teach the participants how an analysis of variance table is developed and how the quality of field plot technique affects the reliability of the analysis. Each participant was furnished a hand calculator with the statistical functions and taught how to use it. Each of the basic statistical designs was presented and discussed. After the discussion, a time was scheduled in which each participant was required to analyze data for the design discussed. All related parameters such as

least significant difference and coefficient of variation and their relation to the reliability of data were also discussed.

With each presentation of the course we learned and became more proficient. We attempted to cover too much material in the first course. We realized this and decided to concentrate on more of the basics. In the final presentation of the course we decided to concentrate on completely randomized, randomized complete block, and split-plot designs, including factorials in randomized complete blocks. We also included two days of discussions during which participants could bring their questions to the teaching staff. This proved to be very beneficial (Appendix D).

Two professors from SAU Tandojam and the statistician from ARI Tandojam were the major contributors in both the planning and the teaching of the course. They gained experience in conducting these courses because the material was not presented in the standard format used in Pakistan universities. The effects of the experience has carried over into the way introductory statistics is now being taught at the Sindh Agricultural University.

As the level of technology increases within the provincial research institutes, those that are involved in research will be required to learn to utilize that technology. Few of the research workers are computer literate and none can use MSTAT, the leading statistical software package for agricultural research. Although courses are given through the Training and Extension Department of SAU, the MSTAT package is too advanced for those without a good background and understanding of both statistics and DOS. Limited training facilities and limited budget also limit the number of persons who can be trained.

At present the researchers send their data to the statistics section and await there turn of the analysis which can take weeks. An intermediate step was needed. A software package requiring no computer skills which could be mastered within one hour would serve to acquaint this group with computers and would assist them in understanding statistics by performing their own analyses with the

package.

EASYSTAT was written to fill this need. It is a user friendly program which is run under MS-DOS with screen prompts to guide the user through each step. Error traps are built into the program to prevent it from terminating prematurely if the user makes an error. It is impossible to anticipate all possible error possibilities, but I attempted to guard against the most common ones.

The package will accept randomized complete block, split-plot, split-split-plot designs, and factorial arrangements in randomized complete block designs. The factorial arrangements it is designed to analyze are 2^n (n=2 to 4) arrangements and arrangements with two or three factors each with two or more levels. The maximum size of an experiment to be analyzed by the program is 19 treatments and 6 replications.

Once files are written to the disk, experiments having the same set of treatments and the same number of replications can be combined for an analysis, across environments, using the combined analysis function of the program. The user is prompted to enter only the number of files to be combined and the file names. A maximum of six experiments can be combined in this analysis.

A special function was written into the program for analysis of variety trials conducted at more than one location or more than one year. Both single experiment and combined analysis may be conducted in this function. The single experiment analysis is the standard analysis for the randomized complete block. The combined analysis uses the analytical technique developed by Dr. Roger Peterson and first presented in his handbook published by the MART Project. (Peterson, 1989).

Each analytical procedure presents the standard analysis of variance table on the monitor. Within the table are both the calculated "F" values and the appropriate "F Table" values and the coefficient of variation. The program also places on screen one or more tables of treatment means which contain the appropriate least significant difference values calculated at the 5% level. As each table is presented on the screen the user is prompted to select if

a printed copy is desired.

In many developing world countries a common problem is the loss of information due to loss of secondary data. Yield data sheets rarely have a notation describing the treatment levels. The most common practice is to use a numerical system. If the notation of treatment levels becomes separated from the yield data, the data are useless. To minimize this problem EASYSTAT has a file system which stores essential data as a permanent record on the disk with the data. For each experiment two files are created and written to disk. One file contains the yield data. The second file contains the secondary data such as treatment levels which accompany the yield data. This information is also printed as a part of the ANOVA and other tables to identify them later.

Two functions which are included in the program as a special convince are the view files function and the edit function. The view files function permits the user to see which files are on the diskette. The filename and the title of the experiment are scrolled onto the screen in blocks of 15. Each block remains on the screen until the user presses the spacebar. The edit functions permits editing of files for any experiment on the diskette.

A user's guide was written to assist in learning the program (Appendix E).

<u>Suggested follow-up actions:</u> Continue to assist in the organization and financing of training courses and seminars on research methodology, applied statistics, FSR methodology, and similar topics. There is now a trained and experienced cadre of instructors within the SAU and the ARI Tandojam who are capable of organizing and conducting these courses.

III OTHER ACTIVITIES.

<u>Private Sector Involvement.</u> I met with and advised the members of the committee from Engineering Associates in the preparation of the PC-1 for the Director General Research, Sindh.

My principal contribution was in the area of the farming systems research component. I have continued the contact throughout my tour.

I have encouraged community leaders to develop projects and submit their projects to USAID for consideration. One such project in now being processed in USAID.

Field Liaison. As a part of my assigned tasks I have acted as the field liaison or support unit for the FSR and the Communications components of the MART Project. As the field representative I was able to make direct contributions as well as monitor the progress of the projects.

Miscellaneous. I brought asparagus into the country for propagation by Mr. Miano of the Horticulture Department of SAU. It is salt tolerant and is surviving quite well. He is presently increasing the mat and plans to introduce it as well as conduct research on the degree of salt tolerance it can withstand.

I also assisted my wife in the construction and introduction of a simple solar cooker in both Sindh and Baluchistan FSR programs. This cooker is made from locally available and economical materials such as cardboard boxes and wheat straw. Many have expressed an interest and she has distributed booklets with the detailed plans for construction of the unit.

TERMS OF REFERENCE

Provincial Research Operations and Support (PROS) Specialist, Sind/Baluchistan

The PROS specialist's duties, in general, are to assist the Sind and Baluchistan provincial institutes in ways which will strengthen their capability and capacity to conduct agricultural research. He will represent PARC through the MART project and will coordinate his activities with the Research Planning and Management, the Farming Systems Research and the Information Transfer specialists as well as CYMMYT and ICARDA specialists. An important responsibility will be to help provincial officials identify project activities that can be carried out in their provinces and to coordinate within Sind and Baluchistan provinces the MART activities that are national in scope.

The tasks of the Provincial Research Operations and Support (PROS) specialist shall include but not be limited to the following:

i) Assist provincial authorities to identify opportunities to further develop provincial research institutions through training, updating in research methods, and managerial improvements. The PROS will also help design these activities and assist in the selection of ST consultants and trainers, if needed, to provide the scopes of work for short-term consultants planned for the province, supervise their performance, and be responsible for follow-up activities.

ii) Assume primary responsibility for the development of a cadre of training officers to identify specific training requirements, recommend specific types of individuals and propose training courses and institutions able to meet training needs in the assigned provinces.

iii) Assume primary responsibility for conducting systems analysis, specific studies and follow-on management improvement interventions in the assigned provinces in the area of agricultural research.

iv) Assist in the implementation of farming system research activities in the Sind and Baluchistan with PARC's FSR coordinator and advisor.

v) Replicate in the assigned provinces the lessons learned from he experiences in improving research/outreach integration in the Islamabad District.

The specialist will reside in either Hyderabad or Karachi in Sind Province. The Specialist's primary counterpart will be Director-General of Agricultural Research of the respective province.

COMPREHENSIVE ANALYSIS OF EXPERIMENTS CONDUCTED BY AGRONOMY SECTION, ARI, SARIAB, 1988-90

I WHEAT.

1. Sowing Rate by Variety.

This experiment was conducted in a split-plot design using six seeding rates as the main plot and four commercial varieities as the sub-plot treatment. The combined analysis included two years data. The ANOVA and tables of means are as follows.

Table 1. ANOVA;Combined data, seeding rate x variety, 1988-90.

Source	df	MS	F
Year	1	0.188	n.s.
Reps/yrs	4	0.051	
Seed Rate	5	7.633	66.18 **
Yr X Rate	5	0.355	3.08 *
Error (a)	20	0.115	
Varieties	3	0.883	7.84 **
Yr X Var.	3	0.633	5.62 **
Rate X Var	15	0.077	n.s.
Yr X R X V	15	0.081	n.s
Error (b)	72	0.113	

Table 2. Year X Seed Rate Means. (kg/ha.)

Rate\	88-89	89-90	Rate means
30 kg/ha	2.16	2.14	2.15
40 "	2.57	2.71	2.64
50 "	3.62(a)	3.53(a)	3.58 a
60 "	3.18	2.95	3.07 b
70 "	2.15	2.62	2.38
80 "	2.08	2.24	2.16
Yr means	2.63	2.70	

LSD(.05)

Between rates = 0.28 kg/ha

Between rates in years = 0.39 kg/ha

Table 3. Year X Variety Means. (kg/ha.)

Var.\	88-89	89-90	Var. Means
Pawan	2.55	2.88(a)	2.72 a
Zarghoon	2.87(a)	2.63(a)	2.75 a
Pak-81	2.64(a)	2.88(a)	2.76 a
Local	2.45	2.41	2.43
Yr Means	2.63	2.70	

LSD(.05)

Between varieties = 0.21 kg/ha

Between varieties in years = 0.30 kg/ha

Interpretation: The data indicate a seeding rate of c. 50 kg/ha using Zarghoon or Pak-81 is the optimum combination.

2. Sowing Date by Variety.

Table 1. ANOVA: Combined data, sowing date x variety, 1988-90.

Source	df	MS	F	
Years	1	232.561	1779.11	**
Reps/yrs	4	0.314		
Sowing Dates	5	36.755	281.18	**
Yr x Dates	5	8.133	62.22	**
Error (a)	20	0.131		
Varieties	7	6.372	53.29	**
Yr x Var	7	3.011	25.18	**
Date x Var	35	0.469	3.92	**
Y x D x V	35	0.292	2.42	**
Error (b)	168	0.120		

Table 2. Year X Sowing Date Means. (kg/ha)

Date \	88-89	89-90	Date Means
15 Oct	1.83	4.01	2.92
1 Nov	2.71(a)	5.05(a)	3.88 a
15 Nov	2.90(a)	5.04(a)	3.97 a
1 Dec	2.55	4.33	3.44 b
1 Jan	1.81	3.98	2.90
1 Feb	1.51	1.67	1.57
Yr Means	2.22	4.01	

LSD(.05)

Between dates = 0.14 T/ha.

Between dates within years = 0.20 T/ha.

Table 3. Variety X Dates Means. (kg/ha)

Variety \	15 Nov	1 Nov	15 Nov	1 Oct	1 Jan	1 Feb	Var Mns
Solanika	2.97(a)	4.02	4.40	3.81	3.43	1.93	3.42 b
Zarghoon	3.05(a)	4.48(a)	4.63(a)	3.61	3.38(a)	1.96(a)	3.52 ab
Pak-81	3.12(a)	4.03	4.88(a)	3.23(a)	3.45(a)	2.08(a)	3.63 a
Pawan	3.30(a)	3.63	4.30	3.57	2.52	1.34	3.11
Faisalab.	2.77	4.03	4.22	3.65	2.99	1.65	3.22
Zaminand.	2.77	3.51	3.08	3.15	2.72	1.52	2.79
V Noor	2.81	3.90	3.22	3.15	2.55	1.40	2.84
Local	2.55	3.45	3.02	2.32	2.18	0.85	2.39
Date Mns	2.92	3.88	3.97	3.43	2.90	1.59	
		a	a	b			

LSD(.05)

Between varieties = 0.16 t/ha

Between varieties in dates = 0.39 t/ha

Table 4. Year X Variety Means. (kg/ha).

Variety \	88-89	89-90	Var Means
Sonalika	2.25	4.59(a)	3.42 b
Zarghoon	2.47(a)	4.57(a)	3.52 ab
Pak-81	2.49(a)	4.78(a)	3.63 a
Pawan	1.85	4.37	3.11
Faisalab.	2.64(a)	3.80	3.22
Zamindar	2.00	3.58	2.79
Vch.Noor	2.21	3.47	2.84
Local	1.83	2.96	2.39
Yr Means	2.22	4.02	

Interpretation: Optimum planting date = last half of November
Most promising varieties = Zarghoon & Pak-81

3. Irrigation by Variety.

This experiment was conducted in a split plot design with irrigation as the main plot and varieties as sub plot. The combined analysis includes two years data.

Table 1. ANOVA: Combined data, irrigation x varieties, 1988-90.

Source	df	MS	F
Years	1	5.081	33.23 **
Reps/yrs	4	0.310	2.03
Irrig.	5	8.518	55.71 **
Yr x Irr	5	3.566	23.32 **
Error (a)	20	0.153	
Variety	3	3.264	33.21 **
Yr x Var	3	0.106	1.08 n.s.
Irr X Var	15	0.415	4.22 **
Y x V X I	15	0.229	2.34 **
Error (b)	72	0.098	

CV= 8.69%

Table 2. Year x irrigation means (kg/ha).

Irrigation \	88-89	89-90	Irr. Means
T + F + M	3.65(a)	4.11	3.88 b
T + F	2.77	3.18	2.98
T + M	3.65(a)	3.00	3.32 c
F + M	3.15	2.79	2.97
15 day intv.	3.54(a)	4.83(a)	4.19 a
20 day intv.	3.75(a)	4.85(a)	4.30 a
Yr Means	3.42	3.79	

LSD(.05)
Between irrigation treatments = 0.24 t/ha
Between irrigation trts in years = 0.29 t/ha

Table 3. Irrigation x Variety Means, (kg/ha).

Treatments \	Sonalika	Pawan	Zamindar	Zarghoon	Irr.Mns
T + F + M	3.91(a)	3.92	4.60(a)	3.09	3.88 b
T + F	2.73	2.95	3.23	3.01	2.98
T + M	3.22	3.48	3.44	3.15	3.32
F + M	3.63	3.13	3.03	2.69	2.97
15 day intvl.	3.92(a)	4.58(a)	4.45(a)	3.80(a)	4.19 a
20 day intvl.	3.82(a)	4.68(a)	4.78(a)	3.92(a)	4.30 a
Var Means	3.44	3.79	3.92	3.28	
		a	a		

LSD(.05)

Between varieties = 0.13 t/ha

Between varieties within irrigations = 0.31 t/ha

Interpretation: A proper interpretation of these results will be possible only with a partial budget analysis to accompany the statistical analysis. Irrigation at 20 day intervals is obviously more economical and statistically both the 15 day and the 20 day interval treatments are equal. The partial budget analysis will clarify whether the T + F + M treatment is more economical than the 15 day interval treatment. Both Pawan and Zamindar varieties performed better than ther other varieties in the experiment.

4. Irrigation Experiment in Wheat.

Table 1. ANOVA: Combined data, Irrigation in Wheat, 84-85 & 85-86.

Source	df	MS	F
Years	1	2.686	21.49 **
Reps/yrs	6	0.072	
Irrigations	3	6.362	50.92 **
Yrs x Irr	3	0.217	n.s.
Error (a)	18	0.125	
Varieties	1	3.837	34.30 **
Yr x Var	1	0.557	4.98 *
Irr x Var	3	0.009	n.s.
Y x I x V	3	0.209	n.s.
Error (b)	24	0.112	

CV= 13.50%

Table 2. Irrigation x Variety Means, Combined data.(kg/ha)

Varieties\	T	T + F	T+F+M	20 day intv.	Var. Mns.
Sonalika	1.42	1.93	2.64	2.85	2.23 b
Pawan	2.02	2.56	3.06	3.34	2.72 a
Irr. Mns.	1.68	2.29	2.85	3.09	
	c	b	a	a	

LSD(.05)

Between irrigation schedules = 0.26 t/ha

Between varieties = 0.37 t/ha

Between varieties within irrigations = 0.40 t/ha

Note: T = At tillering

F = At flowering

M = At milk stage

Interpretation: Without an economic analysis, the data indicate that three irrigations (T+F+M) is the minimum and probably the most economical level. Of the two varieties tested Pawan is significantly better and responses to all levels of irrigation better than Sonalika.

5. Weed Control Experiment in Wheat, 1989-90.

Table 1. ANOVA:

Source	df	MS	F
Replication	3	0.090	n.s.
Treatments	4	2.145	9.80 **
Error	12	0.219	

CV = 15.76 %

Table 2. Treatment Means (t/ha).

No weeding	1.83 d
Weeding @ 20 days	2.88 c
Weeding @ 10 days	3.18 b
Stomp	3.10 b
Dicuran M	3.85a

6. Weed/Crop Competition Experiment.

Table 1. ANOVA: Weed Competition Experiment in Wheat, 1989-90.

Source	df	MS	F
Replications	3	0.058	0.5234 n.s.
Treatments	5	2.395	21.5426 **
Error	15	0.111	

CV = 10.6 %

Table 2. Table of Treatment Means (t/ha).

No weeding	1.95 d
Weeding @ 15 day interval	3.93a
Weeding @ 20 day interval	2.48 c
Weed free all season	3.28 b
Stomp	3.50ab
Dicuran M	3.75ab

LSD(.05) = 0.50 t/ha

Interpretation: Without a partial budget analysis it is difficult to make a valid recommendation from the data. In both experiments on weed control chemical control was superior to most other methods, but we must know the economics.

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LSD(.05) = 0.50 t/ha

Interpretation: Without a partial budget analysis it is difficult to make a valid recommendation from the data. In both experiments on weed control chemical control was superior to most other methods, but we must know the economics.

7. Combined data, Variety Trial in Wheat, 3 data sets.

Table 1. ANOVA:

Source	df	MS	F
Environments	2	5.345	32.54 **
Error (a)	6	0.164	
Varieties	17	2.647	29.99 **
Env x Var	34	0.511	5.79 **
Error (b)	102	0.088	
		CV = 11.74 %	

Table 2. Variety x Environment Means (kg/ha).

Varieties \	Env 1	Env 2	Env 3	Var Means
Barani 83	1.97	2.07	1.97	1.99
Faisalabad 83	2.00	2.17	2.15	2.11
Johar 78	2.13	2.20	2.30	2.21
Koh-i-Noor	1.87	2.13	2.18	2.06
Lyallpur 85	1.80	2.27	2.50	2.19
N-159	3.13(a)	3.03	3.22	3.13
Punjab 81	1.47	2.50	2.60	2.19
Pawan	2.87	3.07	3.39	3.11 b
P-89	3.37(a)	2.93	2.73	3.01 b
Pak-81	2.40	3.53	3.70(a)	3.21 b
S-19	2.40	2.77	2.80	2.66
Sind-81	1.60	1.73	2.12	1.82
Sarhad	1.20	2.87	2.98	2.35
Sonalika	2.00	3.43(a)	3.82(a)	3.08 b
Zamindar	1.00	2.70	2.78	2.16
ZA-77	2.10	2.57	2.50	2.39
Zarghoon	3.27(a)	3.83(a)	4.08(a)	3.73a
Local	2.60	1.90	2.02	2.17
Environ Means	2.17	2.65	2.77	

LSD(.05)

Between varieties = 0.27 t/ha

Between varieties in environments = 0.47 t/ha

Summary of Wheat Research Analysis.

There is sufficient information in the combined analyses to justify entering a set of promising recommendations into the farming systems research program for final testing and adjustment.

Two varieties are outstanding - Zarghoon and PAK-81. The optimum sowing date is in the first 15 days of November and the optimum sowing rate is 50 kg/ha. The crop should be irrigated at tillering, flowering, and at the milk stage for maximum economic yields. Data indicate 20 day intervals may increase yields, but this rate is not the most economical. Both Stomp and Dicuran M are acceptable for chemical weed control. A partial budget analysis should be performed to determine the most economical method of weed control - hand weeding, Stomp, or Dicuran M.

A 2^n factorial comparing the farmers' cultural practice with each experimental practice in the package where they differ is the recommended method. The factors being introduced are variety, seeding rate, irrigation frequency, and weed control. In this experiment either of the two varieties may be used as they have performed equally well. An economic analysis of the data will determine which of the two chemical control methods is most economical. The comparisons in the experiment are:

Experimental Variety	vs	Farmers'Variety
Chemical Weed Control	vs	Farmers' method
Experimental Irrigation freq	vs	Farmers' irrigation freq
Experimental seeding rate	vs	Farmers' seeding rate

If the farmers' practice is the same as the experimental factor it would not be included in the experiment. With four factors the experiment would have 16 experimental plots in each replication. For three factors there would be 8 experimental plots in each replication. One replication may be placed in each location with a minimum of four locations within the target area.

II LENTILS

1. Fertilizer cum seed rate in Lentils.

A split plot design with 7 fertilizer treatments as main plots and 3 seeding rates as sub-plots. The data for two years were combined.

Table 1. ANOVA Combined data, fertilizer x seed rate in Lentils.

Source	df	MS	F
Years	1	0.272	12.41 **
Reps/Yrs	4	0.045	
Fert. Levels	6	1.054	48.15 **
Yrs x Fert	6	0.415	18.98 **
Error (a)	24	0.022	
Seed Rate	2	0.742	45.90 **
Yr x Rate	2	0.228	14.09 **
Fert x Rate	12	0.015	n.s.
Y x F x R	12	0.013	n.s.
Error (b)	56	0.016	
		CV = 11.96 %	

Table 2. Fertilizer levels x years means, (kg/ha).

Fertilizer levels\	86-87	89-90	Fert mns
0 - 0 - 0	0.88	0.66	0.77
25 - 0 - 0	1.05(a)	0.76	0.91
25 - 50 - 0	1.15(a)	1.58(a)	1.36 a
25 - 50 - 50	1.16(a)	1.68(a)	1.42 a
0 - 50 - 0	1.07	1.08	1.08
0 - 50 - 50	0.92	1.07	0.99
0 - 0 - 50	0.90	0.94	0.92
Year means	1.02	1.11	

LSD(.05):
Between fertilizer levels = 0.10 kg/ha
Between fertilizer levels in years = 0.14 kg/ha

Table 3. Seeding rates x years means, (kg/ac).

Seeding rates \	86-87	89-90	Rate mns
8 kg/acre	0.79	1.03	0.91
12 kg/acre	1.10(a)	1.17(a)	1.14 a
16 kg/acre	1.17(a)	1.21(a)	1.14 a
Year means	1.02	1.11	

Interpretation: Data of these experiments indicate the most economical inputs in lentils are a seeding rate of 12 kg/acre with a fertilizer application of 25 - 50 - 0. Both nitrogen and phosphorus contribute to yield with no apparent contribution by potassium. There is probably a N/P interaction, but it could not be detected with these treatments.

Suggestions: A multi-level factorial with three or more levels each of N and P should be designed including levels of both in higher doses than appeared in this experiment. With higher levels of fertilizer a fertilizer x seeding rate interaction may appear. To avoid increasing the size of the experiment by the addition of

a new factor the "sidecar" method may be used to test this hypothesis. In each replication include a single plot in which the highest levels of both N and P are combined with the higher level of seeding (16 kg/ac). In the statistical analysis yield data from the highest levels of N and P with 12 kg/ha seeding rate are compared with the yield data from the "sidecar". If the difference is greater than the LSD then there is a probability of a fertilizer x seeding rate interaction and further investigation is warrented.

2. National Uniform Yield Trial in Lentils, 1989-90.

Table 1. ANOVA, National Uniform Yield Trial.

Source	df	MS	F
Replication	3	0.003	n.s.
Varieties	7	0.105	13.93 **
Error	21	0.008	
		CV= 9.13 %	

Table 2. Table of means, National Uniform Yield Trial.

Variety	Yield (kg/ha)
76 TA 66005	1.06 b
78 S 26010	1.04 b
76 TA 66054	0.72 c
78 S 26052	0.81 c
74 TA 565	1.22a
FLIP-84-62-6	0.97 b
FLIP-84-63-6	0.97 b
Local	0.82 c

LSD(.05)= 0.13 kg/ha

III CUMIN

Table 1. ANOVA, Sowing Date in Cumin, combined data.

Source	df	MS	F
Years	1	2300220.024	234.57 **
Reps/Yrs	4	9806.095	
Sowing Dates	6	62863.579	30.98 **
Yrs x Dates	6	39530.913	19.48 **
Error	24	2028.817	
		CV= 9.23 %	

Table 2. Sowing date x years means (kg/ha), 1988-89 - 1989-90.

Sowing Date \	88-89	89-90	Date Means
1 - 11	168	750	459 c
15 - 11	273(b)	749(b)	511 bc
1 - 12	287(b)	802(b)	546 b
15 - 12	294(a)	777(b)	535 b
1 - 1	294(a)	972(a)	633a
15 - 1	231(b)	597	414
1 - 2	231(b)	403	317
Year Means	254	722	

LSD(.05):

Between sowing dates = 54 kg/ha

Between sowing dates within years = 76 kg/ha

IV Onion.

Table 1. ANOVA, Weed competition in onion, 1990.

Source	df	MS	F
Replications	2	0.858	1.37
Treatments	11	25.043	40.01 **
Error	22	0.626	

CV = 9.30 %

Table 2. Table of Treatment Means.

Treatment	Mean (t/ha)
Weed-free 2 weeks	8.80 c
" 4 "	9.10 c
" 6 "	10.00 bc
" 8 "	11.00ab
" 10 "	11.50a
Weeds present 2 weeks	11.50a
" 4 "	7.10 d
" 6 "	6.20 de
" 8 "	6.00 de
" 10 "	5.30 e
Hand weeding	12.30a
Control, no weeding	3.333 f

LSD(.05) = 1.34 t/ha

Table 3. ANOVA,Chemical weed control experiment in onion, 1990.

Source	df	MS	F
Replication	2	0.647	n.s.
Controls	6	22.624	48.60 **
Error	12	0.465	

CV = 7.02 %

Table 4. Table of means, Chemical weed control in onion, 1990.

Treatment	Mean(t/ha)
Stomp, premerge	8.40 d
Treflan premerge	8.80 cd
Ronslair premerge	12.00 b
Tribunal premerge	10.00 c
Tribunal postmerge	8.70 d
Hand weeding	14.30a
No weeding	5.80 e

V PEAS

Table 1. ANOVA, Spacing X Variety Experiment, 1988-89.

Source	df	MS	F
Replication	3	0.154	n.s.
Spacing	2	0.921	14.29 **
Error (a)	6	0.064	
Varieties	2	0.879	n.s.
Spac. x Var	4	0.460	n.s.
Error (b)	18	1.229	

CV = 24.53 %

Table 2. Table of Means for Spacings.

Spacing	Mean (t/ha)
25 cm	4.56a
35 cm	4.78a
45 cm	4.22

LSD (.05) = 0.25 t/ha

VI MUNGBEAN

Table 1. ANOVA, Variety Trial in Mungbean, 1990.

Source	df	MS	F
Replication	3	0.012	n.s.
Varieties	6	0.053	n.s.
Error	18	0.064	

CV = 27.02 %

RECOMMENDATIONS FOR MASTER PLAN DEVELOPMENT
AGRICULTURAL RESEARCH INSTITUTE
QUETTA, BALUCHISTAN

1. Situation Assessment.

There are five ecological zones in the Province of Baluchistan. The Agricultural Research Institute, Sariab (ARI Sariab) has the mandate to conduct effective research for all zones. As presently structured and with limited resources, it is not possible for the Institute to fulfill this mandate.

The agro-climatic difference between zones and within zones precludes the possibility of conducting all research at one center. The genetic/environmental interaction cannot be estimated nor can breeding materials be tested for adaptability to different environments. Soil formation factors are different under different ecological regimes. In a comprehensive research program all of these factors must be considered and recommendations adjusted to each set of circumstances.

II. Recommendations

A. Allocation of resources Allocation of all resources (financial, material, and manpower) should be based upon a priority system. The first level of allocation should be allocation of resources between zones. The second level should be allocation to crops within zones.

The Quetta Zone should receive the largest share of the resources followed by Sibi and Las Bellas. ARI Sariab as it is presently structured has little to offer to the Turbut and Ziarat Zone because their major crops are dates and deciduous fruits, respectively.

Within the three primary zones wheat should receive the major share of the available resources in both the Quetta and the Sibi zones. Vegetable crops would receive the larger share in the Las Bellas zone. These resources would then be divided according to relative importance of the vegetable crops of the region.

B. Establish research sub-stations. To effectively conduct multi-location experiments necessary for testing breeding materials and other production factors there should be a network of sub-stations. As a minimum, there should be one in each of the ecological zones (one for each 1500 feet of elevation above sea level). Small sub-stations in both the Sibi and the Las Bellas zones should be given top priority. These stations would be used for the intermediate testing of varieties and production factors before entering them into farming system experiments.

The substations should be under the direct administrative control of the Director, Agriculture Research Institute, Sariab, to avoid administrative delays and for effective control of the entire research continuum taking place at all stations and sub-stations. The more levels of administration, the longer the delays in getting anything accomplished. If a planting date is missed due to delays in administration, research is delayed one year. For that reason, plus other, the administration of all stations should be the responsibility of one director who can coordinate all activities in all stations.

Sub-stations should be kept simple and efficient. There should be two building. One would be the machine shed where all heavy equipment such as the tractor and implements are stored. The other will contain the office, work area for seed handling, small equipment storage (shovels, hand tools, etc.), and a seed storage room which is insulated and cooled by airconditioning . This is

adequate for maintaining seed viability for one to two years. These sub-stations should have the following characteristics:

1. Easy access during all seasons.
2. Reliable, year-round and adequate water supply.
3. Near to a city large enough to provide a source of supply for necessary supplies and to provide adequate housing facilities for staff posted at the station.
4. Soil and topographic conditions which permit good research.
5. Perimeter fence of sufficient height to prevent trespassing and destruction of research plots.

These sub-stations should be small, intensively used, and well managed. The area should not exceed 20 hectares. Larger stations become more difficult to manage efficiently and more expensive to maintain. A station of this size could be managed by two junior research assistants would be responsible for all activities on the station. When a researcher from the main center plans to place an experiment in the sub-station, he must contact the sub-station in advance and inform them of his land and labor requirements and his arrival date. The research assistants will then be responsible for having everything ready. When the research arrives, he will not lose time in the preparations. He can go directly to the field and plant his experiment.

It will be the responsibility of the researcher conducting the experiment to apply all experimental factors and take all notes. He must also be present and participate in the planting and harvest activities as well as monitoring progress throughout the growing season. He must also leave a schedule of irrigations and other activities he expects the resident managers to conduct. It is their responsibility to manage the station. It is not their responsibility to conduct the experiments.

C. Reorganize research sections. A review of the Annual Reports from 1985 to the present shows there has been a great deal of research done. The quality of this research varies and much of it lacks objectively, focus and direction. As far as I could determine a great deal of the research has no relation to farmers' need nor is there is mechanism for carrying the results to the farmers' fields.

It was also observed that under the present organizational structure there does not appear to be good coordination of efforts for any single crop. For example the wheat botanist is responsible for the development of varieties. Agronomic work is done by the agronomist and plant protection work by the plant protection section. If there is any multi-disciplinary interaction, it is not apparent.

Finally, it was observed that most research is conducted at ARI, Sariab, and, with the exception of the farming system research at Kanak, there is no interaction or contact between the researches and the farmers.

In the present structure sections are organized by disciplines. It may be more effective and efficient to organize sections by major crop groups. Under this arrangement each section would have the responsibility for coordinating all research being conducted on the crops for which it is responsible. Each section would have a section head who would have overall administrative responsibility as well as provide leadership in program direction. The associate section head should be a crop agronomist who would be responsible for direction in the agronomic area for all crops under the responsibility of the section. A research assistant would be responsible for each of the major crops or two or three crops of lesser importance. He would be responsible for development of the

program for the crop(s) for which he is responsible. He would decide which factors would be included in the experiments and the experimental designs. He would conduct these experiments and report the results. Research plans made by the research assistant would be discussed and approved by both the section head and the associate head before being approved.

In this restructuring, resources should be allocated according to the economic importance and area of the crop. The exceptions to this rule would be those crops in which research is being financed by an outside institution. In these cases the dictates of the financing institution would be followed.

As a first approximation I suggest the following sections:

1. GRAIN CROPS
2. FORAGE CROPS
3. OILSEEDS
4. VEGETABLES
5. PULSES
6. SOIL CHEMISTRY
7. PLANT PROTECTION
8. SOCIAL SCIENCES (to include agricultural economics and statistics)

Each section would have the responsibility to see that research results flow through a sequence of stages until the recommendation is tested in farmers' fields. In the case of varieties this begins with varietal development and continues through testing varieties and agronomic factors on farm in the FSR program and development of seed producers in each area where the crops are of economic importance.

This arrangement does not preclude the conducting of experiments by the support sections such as soil chemistry, and

entomology. However the results of their experiments should be shared with each crop section involved. One example of this sharing would be the use of a crops in the IBSNET-type fertility experiments in which generalized fertility recommendations for a broad set of soil types with similar formative factors developed. The experiment would be designed and conducted by the soil chemistry section and the results would be shared with the appropriate crop section. In this way the section leaders would have a complete set of recommendation practices for the crops of their section.

Some of the advantages of this type organization are: (1) concentrated responsibility, (2) promotion of inter-disciplinary collaboration, and (3) junior research officers will gain experience as they progress from research associates to posts with greater responsibilities. Responsibility for the research program of each major crop is concentrated in one section and one person has responsibility for coordinating all research related to that crop. If assistance is needed in a discipline not represented in the section (e.g. plant protection), assistance can be requested from that section.

III. Responsibilities of each commodity section.

The responsibilities of each section may be divided into three categories: varietal development, agronomic research at both the station and the farm levels, and development of seed sources.

Varietal development begins with germplasm evaluation and continues through varietal evaluation in farmers' fields. The client farmers make the final evaluation. The stages in the procedure are observation nurseries in each district where the crop is of major economic importance, testing of selections from the nurseries in variety trials in each district, and a breeding block at ARI Sariab.

Research on agronomic components in production should be

conducted in farmers' fields as part of the FSR program. Research which can be carried directly from the station to farmers' fields for final adjustments would be conducted first on-station.

A promising varieties are identified and accepted by the local farmers, a system of seed production in which good quality seed is made available. This is the responsibility of the crop section. One or more independent growers in each district can be designated as official sources. The section furnishes these selected growers with basic seed and monitor the production process to assure that proper procedures are being followed in planting, weeding, insect and disease control, roguing of off-types, harvesting, and packaging to insure purity of seed.

Under this structure FSR becomes a multi-disciplinary program. Section heads have the responsibility for development of the program jointly. It would perhaps be more orderly if the head of the agricultural economics acts to convene these meetings and also acts as chairman.

The functions of the support section can be divided into two major categories - collaborative research and technical support. It should be understood that the support groups are not subordinate to the crop sections. They are of equal status and importance.

Collaborative research is "independent" research conducted by the researchers in the support sections. By independent it is meant they design and conduct the experiments and are responsible for all phases. It is important that the research topic and the treatments are directed toward an identified need of farmers. Results must be shared with the section responsible for the crop.

Technical support is primarily advising the researchers within each crop section on topics within the specialty of that support section. When a crop section researcher decides that research should be done upon a fertility problem or a plant protection problem in a particular area, the responsibility of the support section is the advise him on proper designs, chemicals, etc, so that the research will be meaningful.

As a general concept, the support section will be responsible for conducting research covering broad areas which require many experiments. At the same time they will assist and advise the crop section in conducting of experiments which include their respective area of specialization. In this way none is denied the opportunity to conduct "independent" research.

At the highest echelon within the Agricultural Research Institute there should be a well defined division of responsibilities. It is suggested that the director take responsibility for all administrative matters and be the direct liaison with all government offices, both provincial and national. The associate director will be responsible for all aspects of the technical program and interact with the section heads in coordinating research activities.

Organizational Structure
Farming Systems Research Program
Sind Province

Suggested Structure of the Farming Systems Research Program.

The Policy Planning Coordinator Council. (PPCC). Initially this council will consist of the Vice Chancellor SAU, the Director AEARC, the Director ARI Tandojam, and the Director Adaptive Research. Other members may be added as the program develops. The chairman should be an active member of the council and be elected for a specified term of office to allow the chairmanship to rotate among participating members. The council should have a minimum of two meeting a year and preferably should meet quarterly.

At the organizational meeting held at Sind Agricultural University, Tandojam November 1, 1990 it was decided that the PPCC would be held in the first week of February, 1991. At this meeting the chairman of the council would be elected by the members. The council will be convened twice annually. Membership in the council will include, but not be limited to, the following:

Director General, Research, Sind Province,
Director General, Livestock, Sind Province,
Director General, Extension, Sind Province,
Director General, Agriclutural Engineering, Sind Province,
Director, Atomic Energy Agricultural Research Institute, Sind Province,
Vice Chancellor, Sind Agricultural University, Sind Province.

The FSR Coordinator and the MART Project/USAID were appointed as ex-officio members of the council. It was also agreed that other members may be appointed as temporary members as approved by the chairman.

The responsibilities of the council will be:

a) Provide FSR policy guidelines and assist in defining priorities,
b) Develop a mechanism for recognition of performance in FSR projects,
c) Represent and promote the FSR program to provincial government,
d) Seek funding from both public and private sources for continuation and expansion of the FSR program,
e) Promote collaborative efforts between the public and private sectors in the FSR program,
f) Approve and forward FSR budget to provincial and federal agencies for funding.

At the meeting of November 1, 1990 it was approved that the PPCC would finalize the system of budgeting, distribution of finances, and fiscal accountability in the FSR program in its first meeting.

The Coordination Committee. The coordination committee is composed of one representative from each of the participating institutions, one senior Extension official and one prominent agribusiness representative from the private sector. Each representative is appointed by the director of the institute and should be a person who is knowledgeable of the total program of the institute he is representing. Preferably it should be the director of the institute, the associate director, or someone of equivalent rank.

The Chairman of the Coordination Committee will be elected by the members of the committee and the position will be rotated among members. The term of office will be set and elections held during the first meeting. It was decided in the November 1 meeting that the first meeting of the Coordination Committee would be held in January, 1991.

The responsibilities of the Coordination Committee will be:
a) Review ongoing projects and progress,
b) Review and approve new projects,
c) Coordination of the provincial FSR program.
d) Fiscal management of funding as approved by the PPCC,
e) Prepare and present periodic reports of progress to the PPCC,
f) Assure that resources are available to project managers when they are needed,
f) Establish human resource development in FSR and recognition of individual performance.

This committee will be responsible for the day to day management of the FSR program. It will work closely with the project managers and act as the interface or liaison between the PPCC, the institutional committees, and the project managers. As projects are proposed this committee will be responsible for deciding upon the feasibility, development of a budget and long rante project plan for presentation to the PPCC, assigning the project manager, and assigning secondary responsibilities for support of the project manager.

The Institutional Committee. Each participating institute will have an institutional committee which acts as the coordinating body for that institute. The chairman of this committee should be the institutional representative in the coordinating committee.

In the November 1 meeting it was decided that the first meeting of each institutional committee would be held in December, 1990.

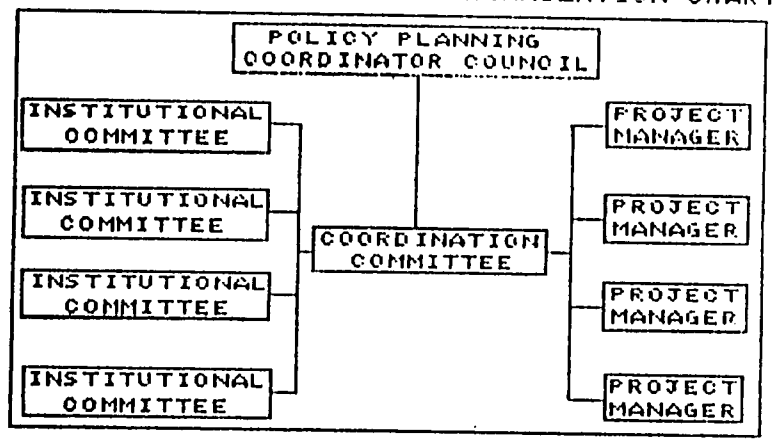
The major responsibilities or the institutional committee are:
a) Plan and coordinate the institution's participation in projects proposed to the PPCC,
b) Assign personnel to projects,
c) Review project proposals from within the institution before submission to the PPCC through the coordination committee.

The Project Manager (Site Coordinator). Each project will have a project manager. This position is comparable to the present site coordinator but with more comprehensive responsibilties. He should be from the institution having major responsibility for the

execution of the project. He will be directly responsible to the coordination committee and keep them informed of progress.

The project managers responsibilities are:
a) The management and execution of the project as approved,
b) Monitor progress with frequent field visits,
c) Coordinate activities of participating institutions,
d) Accountability for funds disbursement and equipment,
e) Submit reports on progress to the coordination committee.

FIGURE 1. PROPOSED FSR ORGANIZATION CHART

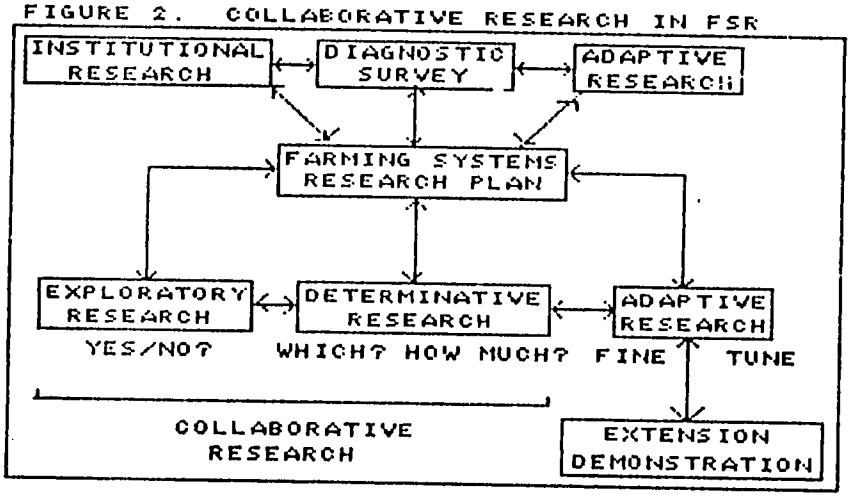


INTER-INSTITUTIONAL COLLABORATION IN FSR.

No single institution contains all of the disciplines necessary to conduct farming systems research adequately. For that reason a collaborative effort is necessary in the FSR approach. This effort which includes the university, the research institutes, and extension creates a linkage which permits research results to flow to the farmers as well as a feed-back mechanism from the farmer to research. This feed-back is used by the research to orient his future research to the actual problem of the client farmer.

Figure 2 illustrates how collaborative research may be done by the collaborating institutions. When a target area is proposed by the PPCC a diagnostic survey will be planned jointly by the institutions which will be involved and the adaptive research unit. Decisions and planning of the project will be based upon the results of this survey and institutional assignments will be made.

FIGURE 2. COLLABORATIVE RESEARCH IN FSR



Exploratory research is designed to determine if a recommended practice is feasible or better than the present farmers' practice. This is planned and conducted jointly by the institutional research and the adaptive researcher. Those experimental factors found to be an improvement and which have potential for adoption will be further tested in the determinative phase of research.

Determinative research identifies the alternatives which are most effective and most economical. This is commonly referred to as "levels" research. This phase of research is also conducted jointly.

Generally, both exploratory and determiniative research will be done on commodities within the farming system but always keeping in mind the place of the commodity within the system and the interactions. The final phase of research, the adaptive research, is conducted by the adaptive research unit of extension. It is in this phase that final adjustments are made and the reserach is conducted in a more extensive area in collaboration with the private sector.

Feedback of information occurs along various paths within the system. Results of adaptive research may feed back information about the non-acceptability of a proposed recommendation directly to determinative research and also indicate a need for more information. The diagnostic survey may indicate areas of immediate research for both the adaptive research unit and the institutional researchers. Determinative research may indicate that none of the alternatives from exploratory research are acceptable, therefore another set of experimental factors should be considered for exploratory research.

The final results of a farming system research program such as that outlined above is a more effective and more efficient research system in which the strengths of each participating institution are utilized to the fullest extent. It also establishes a working relationship between research, extension, and the client farmer. This, in turn, aids the researcher in orienting his research to the actual needs of the client farmer. The results of this research are more easily communicated to the farmer by the efforts of extension agents since it is relative to the needs of the farmers of the area.

A BRIEF ON FSR PROGRESS IN SIND PROVINCE

Background.

The FSR Program began with the collaborative efforts of SAU, ARI, AEARC and technical assistance from the MART Project. The objective was to improve farm income through introduction of improved agronomic and livestock management practices through farming systems research. A team of 12 subject specialists were selected from the participating organizations to form the mulit-disciplinary FSR team.

Two target sites were selected for the initial stages of the program. Several factors were involved in the selection of these sites. The primary factor was that each site be representative of cultural practices for one or more agronomic crops of major economic importance. Hala was chosen for the importance of both cotton and wheat. Tando Mhd. Khan was chosen for the importance of sugarcane, rice, and wheat.

Diagnostic surveys were conducted at both sites to determine the major constraints to production in the major crops and livestock enterprises. These constraints were the same in both sites. These were (1) local varieties of low yield potential, (2) improper fertilization, (3) poor pest management practices, and (4)poor land preparation. In livestock the constraints were (1) poor health care and (2) inadequate feeding due to the shortage of fodder during parts of the year, principally May and June.

The primary cropping system in the Hala area is wheat-cotton-wheat. There are some variatiations which include berseem-millet or mungbean, but all systems include either wheat or cotton. Most farmers apply one bag of DAP per hectare to both wheat and cotton and one or two bags of urea per acre in a split dose. Yields are 20-25 mds/acre for wheat and 6-8 mds/acre for cotton.

The principal cropping system in Tando Mhd. Khan is sugarcane-ratoon-rice-wheat-sugarcane. There are variations which include intercropping of wheat or berseem in sugarcane. Farmers apply one bag of DAP at planting and one or two bags of urea to sugarcane. They do not normally apply DAP to rice or wheat, but do apply one to two bags of urea. Yields are 500-600 mds. sugarcane, 20-25 mds. paddy, and 10-12 mds. wheat per acre.

Many of the experiments were of the simple comparative type in which one or more interventions are combined as one treatment to be compared with the farmers' practice. These are easy to install and are excellent for demonstration purposes, but they do not permit the estimation of the contribution of the individual components or interactions when two or more components are combined. As will be seen, in spite of this problem much useful information has been gained from the experiments.

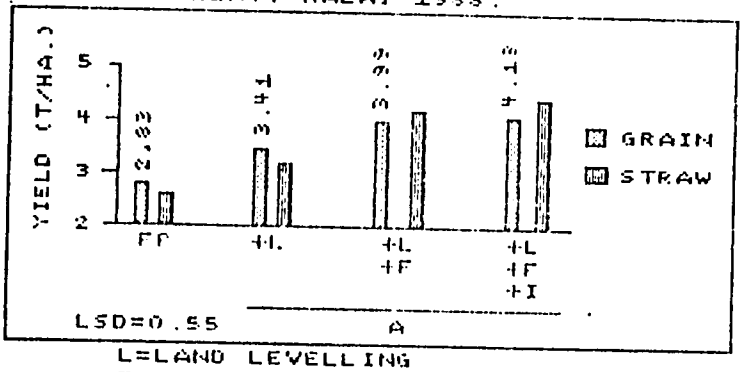
Hala Site Research Program.

Experiments addressing the major production constraints have been conducted in farmers' fields since 1987. The results of each experiment is discussed below.

Weed Control in Wheat. A comparative study was conducted at three sites in which the effect of Buctril-M was compared with the farmers' weed control method. The experiment was too small to permit a meaningful statistical analysis. The average yield increase attributable to the chemical control was 400 kgs./ha. The economic analysis indicated the farmer could expect a return of approximately Rs. 16 for each Rs. spent on chemical control.

Cultural Practices in Wheat. An experiment was conducted to study the effects of land levelling, increased fertilizer use, and irrigation scheduling on yield. The design used did not permit the statistical estimation of individual components, however the highly significant treatment effect in the statistical analysis clearly shows the advantage of the interventions tested. A summary of the data from this experiment is presented in Figure 1.

FIG. 1 INVESTIGATION OF CULTURAL PRACTICES IN WHEAT. HALA. 1988.



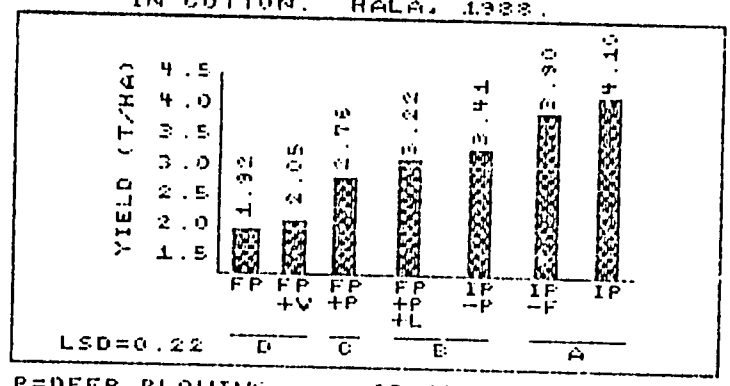
L=LAND LEVELLING
F=FERTILIZER USE
I=IRRIGATION SCHEDULING
FP=FARMERS' PRACTICE

Tillage Practices in Wheat. In this study the effects of minimum tillage and conventional tillage were compared. There was no statistically significant difference in yield detected. By virtue of the fact that minimum tillage does not reduce yield it can be said that minimum till has the comparative advantage. It reduces land preparation costs and permits earlier planting of the crop in the system.

Variety/Fertilizer in Wheat. In this comparative study between the farmers' practice and the alternative "package" the experimental factors were variety, DAP, and urea. The results show that the alternative practices have a clear advantage. Grain yield increased by approximately 2 tons/hectare and straw yield by approximately 1.5 tons/hectare. The benefit/cost was 1:3.49. This experiment was repeated the following year with similar results.

Cultural Practices in Cotton. An experiment was conducted in cotton which was designed to demonstrate the effect of each component in the package. The design used was the "+/-" arrangement in which components are either added to the farmers' practice or deducted from the experimental package. The experimental factors were deep plowing, land levelling, improved variety, population density, and use of phosphate fertilizer. Results are presented in Figure 2.

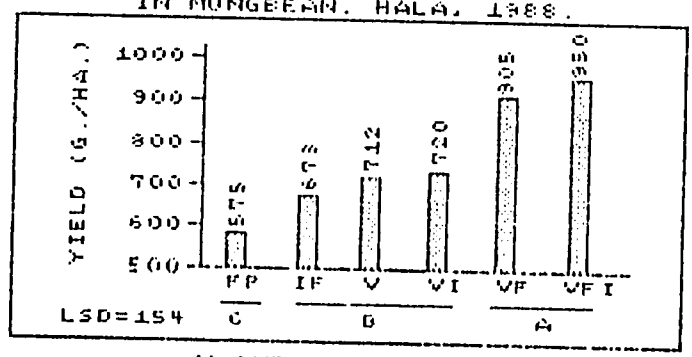
FIG. 2. INVESTIGATION OF CULTURAL PRACTICES IN COTTON. HALA, 1988.



P=DEEP PLOWING
L=LAND LEVELLING
F=ADDED PHOSPHATE
IP=IMPROVED PACKAGE
FP=FARMERS' PRACTICE
V=IMPROVED VARIETY

Cultural Practices in Mungbean. Since mungbean is a component in some rotation practices where it replaces wheat, an experiment was conducted in which the experimental factors were variety, fertilizer use, and inoculum use in a factorial arrangement. The results are given in Figure 3.

FIG. 3. INVESTIGATION OF CULTURAL PRACTICES IN MUNGBEAN. HALA, 1988.



V=IMPROVED VARIETY
I=INOCULUM
F=ADDITIONAL FERTILIZER

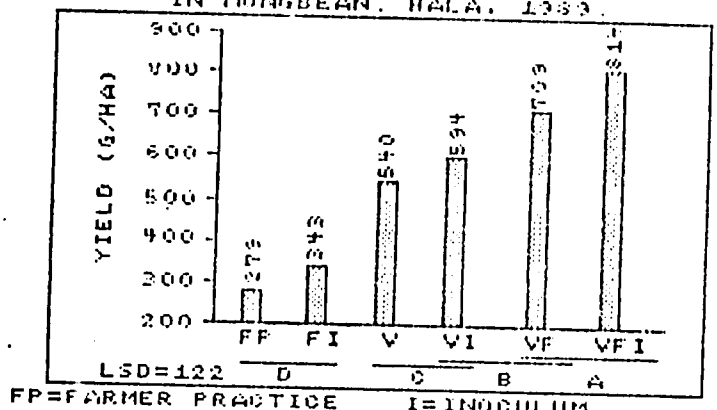
The contribution to yield from the inoculum was non-significant while the contribution of both the variety (2021) and the additional fertilizer were significant. This experiment was repeated the following year with similar results.

The improved variety (2021 from AERAC) not only has a significantly higher yield, it is also much earlier in maturity than the local variety. This early maturity permits the farmer to

follow mungbean with cotton. The local variety matures too late to permit this.

Economic analysis of the above experiments demonstrates that the improved variety used in combination with fertilizer has a comparative advantage over wheat yielding approximatly Rs. 4000 per hectare more than wheat.

FIG. 4. INVESTIGATION OF CULTURAL PRACTICES IN MUNGBEAN, HALA, 1983.



FP=FARMER PRACTICE I=INOCULUM
V=IMPROVED VARIETY F=INCREASED FERTILIZER

Soybean. In 1987-88 an exploratory experiment was conducted with soybeans in which the experimental factors were fertilizer use and inoculum. The treatments were in a factorial arrangement. Analysis showed both factors to be significant with no interaction.

Given the prevailing social and economic conditions in the Hala area the successful introduction of soybean into the region is not promising. The farmers are not familiar with the use of soybean as a food and the economic analysis indicated mungbean as a distinct comparative advantage.

Weed Control in Vegetables. Two experiments were conducted to investigate chemical weed control in vegetables. Both experiments show significant yield increases in the chemical weed control treatment and the chemical treatment had an economic advantage in the analysis. This should be reconsidered, however, since the fact that weeds are removed and used as fodder for the animals was not taken into consideration in the economic analysis.

Cultural Practices in Sunflower. The experimental factors in this experiment were levels of potassium and use of ridges. Treatments were in a factorial arrangement. The effects of both factors were highly significant with no interaction. No additional data were available to indicate the feasibility of introduction of sunflower into the area.

Summarizing the above it appears:

-Sarsabz variety of wheat has a proven advantage over the local varieties in both yield and early maturity. Since no variety trials have been conducted we cannot say that Sarsabz is the best variety for the area.

-Fertilizer levels above those presently used by farmers are economical. We do not know the optimum levels.

-Land levelling alone will increase yields sufficiently to be economical. This practice is one which can be easily extended.

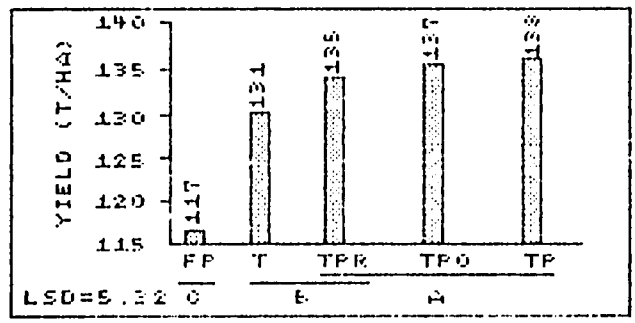
-Deep plowing and land levelling in cotton have a beneficial effect on the cropping system. NIAB-78 variety is a higher yielding variety than the local variety and is earlier maturing permitting more time for land preparation for wheat. Optimum population density and fertilizer use have not been determined.

-Mungbean has a great potential in the area when the variety 2021 is used in combination with proper fertilization. The problem with the inoculum should be studied at the experiment station level.

Tando Mhd. Khan Site.

In the 1988-89 cropping cycle for sugarcane an experiment was conducted to investigate the effects of tractor verses bullock ridging methods, overlap planting verses end-to-end planting and intercropping versus monocropping. The results are given in Figure 5.

FIG. 5. INVESTIGATION IN CULTURAL PRACTICES IN SUGARCANE. TANDO MHD. KHAN. 1989.

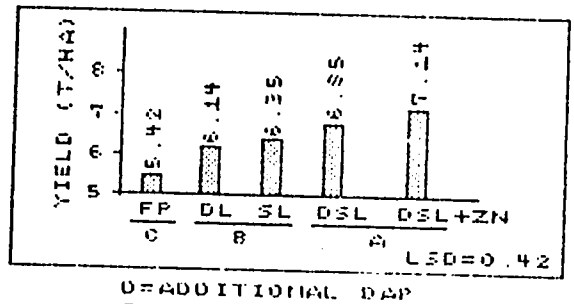


T=TRACTOR RIDGING
P=INCREASED POPULATION
O=ONION INTERCROPPING
R=RADISH INTERCROPPING
FP=FARMERS' PRACTICES

The effects of both tractor ridging and overlap planting are significant. Intercropping has no effect on cane yield while increasing the income potential of the farmer. Since this experiment was conducted many of the farmers of the area have adopted the practice of intercropping cane with onions.

There have been two experiments to investigate cultural practices in rice, the second most important crop of the area. In 1989 an experiment was conducted to study the effect of improved (or pure) seed, line planting, and the use of additional DAP. The farmers' practice is to use local seed and random planting with one bag of DAP. The effects of these experiments is shown in Figure 6.

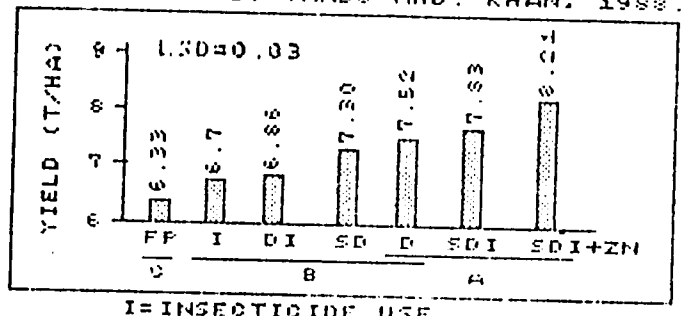
FIG. 6. INVESTIGATION IN CULTURAL PRACTICES IN RICE. TANDO MHD. KHAN. 1988.



D=ADDITIONAL DAP
S=PURE SEED
L=LINE PLANTING
ZN=ADDITIONAL ZINC

The second investigation was on insecticide use, DAP, improved seed, and zinc. The design was not a factorial arrangement and the contribution of individual components is difficult to ascertain. Results are given in Figure 7.

FIG. 7. INVESTIGATION IN CULTURAL PRACTICES IN RICE. TANDO MHD. KHAN. 1988.



I=INSECTICIDE USE
D=ADDITIONAL DAP
S=IMPROVED SEED
ZN=ADDED ZINC
FP=FARMERS' PRACTICES

In summary we have evidence that a potential source of income is the intercropping of sugarcane with onions or another short-duration crop. There has been no investigation of other possibilities other than radishes. Both the tractor ridging method and the overlapping planting method are significant improvements over the farmers' practice and should be placed in verification experiments in combination with intercropping. Investigation to determine optimum doses of fertilizer were not conducted.

In rice line sowing, DAP, improved seed, and insecticide use appear to add significantly to yield. Further investigation is needed to determine the contribution of these individual components accompanied by a partial budget analysis to assess their relative benefits. Evidence from an experiment conducted in 1989 in which improved seed and line sowing were studied in a factorial arrangement indicated both factors were highly significant in their contribution to yield increase with no significant interaction. As in the case of sugarcane optimum level of fertilizer use have not been studied.

Wheat is the major rabi crop in the region but extensive investigation has not been conducted to determine optimum input

levels. Comparative experiments have been conducted in which the farmers' practices of DAP and urea use were compared with the experimental levels of both. Grain yield was increased by 900 kgs/ha and straw yield by 800 kgs/ha. The benefit-cost ratio was 1:2.28. The design of the experiment does not permit the estimation of each component to yield increase.

Livestock interventions in the Tando Mhd. Khan area have included experiments with use of sugarcane tops for silage and the use of urea to enhance the digestability and nutritive value of rice straw.

A BRIEF ON FSR FIELD ACTIVITIES
RABI SEASON, 1990-91

Based upon the program review which was conducted in preparation for the organizational meeting in 2 December 1990, the following program was formulated.

I HALA SITE

A. Cotton-Wheat System. A split-split plot design was used with the following experimental factors:

Main Plot = Broadcast vs Drill planting methods
Sub Plot = One bag DAP/acre vs two bags DAP/acre
Sub-sub plot = One, two, and three bags urea/acre

This experiment will be planted at six locations within the recommendation domain of Hala Site, one replication at each location. The experiment covers one acre. Each main plot is 1/2 acre in size, each sub plot 1/4 acre and each sub-sub plot 1/12 acre. The design permits the estimation of both main effects and all possible interactions. With six replications there will be sufficient degrees of freedom in the error terms to give satisfactory precision.

The purpose of the experiment is to determine the response of wheat to levels of nitrogen and phosphorous. A partial budget analysis will be done to determine the most beneficial treatments. The "check plot" is the farmers' practice of broadcast sowing, one bag of DAP per acre and one bag of urea per acre. There is some variation in this practice, such as applying two bags of urea when no DAP is applied at sowing. This variation is not the standard practice.

In keeping with the systems concept of experimentation, these same fields will be used for the next series of experiments with cotton. The experiments will be designed to study the residual effects of fertilizer levels applied to wheat and the effects of additional levels of fertilizer applied to cotton after wheat.

B. Onion-Wheat. The same experimental design was used to study the effects of fertilizer levels in wheat after onions. After harvest the onion beds are leveled and planted to wheat under a "minimum tillage" system which proved beneficial in previous FSR experimentation. If the farmer chooses the option of complete tillage after onion he must either plant mungbean in February or allow the land to lay fallow until the next onion crop planted in July or the cotton crop planted in April.

Unfortunately no information has been gathered on cultural practices in onion. Practices vary in the use of both DAP and urea, sometimes varying by as much as three bags per acre. There has also been some experimentation on the part of the farmers with the use of potassium fertilizers to hasten maturity and get the product to market before prices drop. This is a research opportunity which illustrates the value of the feedback from farmer to research in the FSR system. The effect of potassium on maturity of onion must be investigated on the research station in the next onion cropping cycle.

C. Onion- Mungbean-Cotton. Previous experimentation has proven that the AEARC Variety 2021 of mungbean is both earlier maturing and higher yielding than the farmers' variety. Previous experiments have also shown that Variety 2021 responds to nitrogen more efficiently than the farmers' variety.

Early maturity of the Variety 2021 permits the planting of cotton following mungbean, a practice not possible with the farmers' variety. The most common practice when using the local variety of mungbean is a onion-mungbean-onion system.

In this cycle experimentation will be conducted to study the response of Variety 2021 to level of fertilizer under farmer practices. The same plots will then be used to study the system effects of these levels on the subsequent cotton crop.

D. Wheat Variety Trials. In collaboration with the Atomic Energy Agricultural Research Center (AEARC), Tandojam and the Agraicultural Research Institute (ARI), Tandojam the FSR program is conducting wheat variety trials in the Hala Site area. The experiment consist of one variety from AEARC, three varieties from ARI, and the farmers' local variety as a check.

The experimental design is a randomized complete block with four replications at each of six locations. The only experimental factor is varieties. All cultural practices are those normally done by the farmer. This is an example of a farmer-managed experiment.

II TANDO MOHAMMAD KHAN SITE

Experimentation in the TMK Site has been confined to cultural practices in sugarcane. These experiments have identified both tractor ridging at planting and "overlap" planting as benefical practices which significantly increase yield. Intercropping with onion or radish had no significant effect on cane yield but did significantly increase farm income. Onion is the preferred crop by the farmers.

This cycle an experiment was designed to study the response of sugarcane to fertilizer levels. The experimental design is a split-split plot design with one replication at each of six locations. The experimental factors in the experiment are as follows:

Main Plot = Planting density (end-to-end vs overlap)
Sub Plot = DAP (one bag/acre vs 2 bags/ acre)
Sub-sub Plot = nitrogen and potassium (5 plots)
(one, two, or three bags of urea, three bags urea + one or two bags potassium sulfate).

Onions have been intercropped in three of the six locations. At harvest note will be taken during the analysis to assess if there is a yield difference that can be attributed to the onion intercropping.

After harvest of the cane crop in September-October, 1991 the same fields will be used to continue the system analysis with experiments of fertilizer levels with and without wheat intercropping in the ratoon crop. Crops other than wheat may also be tested as intercrops.

B. Wheat intercrop in Ratoon. Farmers in the TMK site often plant wheat mainly for home consumption. If they fertilize at all it is a low level, usually one or two bags of urea per acre. The hypothesis is that if an economical set of practices could be developed farmers may become interested in growing more wheat to provide extra income as well as wheat for home comsumption.

The purpose of the experiment developed for this cycle is to determine the response of wheat to a set of fertilizer practices. A secondary purpose will be to determine the effect of these levels and the intercropping of wheat on the sugarcane yields in the ratoon crop.

To test the hypothesis a randomized complete block design will be superimposed upon the farmers' wheat plantings. The only experimental factor will be nitrogen in the form of urea. The levels of urea will be 3, 4, 5, and 6 bags per acre. The applications will be split with one-third of the total amount being applied at each of three dates - November, January, and March. This split application is designed to give the wheat a "starter" dose at planting and a "booster" dose at heading. The third application is to assure that the ratoon crop of cane will have sufficient nitrogen as it matures.

Neither phosphorus nor potassium will be included since the soil will not be disturbed and these elements would have no effect on the crop unless mixed with the soil. The farmers' planting method in this situation is to broadcast the seed and irrigate.

C. Sugarcane Variety Trials. With collaboration from the Sugarcane Section of ARI, Tandojam, the FSR program has placed a sugarcane variety trial at six locations in the Tando Mhd. Khan Site. The trial consist of three varieties from the ARI program and the farmers' variety (BL-4) as a check.

The experimental design is a randomized complete block with four replications at each location. It will be planted at six locations. The trial was planted using tractor-ridging and overlap-planting since these practices have been introduced into the area through the FSR program and adopted by many of the local farmers. All other cultural practices are those of the farmers.

D. Wheat Variety Trials. The wheat variety trials placed in the Tando Mhd. Khan site are identical to those in the Hala Site.

10-00 - 10-30	Refreshment	
10-30 - 11-30	Data Entry in Lotus	DR. K.S. MEMON
11-30 - 13-00	Data Entry in Lotus	DR. K.S. MEMON
13-00 - 14-00	Lunch and Prayer	
14-00 - 16-00	Graphs in Lotus	DR. M.Y. MEMON

January 30 1990 Tuesday

06-30 - 10-00	Mathematical functions in Lotus	DR. M.Y. MEMON
10-00 - 10-30	Refreshment	
10-30 - 11-30	Mathematical functions (Lab.)	DR. M.Y. MEMON
11-30 - 13-00	Mathematical functions (Lab.)	DR. JIM BARNETT
13-00 - 14-00	Lunch and Prayer	
14-00 - 16-00	Print Command in Lotus	DR. JIM BARNETT

January 31, 1990 (Wednesday)

08-00 - 10-00	Data of FSR in Lotus	DR. JIM BARNETT
10-00 - 10-30	Refreshment	
10-30 - 11-30	Data Management (Lab.)	DR. JIM BARNETT
11-30 - 13-00	Data Management (Lab.)	DR. JIM BARNETT
13-00 - 14-00	Lunch and Prayer	
14-00 - 16-00	Data Management (Lab.)	DR. JIM BARNETT

February 1st 1990 Thursday

08-00 - 10-05	Recitation from Holy Quran	
10-05 - 10-20	Welcome Address	DR. G.H. MEMON
10-20 - 10-30	Introductory Remarks	DR. K.S. MEMON
10-30 - 10-50	Views of Course Director	DR. JIM BARNETT
10-50 - 11-10	Views of participants	
11-10 - 11-30	Certificate Awarding Ceremony	DR. L.M. BHATTI
11-30 - 11-45	Speech of Chief Guest	DR. L.M. BHATTI
11-45 - 11-50	Vote of Thanks	DR. M.Y. MEMON
11-50 -	Refreshment	

SAU - PARC

FSR MICRO-COMPUTER TRAINING COURSE

ORGANIZED BY

FSR SINDH UNIT

and

Department of Agricultural Education, Extension and Short Courses

SINDH AGRICULTURE UNIVERSITY TANDOJAM

In Collaboration with

PARC, MART-US-AID

January 22nd to February 1st, 1990

COURSE OBJECTIVES:

1. Introduction to proper use handling and care of computers.
2. Introduction to various basic computer operations such as operating systems, copying etc.
3. Word processing through Wordstar package
4. LOTUS 1-2-3 basic functions, data entry in spread sheet graphics, statistical functions.
5. Use of LOTUS 1-2-3 for FSR data management.

ORGANIZING COMMITTEE:

1. Dr. Ghulam Hussain Memon
2. Dr. Kazi Sulaman Memon
3. Mr. Fazal Karim Rajput
4. Dr. M. Yameen Memon
5. Mr. Nazir Ahmed Chaudhry
6. Dr. Shafi Mohammad Nizamani

PROGRAMME

January 22, 1990 (Monday)

08-30 - 09-30 Registration

09-30 - 11-00 Introduction to Micro Computer — DR. K.S. MEMON

11-00 - 11-30 Refreshment

11-30 - 13-00 Computer Hardware and Software — DR. NIZAMANI

13-00 - 14-00 Lunch and Prayer

14-00 - 15-00 Operating Systems (MS-DOS) — DR. JIM BARNETT

15-00 - 16-30 MS-DOS Commands (Lab. Session) — DR. S. BUKHARI

January 23, 1990 (Tuesday)

09:30 - 10-00 Introduction to Word Processing and Wordstar — DR. M.Y. MEMON

10-00 - 10-30 Refreshment

10-30 - 11-30 Edit Menu of WS — DR. M.Y. MEMON

11-30 - 13-00 Edit Menu (Lab) — DR. NIZAMANI

13-00 - 14-00 Lunch and Prayer

14-00 - 16-00 Edit Menu (Lab) — DR. S. BUKHARI

January 24, 1990 (Wednesday)

08-30 - 10-00 On Screen Margins, typing and display — DR. S. BUKHARI

10-00 - 10-30 Refreshment

10-30 - 11-30 On Screen Margin, typing & display (Lab) — MR. K.A. MAHAR

11-30 - 13-00 On Screen Margin, typing & display (Lab) — MR K.A. MAHAR

13-00 - 14-00 Lunch and Prayer

14-00 - 16-00 On Screen Margin (Lab) — MR K.A. MAHAR

January 25, 199[illegible] [illegible]rsday)

08-30 - 10-00 Block Move Copy, Save Commands — DR. S. BUKHARI

10-00 - 10-30 Refreshment

10-30 - 11-30 Blocks Lab. — MR. K.A. MAHAR

11-30 - 13-00 Blocks Lab. — MR. K.A. MAHAR

13-00 - 14-00 Lunch and Prayer

14-00 - 16-00 Print Control (Lab.) — DR. S. BUKHARI

January 27, 1990 (Saturday)

08-00 - 10-00 Quick Cursor Movement — DR. NIZAMANI

10-00 - 10-30 Refreshment

10-30 - 11-30 Cursor Movement (Lab.) — DR. NIZAMANI

11-30 - 13-00 Cursor Movement (Lab.) — DR. NIZAMANI

13-00 - 14-00 Lunch and Prayer

14-00 - 16-00 Spelling Check (Lab.) — MR. K.A. MAHAR

January 28, 1990 (Sunday)

08-30 - 10-00 Work Sheet LOTUS Introduction — DR. K.S. MEMON

10-00 - 10-30 Refreshment

10-30 - 11-30 LOTUS Menu (Th.) — DR. K.S. MEMON

11-30 - 13-00 LOTUS Menu (Lab.) — DR. NIZAMANI

13-00 - 14-00 Lunch and Prayer

14-00 - 16-00 LOTUS Menu (Lab.) — DR. M.Y. MEMON

January 29, 1990 (Monday)

08-00 - 10-00 Data Entry in Lotus — DR. K.S. MEMON

[illegible] - 11-00	Practical Session Factorial Experiments) DR. JIM BARNETT NAZIR A. CHAUDHRY DR. SHAFI M. NIZAMANI

AUGUST 25. SUNDAY

[illegible] - [illegible] 30	Planning of Field Experiments-V Split Plot Split Block Experiments DR. JIM BARNETT NAZIR A. CHAUDHRY
09-30 - 10-30	Data Analysis and Interpretation-VI Split plot Experiments NAZIR A. CHAUDHRY
10-30 - 11-00	Tea Break
11-00 - 12-00	Data Analysis and Interpretation-VII. Split Block Experiments) NAZIR A. CHAUDHRY
12-00 - 14-00	Practical Session (Split Plot,Split Block Experiments) DR. JIM BARNETT NAZIR A. CHAUDHRY DR. SHAFI M. NIZAMANI A. KARIM AKBANI

AUGUST 26. MONDAY

08-30 - 09-30	Experiments at Farmer's Field and Recommendation Domain DR. JIM BARNETT
09-30 - 10-30	Analysis of Data from Experiments Conducted at Different Locations-I NAZIR A. CHOUDHRY
10-30 - 11-00	Tea Break
11-00 - 12-00	Analysis of Data from Experiments Conducted at Different Locations-II NAZIR A. CHAUDHRY
12-00 - 14-00	Practical Session (Experiments at Farmer's Fields) DR. JIM BARNETT NAZIR A. CHAUDHRY DR. SHAFI M. NIZAMANI A. KARIM AKBANI

AUGUST 27. TUESDAY

08-30 - 09-30	Practical Budget Analysis DR. JIM BARNETT
09-30 - 10-30	Presentation of Results DR. JIM BARNETT
10-30 - 11-00	Tea Break
11-00 - 12-00	Transforation of Data NAZIR A. CHAUDHRY
12-00 - 14-00	Practical Session DR. JIM BARNETT NAZIR A. CHAUDHRY DR. A. KARIM AKBANI

AUGUST 28. WEDNESD

08-30 - 12-00	Discussion and Practicals (Factorial and Split Plot Experiments) DR. JIM BARNETT NAZIR A. CHAUDHYR DR. SHAFI M. NIZAMANI A. KARIM AKBANI
12-00 - 14-00	Test & Evaluation DR. JIM BARNETT

AUGUST 29. THURSDAY

(Closing Ceremony)

09-00 - 09-30	Recitation from Holy Qura'an
09-30 - 09-40	Introductory Remarks NAZIR A. CHAUDHRY
09-40 - 10-10	Welcome Speech DR. A. HAMID BAJOL Director A.R.I. Quetta
10-10 - 11-00	Comments on the course by Participants
11-00 - 12-00	Course Certificate Awarding Ceremony
12-00 - 12-10	Concluding Remarks DR. JIM BARNETT
12-10 - 12-15	Vote of Thanks
12-15 - 13-00	Refreshment

PARC — MART — USAID

PLANNING, ANALYSIS AND INTERPRETATION OF AGRICULTURAL EXPERIMENTS

Organized by

DR. JIM BARNETT
REGIONAL DIRECTOR MART
SINDH BALUCHISTAN PROVINCES

In Collaboration with

PARC – MART – USAID

AUGUST 17—29, 1991

1. To train the researchers in general principles techniques, assumptions and procedures applicable to experimentation in agricultural and biological sciences.

2. To train the researchers in the principles of field plot techniques.

3. To impart training in the practical applications of statistical methods in agricultural research.

4. To equip the researchers with appropriate Statistical Methodology so as to enable them to conduct experiments, analyse data and interpret results properly for effective research programme.

PROGRAMME

17, SATURDAY

[illegible] .0-30	Registration, Orientation, and Use of Calculators DR. JIM BARNETT
10-30 - 11-00	TEA BREAK
11-00 - 12-00	Measures of Variability NAZIR A.CHAUDHRY
12-00 - 13-00	Analysis of Variance, Its Basis & Uses NAZIR A. CHAUDHRY
13-00 - 14-00	Planning of Field Experiments-I (Purpose, aims and objecives) DR. JIM BARNETT

AUGUST 18, SUNDAY

08-30 - 09-30	Data Recording (Problems and Precautions) DR. SHAFI M. NIZAMANI A. KARIM AKBANI
09-30 - 10-30	Practical Agronomic Considerations in Field Experiments. DR. JIM BARNETT
11-00 - 12-00	Principles of Field Experimentation. NAZIR A. CHAUDHRY
12-00 - 14-00	Practical Session (Measures of Variability and Analysis of Variance) DR. JIM BARNETT NAZIR A CHAUDHRY A. KARIM AKBANI

AUGUST 19, MONDAY

08-30 - 09-30	Planning of Field/ Laboratory Experiments-II (CRD) DR. SHAFI M. NIZAMANI A. KARIM AKBANI
09-30 - 10-30	Data Analysis and Interpretation-I (CRE) DR. SHAFI M. NIZAMANI A. KARIM AKBANI
10-30 - 11-00	Tea Break
11-00 - 12-00	Data Analysis and Interpretation-II (Unequal Observations) DR. SHAFI M. NIZAMANI A. KARIM AKBANI
12-00 - 14-00	Practical Session (CRE) DR. JIM BARNETT NAZIR A. CHAUDHRY DR. SHAFI M NIZAMANI A. KARIM AKBANI

AUGUST 20, TUESDAY

08-30 - 09-30	Planning of Field Experiments-III (RCBD) DR. SHAFI M NIZAMANI A. KARIM AKBANI
09-30 - 10-30	Data Analysis and Interpretation-IV (RCBD) DR. SHAFI M. NIZAMANI A. KARIM AKBANI
10-30 - 11-00	Tea Break
	MR NAZIR A. CHAUDHRY
12-00 - 14 00	Practical Session (RCBD) DR JIM BARNETT NAZIR A. CHAUDHRY DR. SHAFI M NIZAMANI A. KARIM AKBANI

AUGUST 21, WEDNESDAY

08-30 - 09-30	Practical and Discussion Session (CRD & RCBD)-I DR. JIM BARNETT. NAZIR A CHAUDHRY DR. SHAFI M. NIZAMANI A. KARIM AKBANI
10-30 - 11-00	Tea Break
11-00 - 14-00	Practical and Discussion Session (CRD & RCBD)-II DR. JIM BARNETT NAZIR A. CHAUDHRY DR. SHAFI M NIZAMANI A. KARIM AKBANI

AUGUST 22, THURSDAY

08-30 - 14-00	Field Trip to Experimental Sites (KANAT VALLEY, FSR SITE)

AUGUST 23, FRIDAY

HOLIDAY

AUGUST 24, SATURDAY

08-30 - 09-30	Planning of Field. Experiments-IV (Factorial Expts) DR. JIM BARNETT NAZIR A. CHAUDHRY
09-30 - 10-30	Data Analysis and Interpretation-V (Factorial Experiments) NAZIR A CHAUDHRY
10-30 - 11-00	Tea Break
11-00 - 12-00	Data Analysis and Interpretation-VI (Factorial Experiments) NAZIR A. CHAUDHRY

[illegible] - 12-00	Recommendation Domain Dr. Jim Barnett
[illegible] - [illegible]	Practical Session Dr. Jim Barnett Mr. Nazir Ahmad Choudhry

August 27. Monday

[illegible]	Experiments at [illegible] Dr. Kazi Suleman Memon
09-30 - 10-30	Analysis of Data from Experiments conducted at different locations-I Mr. Nazir Ahmed Choudhry
10-30 - 11-00	Tea Break
11-00 - 12-00	Analysis of Data from Experiments conducted at different locations-II Mr. Nazir Ahmed Choudhry
12-00 - 14-00	Practical Session Dr. Jim Barnett Mr. Nazir Ahmed Choudhry

August 28. Tuesday

08-30 - 09-30	Contrasts Dr. Jim Barnett
09-30 - 10-30	Analysis of Data with Missing Values (RCB Experiments) Dr. Shafi Mohd. Nizamani
10-30 - 11-00	Tea Break
11-00 - 12-00	Transformation of Data Dr. Shafi Mohd. Nizamani
12-00 - 14-00	Practical Session Dr. Jim Barnett Dr. Shafi Mohd. Nizamani Mr. Abdul Karim Akbani

August 29. Wednesday

08-30 - 09-30	Partial Budget Analysis Dr. Jim Barnett
09-30 - [illegible]	Presentation of Results-I Mr. Fazal Karim Rajput
10-30 - 11-00	Tea Break
[illegible] - 12-00	Presentation of Results-II Mr. Fazal Karim Rajput
[illegible]	Practical Session Dr. Jim Barnett Dr. M. Yameen Memon

August 30. Thursday

CLOSING CEREMONY:

08-30 - 10-00	Evaluation of Course
10-00 - 10-05	Recitation from Holy Qura'an
10-05 - 10-25	Introductory Remarks MR. FAZAL KARIM RAJPUT Chairman, Department of Agricultural Education, Extension and Short Courses
10-25 - 10-40	Welcome Speech DR RAJAB A. MEMON Dean, Faculty of Agricultural Social Sciences
10-40 - 11-00	Course objectives & achievements DR. JIM BARNETT Course Coordinator
11-00 - 11-20	Comments on Course MR. NAZIR A. CHOUDHRY Course Instructor
11-20 - 11-30	Evaluation of Course by Course Participant
11-30 - 11-40	Evaluation of Course by Course Participant
11-40 - 12-00	Speech (To be announced)
12-00 - 12-55	Certificate Awarding Ceremony & Concluding Remarks DR. L. M. BHATTI Vice Chancellor & Chief Guest
12-55 - 13-00	Vote of Thanks DR M. YAMEEN MEMON Member, Organizing Committee
13-00	Refreshment

SAU–PARC MART

PLANNING AND ANALYSIS OF AGRICULTURAL EXPERIMENTS

ORGANIZED BY

DEPARTMENT OF AGRICULTURAL EDUCATION, EXTENSION & SHORT COURSES

SINDH AGRICULTURE UNIVERSITY TANDOJAM

In Collaboration with

PARC-MART-USAID

August 18-30, 1990

COURSE OBJECTIVES

1. To train the researcher in general principles, techniques, assumptions and to procedures applicable to e-perimentation in agriculture and biology.
2. To instruct the researchers in the principles of field plot techniques.
3. To teach the practical application of statistical methods in agricultural research.
4. To equip the researcher to design and conduct an effective programme including the analysis and interpretation o. data.

ORGANIZING COMMITTEE

i. Mr F.K. Rajput, SAU, Tandojam
ii. Dr. Jim Barnett, USAID Advisor
iii. Dr. M. Yameen Memon, SAU, Tandojam
iv. Mr. Nazir Ahmed Choudhry, SAU, Tandojam
v. Dr. Sayed Saban Shah Bukhari, SAU, T. Jam

PROGRAMME

August 18, Saturday

08-30 - 10-30	Registration & Inauguration
10-30 - 11-00	Tea Break
11-00 - 12-00	Principle of Field Experimentation Mr. Khadim Hussain Tahir
12-00 - 13-00	Practical Agronomic cosiderations in field Experiments Dr. Kazi Suleman Memon
13-00 - 14-00	Planning of Field Experiments-I, (Purpose, Objectives, etc.) Dr. Jim Barnett

August 19, Sunday

08 30 - 09-30	Data Recording: Problems & Pre-cautions Mr. Fazal Karim Rajput
09-30 - 10-30	Analysis of variance: Its basis & Uses Mr. Khadim Hussain Tahir
10-30 - 11-00	Tea Break
11-00 - 12-00	Planning Field Experiments-II (CR,RCB & Latin Square Experiments) Mr. Nazir Ahmed Choudhry
12-00 - 14-00	Practical Session Mr. Abdul Karim Akbani Dr. Jim Barnett

August 20, Monday

08-30 - 09-30	Statistical Hypothesis and Tests of Significance-I Mr. Khadim Hussain Tahir
09-30 - 10-30	Statistical Hypothesis and Tests of Significance-II Mr. Khadim Hussain Tahir
10-30 - 11-00	Tea Break
11-00 - 12-00	Analysis of Data-I (CR Experiment) Mr. Shafi Mohd. Nizamani
12-00 - 14-00	Practical Session Mr. Abdul Karim Akbani Dr. Shafi M. Nizamani

August 21, Tuesday

08-30 - 09-30	Analysis of Data-II (RCB Square Experiment) Dr. Kazi Suleman Memon
09-30 - 10-30	Analysis of Data-III (Latin Square) Dr. Shafi Mohd. Nizamani
10-30 - 11-00	Tea Break
11-00 - 12-00	Statistical Hypothesis and Tests of Significance-III Mr. Khadim Hussain Tahir
12-00 - 14-00	Practical Session Dr. Kazi Suleman Memon Dr. Shafi Mohd. Nizamani Mr. Abdul Karim Akbani

August 22, Wednesday

FIELD TRIP TO HALA

August 23, Thursday

FIELD TRIP TO SAU, AEARC & A R I, TANDOJAM

August 24, Friday

HOLIDAY

August 25, Saturday

08-30 - 09-30	Planning of Experiments-III (Split&Split Block experiments) Dr. Jim Barnett
09-30 - 10-30	Analysis of Data-IV (Split Plot Experiment) Dr. Kazi Suleman Memon
10-30 - 11-00	Tea Break
11-00 - 12-00	Analysis of Data-V (Split Block Experiment) Dr. Kazi Suleman Memon
12-00 - 14-00	Practical Session Dr. Kazi Suleman Memon Dr. Jim Barnett Mr. Abdul Karim Akbani

August 26, Sunday

08-30 - 09-30	Planning of Experiments-IV (Complex FactorialExperiments) Mr. Nazir Ahmed Choudhry
09-30 - 10 30	Analysis of Data VI (Complex Factorial Experiments) Mr. Nazir Ahmed Choudhry
10-30 - 11-00	Tea Break

USER'S GUIDE

FOR

EASYSTAT

A user friendly statistics package
for novices in both statistics
and use of computers.

User's Guide to EASYSTAT

INTRODUCTION

EASYSTAT was written for those who have a rudimentary understanding of statistics and limited experience working with computers. The program is user friendly with screen prompts to guide you. Every attempt was made during program development to anticipate errors and build "traps" to permit you to correct the errors before they cause the program to terminate prematurely.

EASYSTAT was designed to fill a need in research organization in the developing world. In this environment many research personnel have had little opportunity to become comfortable with using computers and some have had no exposue to them. Most research workers have passed at least one course in statistics. Few of them have more than a vague idea of how to use this valuable research tool. Often the data are sent to some central point where a statistician analyzes the data and returns the ANOVA with comments to the research worker. This system is open to many changes for error and delays in processing are inherent. The objective of the EASYSTAT package is to have available to these research workers a statistical package which can be mastered within one hour using only this instruction guide. As for computer literacy, they need to know only how to turn the computer on, place the formatted diskette and the program diskette in the proper drives and type.

This is a basic package. It has its limitations. It will accept experiments which have no more than 19 treatments and a maximum of six replications. This version does not have graphics. Plans are to include it in later versions. It also has its strengths. Simplicity is the primary one. It will analyze randomized complete block, split-plot, split-split plot designs, Factorial arrangement of 2^x for x = 2, 3, or 4 in randomized complete block designs and multi-level factorials up to 3 factors in a randomized complete block design. It will also combine up to six files for a combined analysis for randomized complete block and split-plot designs. All analyses are accompanied by appropriate tables of means with least significant differences at the 5% level calculated. All tables can be printed on any standard printer.

INSTALLATION AND PROGRAM STARTUP.

THE FIRST THING YOU MUST DO IS TO MAKE A WORKING COPY OF THE PROGRAM DISKETTES. AFTER MAKING A COPY STORE THE ORIGINAL DISKETTES IN A SAFE PLACE AND USE YOUR WORKING COPY WHEN RUNNING THE PROGRAM.

```
Data for Variety X Spacing in Cotton
ARI, Tandojam.  Kharif.

NAME TO BE GIVEN FILE:? VXSPCT87


Filename must be 8 characters or less.
Letters and numbers only - NO SPACES!
Program automatically adds extension.
```

Each information file must contain the number of treatments and the number of replications before it can format the data and the data screens. The program also prompts for the unit of measure used in the data. This information will appear as a part of the table of means when it is displayed and printed.

```
DATA INPUT FOR SPLIT PLOT DESIGN
FILE:                VXSPC088

Number of replications:4
Number of main plot treatments:3
Number of sub-plot treatments:3
Units of measure (e.g. tons/ha, etc):t/ha
```

Frequently the data from an experiment remain after the researcher has been transferred and his successor wishes to analyze the experiment or combine the data with another experiment. If he cannot locate a listing of the treatments and the data sheets have only numbers for the treatments the data are useless. For that reason the EASYSTAT program prompts the user for a short description of the treatments. Limit your description to as few words as possible. An abbreviation of each treatment will appear on the data input screen later. An example of a completed treatment description screen is shown below.

```
Description of treatments:
Main Plot: Varieties
    Trt Level: Rehmani
    Trt Level: Niab78
    Trt Level: TH-1174
Sub-plot:Spacings
    Trt Level: 60cm
    Trt Level: 75cm
    Trt Level: 90cm
```

EASYSTAT consist of several programs distributed on three diskettes. If you are using a system with two floppy disk drives you will be prompted when to change diskettes.

A. SYSTEMS WITH HARD DISK DRIVE.

If you wish to install the programs on a hard disk place the program disks in drive A and type the command COPY A:*.* C: . If you wish to place the program in a subdirectory you must make the directory before copying. The details on making directories are found in any DOS guide and will not be discussed here.

B. SYSTEMS WITH TWO FLOPPY DISK DRIVES.

NO installation is necessary. Insert a formatted diskette in the B drive and Program Disk I in the A drive.. All files generated by the EASYSTAT program will be written to the B drive.

RUNNING THE PROGRAM

Insert a formatted diskette in the B drive and close the gate. At the proper DOS prompt (C:\ if the program is on the hard disk, A: if hard drive not present) type EASYSTAT and press the <ENTER> key. There may be a short time lapse while the program is being loaded into your system before the first screen appears.

The first screen is an introductory screen with basic information. Near the bottom of the screen is the prompt telling you what action to take to continue. The convention used throughout this guide is to indicate action keys which you must press using arrow brackets < >. For example to indicate that you must press the ENTER key on the keyboard to continue it is written <ENTER>.

ANALYTICAL PROCEDURES FOR AGRICULTURAL RESEARCH.

A program for the statistical and economic analysis of experimental designs commonly used in basic agricultural research.

Developed by Dr. James B. Barnett,
MART Project USAID. Pakistan. 1991.

PRESS <ENTER> TO CONTINUE.

The second screen is the main menu which prompts you to choose the program function you wish to use. You select the function by typing the number corresponding to your choice and press <ENTER>. A short description of each function follows.

```
                Menu
 ------------------------------------

 1) Data Entry
 2) Single Experiment Analysis
 3) Combined Analysis
 4) Variety Trial Analysis
 5) View/Edit Files
 6) File Directory
 7) Quit
 ------------------------------------

 CHOICE (1 - 7)-->
```

INSTRUCTIONS:
Press letter key corresponding to your choice.

1) Data Entry. The data entry function is used for opening and entering data into a new file. For each set of data entered into the EASYSTAT program two files , a data file and an information file, are created. The data file stores the numerical data from the experiment and the information file stores the secondary information about the experiment.

2) Single Experiment Analysis. Once data have been entered into a file it can be analyzed at any time by using the single experiment analysis function. After indicating selection 2 as your choice a prompt screen appears requesting the drive in which the data files are located. You will type the letter <B> and <ENTER>. The screen will then display all data files on the diskette in drive B. You are prompted to enter the file name which you previously assigned to the experiment. The program then retrieves the file analyzes the data and prints the analysis of variance on the screen.

3) Combined Analysis. When the same experiment has been conducted in different years or in different locations it is interesting to perform a combined analysis of the data. This procedure permits the researcher to estimate the stability of the experimental factors in more than one environment. The combined analysis function will do this for randomized complete block and split-plot designs combining up to six experiments. After

selecting this function a prompt screen appears requesting the drive where data are stored. the user types the letter <B> then presses <ENTER>. The names of all data files on the diskette in drive B are displayed. The user is prompted to enter the number of files to be combined then is prompted to enter the file names. After the program accepts the file name it is erased and the next file name may be typed. When the last file name is entered the program begins the combining procedure and when complete displays the analysis of variance table.

4) Variety Trial Analysis. The analysis used by this program was developed by Dr. Roger Peterson (1989). This analysis differs from the randomized complete block analysis. For the correct analysis the experimental varieties are listed first followed by the check varieties. On single experiments the randomized complete block analysis is used but where ther are two or more experiments with the same varieties the data are combined and the special analysis is performed.

5) View/Edit Files. It may, at times, be necessary to review the data in either the information file or the data file of an experiment. This function is designed to allow viewing and editing.

6) File Directory. Each time a new file is made the file name and the title are listed in a separate file called "CONTENTS". This file list all files on the diskette and can be used to review the file directory. It is helpful when you have more than one diskette of files are are looking for a particular file.

7) Quit. When you have terminated your work you can leave the program by typing the number,<7> and pressing <ENTER>. This will take you back to the DOS prompt.

GOING THROUGH THE PROGRAM - STEP BY STEP .

The introductory screen and the Main Menu screen have been displayed. To enter the data from an experiment type the number <1> then press <ENTER>. The screen displayed is the information screen shown below.

```
This information will be written to a permanent disk file and
also used in the analysis programs. Please follow instructions.

                    GENERAL INFORMATION FILE

   Title of experiment:
             Objective:
           Responsible:
Location of experiment:
                Season:
                  Year:
   Experimental Design:

   INSTRUCTIONS:
   Title must be less than 40 characters including spaces.
   Type title and press <ENTER>
```

It is very important that you take the time to complete the information requested on this screen. It forms a permanent file which accompanies the data on the disk and will also be printed as part of the ANOVA tables. For each entry read the INSTRUCTIONS given on the screen. Each time you move to the next item the instruction set changes to correspond to that item. If you should make an error in entering the experimental design your program will not be analyzed. The experimental design designation may be typed in either capital letters or small letters but it must be exactly as shown in the example given in the instruction set. Below is a sample GENERAL INFORMATION FILE properly completed. This file will be used as the example in the remainder of this guide.

```
This information will be written to a permanent disk file and
also used in the analysis programs.  Please follow instructions.

                    GENERAL INFORMATION FILE

      Title of experiment:   Variety X Spacing in Cotton
                Objective:   Determine optimum spacing for varieties
                Responsible: Zahoor Muhammad
Location of experiment:      ARI, Tandojam
                   Season:   Kharif
                     Year:   1986-87
   Experimental Design:      sp

INSTRUCTIONS:
Use one of following abbreviations:
RCB - Randomized Complete Block
SP - Split Plot
SSP- Split-split Plot
2F - Two-level factorial
MF - Multi-level factorial
```

After the General Information File is completed and you press <ENTER> the screen prompting for the filename is displayed. The filename given must follow the DOS requirements. These requirements are that the name cannot contain more than 8 characters nor can it begin with a number. It cannot contain a space and certain punctuation marks are not permitted. To be safe use only letters and numbers.

The DOS format for a filename has two parts - the filename and an extension. The extension is separated from the name by a period and may be up to three characters in length. You are prompted not to add an extension as the program adds the extensions it is designed by recognize. Throughout the program you will be prompted for the filename without the extension. The filename screen is given below. The example file was given the name VXSPCT87. If you refer to the title of the experiment in the General Information File you may understand the filename. Using a standardized set of code letters in the development of filenames is useful and aids in identifying the the nature of a file by reading the filename.

After completing the treatment description screen and pressing <ENTER> the DATA ENTRY SCREEN is displayed.

ERROR CORRECTION: [<--] before entering. Others after all data entered.

DATA ENTRY SCREEN

MP	SP	Rep. 1	Rep. 2	Rep. 3	Rep. 4
Rehma	60cm				
	75cm				
	90cm				
Niab7	60cm				
	75cm				
	90cm				
TH-1I	60cm				
	75cm				
	90cm				

The features of the screen which should be noted are :

(1) The prompt bar across the top of the screen. During the remainder of the program all prompts will appear in this area. Check it after each operation for instructions.

(2) The data entry box has already been formatted with the treatment abbreviations printed to the left and the replication numbers across the top. Inside the box the prompt is positioned at the first treatment in the first replication.

The program is designed to accept data by treatments within each replication. As you enter data the prompt expands downward and waits for the next entry. When the data for the replication is complete the prompt moves to the first treatment of the next replication.

An error may be corrected by using the <BACKSPACE> key to erase and then retyping before the <ENTER> key is pressed. Errors noted after they have been entered may be corrected after all data are entered.

After all data are entered the prompt bar displays the prompt

"ARE ALL ENTREES CORRECT? (Y/N)".

If there are errors to correct press the letter <N> then <ENTER> and the error correction procedure will be displayed. In this procedure the treatments are given a number which appears to the left of the data box and three prompts appear at the top of the screen. The first prompt ask which row the error appears in. This is referring to the treatment number given to the left of the screen. The second prompt request the rep number in which the

error appears. The third prompt request the correct data. You must press <ENTER> after answering each prompt. After the third prompt has been answered the prompts disappear and the correct data appears in the proper location in the data box. You are again asked if all entrees are correct in the prompt bar. The correction routine may be repeated as many times as necessary. You simple continue to press the letter <N>. After you have verified that all entrees are correct press the letter <Y> and <ENTER> to continue. An example of a completed DATA ENTRY SCREEN is shown below.

ARE ALL ENTREES CORRECT? (Y/N)

DATA ENTRY SCREEN

MP	SP	Rep. 1	Rep. 2	Rep. 3	Rep. 4
Rehma	60cm	2.44	1.85	2.50	2.32
	75cm	2.37	1.70	2.37	2.22
	90cm	2.22	1.63	2.32	2.07
Niab760	60cm	2.26	2.41	2.44	2.41
	75cm	2.13	2.32	2.37	2.35
	90cm	2.0	2.22	2.26	2.26
TH-1160	60cm	1.85	2.07	2.13	2.17
	75cm	1.52	1.94	2.0	2.04
	90cm	1.44	1.85	1.89	1.94

After all data are entered and you have pressed <Y> the prompt bar displays the following:

"Do you want analysis now? (Y/N)".

If you answwer <Y> the program will call the analysis routine and the screen will display to analysis of variance for you experiment. If you answer <N> you will be returned to the Main Menu Screen.

For our example we will answer by typing the letter <Y> and have an immediate analysis. The analysis which appears on the screen is shown below.

Do you want a printout? (Y/N):
File:VXSPCT87, Title:Variety X Spacin
g in Cotton
Objective: Determine optimum spacing for varieties
Researcher: Zahoor Muhammad
Location of Experiment: ARI, Tandojam Year: 1986-87

Source	df	SS	MS	F	F(tab)
Reps.	3	0.4267	0.1422	0.9653	4.7600
Main	2	0.9204	0.4602	3.1232	5.1400
Error (a)	6	0.8841	0.1473		
Subs	2	0.3163	0.1581	107.0258	3.6000
M X S	4	0.0109	0.0027	1.8193	3.0600
Error (b)	18	0.027	0.001		
Total	35	2.5848	CV(b): 1.81		

Note that the prompt bar is asking if we want a printout of the ANOVA displayed on the screen. By typing the letter <Y> then pressing <ENTER> we can get the printout. There is a delay between the time you press <ENTER> and the start of the printing by the printer. Making the proper file and transferring it to the printer takes a few seconds, so do not get alarmed.

You should also note that much of the information collected when you first entered the program is now displayed on the screen and will be printed as a permanent record with the ANOVA.

After you answer the prompt about the printout you will be prompted to press the <SPACEBAR> to continue. A table of treatment means will be displayed and you will again be asked if you want a printout. For designs other than the randomized complete block the means will be displayed in two-way tables. In all cases the least significant differences at 5% will accompany the tab es.

Do you want a printout? (Y/N):
FILE: VXSPCT87 TITLE: Variety X Spacing in Cotton
TABLE OF MEANS
Sub Plots in Main Plots
MP Treatment: Varieties SP Treatment: Spacings

	Main Plot Levels			
(t/ha)	Rehmani	Niab78	TH-1174	SP Means:
60cm	2.28	2.08	2.06	2.24
75cm	2.16	2.29	1.89	2.11
90cm	2.06	2.13	1.78	2.01
MP Means:	2.17	2.29	1.90	0.06

LSD(5%) between main plots = 0.40
LSD(5%) between sub plots = 0.03
LSD(5%) subs within main = 0.06

After all tables have been displayed and you have answered the prompt for the printout the program you will be returned to the Main Menu. If you have completed your work press the number <7> and <ENTER> to close the program and return to the DOS prompt.

* * * * * * * * * * * * * * E N J O Y * * * * * * * * * * * * * *