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AGRICULTURAL RESEARCH IN PAKISTAN

REPORT OF THE SECOND JOINT PAKISTAN-AMERICAN TEAM

Presented by A. H.

ISLAMABAD

MARCH 1973

March 10, 1973

His Excellency
Sardar Ghaus Bakhsh Raisani
Minister for Food and Agriculture
Government of Pakistan
Islamabad, Pakistan

Dear Mr. Minister:

It is a pleasure to present herewith the Report of the Second Joint Pakistan-American Agricultural Research Review Team.

The Team had the opportunity to travel together in visiting the Agricultural University, the two Colleges of Agriculture and the principal research institutes in the Provinces with the exception of Baluchistan. The representatives of Baluchistan were kind enough to come to Islamabad to discuss agricultural research in that Province with the Team.

The Team was well received at all points visited. The key personnel with whom we met discussed freely and openly the important research needs and problems with the Team. This gave the Team a good insight into problems and issues facing Pakistan.

The Report of the Review Team represents its views relative to improving the research capability of Pakistan at the national and provincial levels.

The Team is grateful for this opportunity and wishes to express its sincere appreciation for the assistance and many courtesies extended to it in this task.

Sincerely yours,

A. H. Moseman

Israr-ul-Haq

Guy B. Baird

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GENERAL OBSERVATIONS

1. Agricultural research generally in Pakistan has not been improved significantly in the past five years.
2. There is need for clarification of the role and responsibility of the Central Government with respect to agriculture and particularly with respect to agricultural research.
3. There is need for increased support in terms of funds, scientific manpower, equipment, etc.
4. There is opportunity for improvement of research through better consolidation and use of existing resources.
5. There is need for a change in attitudes on the part of institutions and individuals concerned with research if closer cooperation and effective coordination are to be achieved.

SUMMARY OF RECOMMENDATIONS

Basic Considerations

1. There should be a statement of policy with respect to the responsibility of the Central Government in supporting and conducting agricultural research, to minimize present restraints because of the view that "agriculture is a provincial subject."
2. Positive action should be taken to develop an effective national capability and system for agricultural research.
3. Research priorities should be related to national development goals.
4. There should be maximum use of present resources and new institutions or centers should be established only when suitable facilities are not available from existing institutions of the Central Government or provinces.

Pakistan Council for Agricultural Research

1. The Council should serve as the technical arm of the Ministry of Agriculture and for the Government of Pakistan.
2. The Council should assume major responsibility for the planning, operation and evaluation of research for problems of major national concern.
3. The Council should furnish coordinating leadership to insure effective use of all national research resources, as well as effective progress in specific research programs.
4. The Council should employ scientific staff for research at the headquarters station and also maintain a pool of permanent staff for deputation to cooperating institutions at national or regional centers as and when required in providing multi-disciplinary research capabilities.
5. The Council should furnish support for both national and provincial research personnel, for staff training and development, for seminars and workshops, for operational budgets of research programs and for participation in international meetings.
6. The Central Government resources, including those of the Council, should be applied mainly to coordinated national or regional research schemes, rather than applied to scattered grants to small projects as is now the practice.
7. The Council staff should be upgraded to furnish the capability for professional leadership consistent with the operational responsibilities.
8. The Council should be reorganized to provide for effective operational functions, with provision for the degree of autonomy required for effective management and operations.

Provincial Research Institutions and Provincial Research Programs

1. The provincial research institutes would be expected to continue major responsibility for research of particular concern within the province.
2. The provincial research institutes should be strengthened, particularly in Sind, Baluchistan and the N. W. F. P., to handle more adequately the research within the province.
3. The provincial research institutes should participate in national or regional cooperative research schemes in the planning, operation and evaluation of such schemes.
4. There should be a more complete evaluation of the present use of resources in the provinces to consolidate activities, equipment and manpower resources now scattered to an excessive number of substations.

The University of Agriculture and Colleges of Agriculture

1. The educational institutions within Pakistan should provide the facilities and programs for the training and education of the major portion of the agricultural research manpower.
2. The capability of the University of Agriculture should be broadened by the establishment of such new departments as may be required to furnish education through the B. Sc., M. Sc., and Ph.D. levels.
3. The University of Agriculture should serve more effectively as the "National University for Agriculture."
4. There should be further support to the Colleges of Agriculture of the Sind and N. W. F. P.
5. The University of Agriculture and Colleges of Agriculture should participate fully in the planning, operation and evaluation of coordinated national or regional research schemes, consistent with their facilities and staff resources.

Other Research Organizations

1. The research components of the institutes and departments now falling within the Ministry of Agriculture should be incorporated within the Pakistan Council for Agricultural Research.
2. The agricultural research programs and resources of the Atomic Energy Commission Laboratories should be involved fully in the planning, operation and evaluation of coordinated national and regional research schemes.
3. The agricultural research activities of the CSIR, WAPDA and other organizations should be reviewed and arrangements made for close integration with national research programs through the coordinating leadership of the Council.

Funding of Research

1. The Central Government support for research, to be provided through the Council, should be increased commensurate with the importance of agriculture to the national economy and to national development.
2. Provision should be made through the Council for the support of personnel, operations, equipment and supplies, travel, etc., to be utilized in the provincial research institutes and other organizations for operation of coordinated national research programs.
3. Council funds and resources should be applied to selected basic or background research schemes related to critical problems of special concern in Pakistan.
4. The funds for agricultural research should be set up in an "ARC fund" and made available for use by the executive staff of the Council in a manner to minimize unnecessary delays in operation of research.

Research Manpower

1. There should be a comprehensive review of the available trained manpower for agricultural research in Pakistan.
2. The future manpower requirements should be determined, primarily on the basis of staffing needed for national research programs, for upgrading the University of Agriculture and the Colleges, and for selected specialized projects.
3. A staff training and development program should be evolved with attention given to in-service training, to basic degree level and postgraduate level training.
4. The staffing of the Council, as well as other research institutes, should be reviewed and upgraded as necessary to insure the level of competence required for the planning, operation and coordination of effective research programs.
5. The personnel policies and procedures in the Council should be modified to insure maximum consideration for competence and merit in the recruitment, selection and promotion of research workers.

Facilities

1. There should be established a National Headquarters Research Station for the Council, near Islamabad, for the conducting of selected research programs, for offices of the executive staff and research program leaders or coordinators, and for certain facilities for servicing national research, such as the library and documentation center, conference facilities etc.
2. The building of additional research institutes, centers or laboratories should be held to a minimum, with facilities constructed only where it is fully determined that the existing Central Government, provincial or other facilities are not available.

3. Special attention should be given to more effective operations, and to improvement or development of research stations to insure the type of precise experimentation necessary to produce reliable results.

Research Relationships to Extension and Development

1. Subject matter specialists should be appointed under the Council at the provincial research institutes and at such other research centers as required to insure prompt transmission of new research results to the organizations responsible for extension and development activities.
2. Special attention should be given to development of effective seed laws and procedures for the release of improved varieties and for the increase and distribution of seed supplies.
3. There should be a continuous critical evaluation of the effectiveness of practices for dissemination and use of new agricultural technology to insure a maximum impact in improving national agricultural productivity.

International Cooperation

1. The linkages with the international agricultural research centers, such as IRRI, CIMMYT and others should be maintained and improved to insure prompt availability of external research resources.
2. Linkages should be established with the emerging national research organizations in other countries of Asia for exchange of experience in the development of the national institutional capability, and also knowledge and materials from the respective research programs.
3. External technical assistance resources should be applied in a coordinated manner to insure maximum contribution of such support to the development of a national agricultural research institutional structure and system in Pakistan.

AGRICULTURAL RESEARCH IN PAKISTAN

Report of the Second
Joint Pakistan-American Team
March 1973

INTRODUCTION

The Government of Pakistan recognizes the importance of new technology in increasing the productivity and development of agriculture. Improved varieties and production practices formed the base of the substantial increases in wheat and rice production in Pakistan from 1966 onward, the period of the "Green Revolution" in Asia. The experience with the wheat and rice technology introduced from abroad demonstrated not only the need for and benefits from new agricultural technology, but also the importance of a national research capability to adapt and utilize such introduced technology for the specific growing conditions throughout the country. This national research capability is necessary also to produce innovations and new technology for other crops, livestock production, and aspects of agriculture other than wheat and rice production that are important for national development in Pakistan.

In initiating action to strengthen the country's agricultural research capabilities, the Government of Pakistan, in 1968, arranged for a Joint Pakistan-American Agricultural Research Review Team to assess the then current research resources and to develop recommendations for improving the national research system.

Some of the recommendations of the 1968 Team have been implemented, including the reorganization of the executive staffing pattern of the Agricultural Research Council to provide for a Director-General and six Directors for Crops; Animal Husbandry; Soils and Irrigation; Forestry and Range Management; Fisheries; and Agricultural Economics. The Director-General was appointed in July 1972.

Some recommendations of the 1968 Team were difficult to activate because of the geographic restraints of the East Wing and West Wing of Pakistan, each with somewhat divergent interests and priorities. The separation of West Pakistan into four provinces on July 1, 1970 caused further complications in the structuring of a

more effective national research system along the lines recommended in the 1968 Team report.

The separation of East Pakistan from Pakistan in December 1971 changed the base for devising the scope and functions of a national agricultural research organization. While this separation helped to minimize some of the problems in developing an effective national system, the emergence of the four provinces posed new problems in designing an integrated research system to serve more effectively all agricultural areas of the country.

The Review Team

The Second Joint Pakistan-American Agricultural Research Review Team, established in February 1973 at the request of the Minister of Agriculture, Government of Pakistan, and supported in part by US A. I. D. /Pakistan, was charged with the task of reviewing the status of the national agricultural research capabilities in 1973 and providing further guidance for their improvement. The membership of the Team, with biodata, is given in Appendix I.

Terms of Reference

The Team was requested to assess present research resources and to consider actions required to improve such resources. The specific factors taken into account included:

1. Current research resources
2. Program definition and priorities
3. Program planning, operation and coordination
4. Funding of research
5. Research personnel--staff development
6. Relationship of research to extension and development programs.
7. International cooperation.
8. Strengthening the national agricultural research system

The Team gave consideration also to steps for implementation of the actions proposed to improve the national research capabilities. Those recommendations of the 1968 Team which are still relevant were taken into account in developing the suggestions for implementation.

Itinerary and Contacts

The Team visited the principal agricultural research and education centers in each province, with the exception of Baluchistan, where the scheduled visit was cancelled because of conflict with other local activities in Quetta. The Team met in Islamabad on March 3 with the Deputy Director of Agriculture and Assistant Director of Animal Husbandry, deputed by the Secretary of Agriculture of Baluchistan, to discuss agricultural research activities and needs in the province.

The review was not concerned with detailed inspection of projects, facilities and equipment at each location, but rather with an assessment of the scope of research, suitability of station resources, adequacy of staffing, and procedures for selection, operation and coordination of programs of mutual interest to several institutions in the province or nationally.

The Team concentrated attention primarily on research of high priority in national development. It is recognized that the review did not give sufficient attention to certain problem or program areas such as animal husbandry, fisheries, water management, agricultural economics and the social sciences, etc. However, the recommendations and general principles and procedures as evolved by the Team should be applicable or adaptable to these fields of work.

There was a positive interest and constructive concern in all institutions visited about the problems involved in improving the total national research capability. In addition to identifying the common restraints of shortage of research staff, limited budgets, inadequate equipment, lack of transport and travel, the persons contacted were all candid and forthcoming in discussing factors involved in improving coordination of efforts and in maximizing use of available resources from various institutions of the Central Government and in the Provinces.

The itinerary, institutions visited and persons contacted are presented in Appendix II.

CURRENT RESEARCH RESOURCES

Central Government

In the agriculture sector not much emphasis has been placed on developing research institutes, centers or capabilities at the federal government level to cater to the need of the nation in various disciplines. The Ministry of Food and Agriculture, which is responsible for agricultural planning and coordination, has a few research establishments as "Attached Departments" where research on different aspects of agriculture is being carried out. These federal establishments, designed primarily to conduct applied research to support field services presently carried out by the federal agencies, are as follows:

1. Central Plant Protection
2. Central Marine Fisheries
3. Zoological Survey
4. Soil Survey
5. Agricultural Census
6. Agricultural Marketing
7. Central Cotton Committee
(Though autonomous, it is a part of the Central Ministry of Agriculture.)
8. Commonwealth Institute of Biological Research
9. Agricultural Research Council

The Central Department of Plant Protection carries out research on desert locust control, pests of stored grains, pesticides and toxicology, cereal diseases, application of radio-isotopes and radiation in the field of entomology and plant pathology, taxonomic studies of insects and fungi, methods of sampling and fumigation for plant quarantine. The headquarters for the Department is at Karachi, where most of the laboratories

are located, except the field station for desert locust research at Bhawani and the Cereal Diseases Research Institute, which is located at Murree and Islamabad with a substation at Karachi. A new institute for research and control of vertebrate pests under the joint auspices of the UNDP and Government of Pakistan will soon start with facilities in Karachi.

The Marine Fisheries Department at Karachi is undertaking research on oceanography, biology of fishes, improvement of fishing gear and various other technological aspects for improving fishing catches.

The Zoological Survey Department in Karachi is doing research on the fauna of Pakistan, as well as some studies on the biology and ecology of animals, birds and reptiles.

The Soil Survey Organization is mapping the soils of Pakistan. The Directorate of Agricultural Marketing conducts research on various aspects of the marketing of agricultural produce and live-stock products, with a particular emphasis on the standardization and grading of exportable commodities like wool.

The Central Cotton Committee, which is an autonomous body under the Ministry of Agriculture, carries out research on various aspects of cotton production in the country. Cotton is a main foreign exchange earner for the country and, therefore, great emphasis is being laid to accelerate cotton production, fully backed by research. In order to achieve the research objectives, a Central Institute of Cotton has been established at Multan, where agronomical, entomological, plant pathological, physiological and other research programs are carried out. The industry-related technological research is carried out in the laboratory at Karachi. Research on cotton is also conducted by the Punjab and Sind Agricultural Research Institutes, as well as by the universities and colleges. The major establishments involved are at Multan, Lyallpur, Tandojam and Thatta.

The management of the Central Cotton Committee is headed by a Chairman who is the Central Minister for Food and Agriculture. The Secretary of the Committee attends to administration and the technical aspects are looked after by a Director of Research and Director of Technology.

The membership of the Committee is drawn from representatives of central and provincial agricultural research institutes, cotton botanists, progressive farmers, parliamentarians, public representatives, industrialists, mill owners, cotton exporters and spinners. The main Committee is assisted by a Technical Committee and Finance Committee. The Technical Committee is further subdivided in special committees for various disciplines, which scrutinize new research programs and the progress of outgoing schemes before they are sent to the Main Committee for financial support and continuation.

The Agricultural Research Council does not have its own research institutes, but supports important provincial and central research schemes in various disciplines. As such, the existing number of its technical staff is small. To make ARC a viable organization, it is imperative to increase its strength of technical staff, as well as to establish its central secretariat and research laboratories at Islamabad.

In general, research sections of all central organizations have weak research capabilities, and there is a need to find resources to modernize them rapidly. As scientists are often handicapped by a lack of scientific equipment, the latter should be provided according to needs. The provision of other facilities, such as a reference library, should also be provided to remove restraints on the pursuit of excellence.

Provincial Research Centers

Agricultural research work in the provinces is undertaken by their research institutes, which maintain one or more experimental stations each. The main centers are: the Punjab Agricultural Research Institute, Lyallpur; Veterinary Research Institute, Lahore; Directorate of Livestock Farms in the Punjab; the Agricultural Research Institute, Tandojam; Poultry Institute, Karachi; Livestock Research Farms at Nabisar and Malir in Sind; the Agricultural Research Institute, Tarnab; Veterinary Research Institute, Peshawar in the N. W. F. P. ; the Agricultural Research Institute, Seriab, Beef Production Center, Sibi, and Sheep Research Center, Yetabad, in Baluchistan. The Irrigation Research Institute, Lahore, also serves the cause of agriculture in the country.

The number of technical staff at these institutes varies considerably, but there is a general shortage in Sind, N. W. F. P. and Baluchistan. There is also a shortage of highly-trained men in one or more disciplines at all institutes. Acreage under experimental land available with the institutes, except in the Punjab, is generally small, particularly in Baluchistan. As regards finances, the bulk of the allocations account for staff salaries and common services, and only a small proportion of the funds is left to meet research needs for equipment, supplies, etc. Budgetary allocations dwindle down further at the level of various sections because of the general tendency of these institutes to add as many sections as they can, even if real justification for such a tendency does not exist, e. g. , non-availability of trained men and necessary investigational facilities, or existence of another institution engaged in similar work nearby. Unnecessary multiplication of sections not only leads to duplication in work, but also diffuses research to peripheral interests only. The over-all effect is wastage of resources, which Pakistan cannot afford. While strengthening the research capability of various centers by enhancing their resources and facilities, steps should also be taken to avoid unnecessary additions to research sections, and to bring home to all workers the necessity of devotion to work in a missionary spirit.

Universities and Colleges

Physical facilities in the way of lands, buildings, equipment, and library resources on the campus of the University of Agriculture at Lyallpur have been developed to a good extent during the last decade, and a variety of instructional programs are under way. There are, however, some disciplines in which facilities for research are either non-existent, e. g. , rural home economics, or fall short of their requirements, e. g. , human nutrition and basic sciences. The recent addition of two new faculties, viz. , Faculty of Basic Sciences and Humanities and that of Rural Home Economics, as well as ever-increasing needs of research in various fields, has necessitated expansion in the existing facilities, more especially by way of scientific equipment and literature (both books and periodicals).

At the Agricultural Colleges at Peshawar and Tandojam much greater over-all support for academic programs and faculty research programs is needed. Apart from buildings, including residences for foreign specialists at Tandojam, their main requirements are for research equipment and literature. Of the several areas they wish to develop, especially at Tandojam which is planning for an agricultural university, the more important ones are: agricultural engineering, crop breeding, animal husbandry, entomology, agronomy, pathology, economics, veterinary science, biochemistry, plant physiology, and agricultural extension. The Agricultural College at Peshawar has some laboratories and farms, but the faculty is budgeted full-time on teaching, with heavy teaching loads. Therefore, it is not able to carry on research as it should, apart from the fact that it needs additional funds for operational purposes.

Autonomous Organizations

The autonomous organizations engaged in agricultural research, in addition to the University of Agriculture at Lyallpur, and the Agricultural Colleges at Peshawar and Tandojam, are: 1) the Pakistan Atomic Energy Commission (PAEC); 2) the Pakistan Council of Scientific and Industrial Research (PCSIR); and 3) the Water and Power Development Authority (WAPDA).

The PAEC maintains two agricultural research centers, viz., the Nuclear Institute for Agriculture and Biology, Lyallpur, and the Atomic Energy Center, Tandojam. Both of these centers have highly-qualified staff and excellent facilities for conducting research. These centers are doing good work, but (a) a major portion of their research undertakings represents work that can be done in other research institutes without the use of atomic energy, and (b) these centers have not yet initiated research in disciplines like veterinary science in which the use of atomic aids may prove more helpful. Consequently, there is a need for an intimate liaison and coordination between these centers and other agricultural research institutes in the country.

The PCSIR mainly concerns itself with industrial research, but it also maintains some sections of interest to agriculture, e.g., wool testing and fruit technology. Such sections are breaking some new ground, but the over-all output has been

rather limited, primarily because of paucity of trained men and funds. There is good room for coordination of the research of the PCSIR with that of other organizations engaged in similar endeavors nearby.

The WAPDA conducts research of interest to agriculture, e. g. , on water logging and salinity, land and water use, and farm management. They are doing useful work, and given better support, especially in the way of higher training for the staff, will be able to do more effective research. Coordination in research among PCSIR, WAPDA, and other organizations does not seem to exist.

Special Projects

After the separation of East Pakistan new problems of shortages of jute and tea have cropped up and special research programs for these commodities have been initiated.

A modest research project on the production of jute fiber has been initiated in various zones of West Pakistan in the provinces of Sind, Punjab and N. W. F.P.

Some exploratory surveys for tea cultivation in West Pakistan have been conducted and preliminary tests and trials have been initiated in suitable localities.

Besides the above, due to shortages of edible oils, serious thought was given to olive cultivation in the northern parts of Pakistan and a modest beginning has been made.

These special projects are carried out directly under the Ministry of Food and Agriculture and are funded by the Central Government.

The Private Sector

Private organizations and individuals do not invest significant funds in research. A few enterprises spend small amounts on surveys and feasibility reports with the express object of establishing a new or expanding an existing business. Some agencies and individuals give scholarships for graduate and postgraduate studies, but the number and amount of such allocations is extremely small.

In several advanced countries, private organizations and individuals spend large sums on scientific research. Private concerns in Pakistan, therefore, would do well to recognize that grants for research would be to their interest and also in the national interest. In the United States, over one-half of the total expenditures for research related to agriculture comes from the private sector.

As Pakistan has essentially an agrarian economy, she has to modernize her agriculture by introducing science and technology in all agricultural operations. This is a big task and involves a massive research effort over a wide range of problems. Unless the people share this research burden, mentally and financially, the Government alone may not be able to accomplish the development objectives as speedily as the nation requires. There is, therefore, a need for organizations like ARC to devise ways and means for insuring increased allocations of private funds for research in appropriate ways.

PROGRAM DEFINITION AND PRIORITIES

There appear to be no well-defined procedures at the present time for setting priorities for agricultural research, at either the national or provincial level. Personnel at the provincial research institutes tend to direct their research to problems considered to be of major concern in improving agriculture in the province and in meeting such specific and obvious national objectives as increasing food grain production.

Research in the Punjab Agricultural University at Lyallpur is geared primarily to the thesis or dissertation research of students, with some research conducted also by faculty members. The research is selected on the basis of proposals by individual staff members which are reviewed at the departmental level. The research usually has relevance to national agricultural development objectives, but tends to reflect the special interests of the individual staff member or student.

Most current research at the College of Agriculture, University of Sind, at Tandojam, is relatively academic, primarily in agronomy and economics, and is done largely by the students. There is virtually no budget for faculty research. Similarly, the lack of funds for research (about Rs. 2,000 annually) at the College of Agriculture, University of Peshawar (N. W. F. P.), at Peshawar, precludes meaningful participation and planning in relationship to national or provincial needs for research.

Relationship to National Development Goals

In Pakistan, improving the productivity of agriculture is essential if national objectives in economic and social development are to be achieved. The goal of a 4 per cent annual increase in agricultural output, regarded as the minimum required to meet the demands of a growing population, will not be reached or maintained without a sustained flow of new technological inputs,

Agricultural research in Pakistan must be directed toward practical objectives of increasing productivity and of protecting and maintaining this productivity. There is little scope for

academic research--or pursuit of knowledge for the sake of knowledge--when demands for problem-solving research have such a high order of urgency.

In the discussions with personnel of the research institutes and educational institutions, there appeared to be a general awareness of the need to concentrate research resources on problems standing in the way of national agricultural development. However, there appears to be little or no communication of such needs or problems from those concerned with national development planning to those responsible for planning of research at either the national or provincial levels.

There is an interdependence of national development planning and of agricultural research planning in all countries where national growth depends upon agricultural growth. This requires a continuing dialogue between agricultural scientists and development planners to: 1) determine the feasibility of development goals; and 2) concentrate research resources on problems that limit the achievement of such goals. Since it is not feasible to maintain continuous liaison directly between the National Planning Commission and each institution concerned with research at the national and/or provincial level, the linkage should be made with the Director-General of the Agricultural Research Council. He and his executive staff should be responsible for insuring that all institutions engaged in agricultural research are kept informed of national development goals and related research priorities.

Current National Research Priorities

Research on many important problems is in progress in the country, yet there are certain areas which need immediate research attention in an accelerated manner. Some of these are:

1. Wheat and Rice Production. Increasing food grain production is a matter of special and continuing urgency. The present wheat and rice improvement programs require more effective coordination between various research centers involving different essential disciplines, and further strengthening, to maintain steady pace of progress.

2. Oilseeds. Pakistan is deficient in edible oils and large quantities are imported. There is urgent need to develop accelerated oilseed improvement programs to evolve high-yielding, pest-and-disease-resistant varieties, as well as to introduce new oilseed crops.
3. Pulses. There is acute protein deficiency in Pakistan and an accelerated improvement program is urgently needed to develop high-yielding, protein-rich pulses to increase vegetable protein supply.
4. Feed Grains and Forage Crops. These crops have received little attention in the past, although tremendous scope exists for manifold increase in their production. Research on feed crops is required to increase milk and dairy production.
5. Soil Management. Many problems involving the soil deserve greater attention. These include reclamation or improvement of soils affected by salinity or alkalinity; effective use of fertilizers to take care of major and minor element deficiencies; and improvement in the physical conditions of soils to facilitate better root and water penetration under both irrigated and barani conditions.
6. Soil Fertility. The ever-growing need for fertilizers, especially after the introduction of highly responsive dwarf wheat and rice varieties and the limited supply, call for intensified research on crop responses, economic dosages, timing and method of application, and effects on root development, especially in low rainfall areas. Effects of minor elements also require investigations.
7. Water Management. Water for agricultural use is a scarce commodity, both under irrigated and rainfed conditions. Research is needed to determine the most effective conservation and use of canal and well water in irrigated areas, as well as of rainfall in the barani areas.

8. Pest and Disease Control. Regular pest and disease surveys should be conducted to evaluate precise losses, to develop an early warning system, to prevent epidemics and to detect new pests and diseases that may emerge as a result of introduction of new crops and varieties. Research on crop diseases is still deficient, especially in case of diseases caused by viruses, bacteria, fungi and nematodes, although evidence of such disorders exist in Pakistan. These studies need to be developed,
9. Animal Production. The major agricultural commodities in large parts of the country--for food, fiber and other products--come from one or more of the several classes of livestock. Coupled with studies on forage, feed production and management of natural grasslands is a need for more research in selected livestock areas. Goat and sheep management would appear particularly promising.
10. Socioeconomic Research. There is a dearth of data on production economics, as well as studies bearing on national policies affecting the agricultural economy. Further, greater attention needs to be directed toward systematic and scientific identification of constraints limiting the more extensive utilization of technology resulting from biological research.
11. Agricultural Marketing, To reap full benefits of increased agricultural production for the mutual benefit of producers and consumers, strenuous efforts are indicated to organize goal-oriented researches on important aspects of agricultural marketing and develop this hitherto underdeveloped sector.
12. Forest Produce. Pakistan's forest resources being very limited (only 4 per cent of the area is under forest), elaborate researches should be organized to insure greater forestation and higher production of timber, fuel wood, and forest products of both plant and animal origin.

13. Fish and Fish Products. Researches in the fisheries sector have hitherto been very small, and there is a need to augment them in the interest of larger catches and greater production of sea and freshwater food, as well as needed fish products.

The priorities of the different regions or provinces tend to fall into a pattern similar to the national needs. The more specific priorities of the provinces are listed in Appendix III.

Research of Educational Institutions

The conduct of research by faculty members of colleges and universities is generally recognized as essential to effective and relevant teaching. This is of the utmost importance. Opportunity should be provided for the recognized scholars in teaching to carry on needed research in their field of specialty as a means of increasing the output of both basic and applied research. Faculty members who engage in creative and scholarly research do a more effective job of teaching since productive and relevant research makes it mandatory that the teacher keep abreast of scientific literature and technological developments in his discipline. Students are motivated to be more analytical and inquisitive when the teacher bases the subject matter presented to his students on facts generated by the scientific method as compared to theoretical and empirical lectures. Most important of all, students taught by scholars who are active in relevant scientific research are usually prepared to make greater contributions to the progress of the nation.

Some educational institutions consider research as a faculty responsibility and allocate a portion of time for this purpose. This should be a standard practice in all institutions. Funds should be made available to support relevant scientific research by qualified faculty members on a project basis which contributes to institutional goals and national priorities.

In general, research in the Agricultural University and Colleges of Agriculture should be addressed to problems of high priority in national development. However, the need for

professors to remain in the proximity of their classrooms and teaching laboratories poses some restraint to their contributions to certain types of development-oriented research.

While fundamental research may be of lesser priority in developing nations, there is need for certain basic and background studies to furnish understanding of particularly difficult problems. Physical and chemical properties of soils as related to tillage practices, water infiltration and management, and salinity control is one type of problem deserving of basic research in Pakistan.

PROGRAM PLANNING, OPERATION AND COORDINATION

The definition of national and provincial goals and priorities in agriculture provides the basis for development of the supporting research programs. Agricultural research must be responsive to development goals. With this in mind, specific research programs are initiated and their success is determined by the extent to which they provide the technology required.

Integrated National Research Programs

In planning national research programs, one must be concerned with the resources required to assure success. To consider a specific case, one priority goal in Pakistan's agricultural sector is increased production of wheat. Consequently, a priority area in research--both at the national and provincial levels--is a program designed to meet the continuing requirements for improved production technology; and, since research is expensive and resources are limited, ways must be sought to maximize efficiency.

In the first place, when examining the package of wheat technology required, it is found to be of a highly interdisciplinary nature. It is the result of the integrated input of scientists from a number of disciplines, e. g., the breeder, pathologist, agronomist, soil chemist, cereal chemist, etc. Secondly, in looking at national and provincial institutions having responsibility for and/or involvement in research in wheat, institutional collaboration looms as an essential ingredient to an effective and efficient national wheat research program.

1. Multidisciplinary Teams. In the development of a given national research program, again using wheat as an example, it is important to identify all concerned scientists in the country, and to provide a mechanism that will enable and encourage them to work together effectively--to operate as an All-Pakistan Coordinated Research Team. Some members of this team will be operating at the national level, e. g., ARC; others at the provincial level, e. g., in the ARIs or agricultural universities and colleges; and others in autonomous or

private institutions. Some will be breeders, others plant pathologists, others agronomists, etc.

How can the wheat scientists of the country work effectively as a national multidisciplinary team? Certainly the coordinated wheat project provides useful guidelines. Support and technical coordination are essential ingredients. Financial support from the Government of Pakistan (through ARC) must complement existing support at the province level; and technical coordination is needed to insure a balanced, multidiscipline effort.

The coordinated wheat project in Pakistan, and similar projects in other countries, amply demonstrate the key role of a technical coordinator or leader for national multidisciplinary research programs. This coordinator must have the professional competence to command the respect and inspire the confidence of the scientists in the program. His role is to facilitate the work of the other scientists, to encourage exchange of information and materials, to arrange for workshops where results can be reviewed and continuing work planned, and to insure effective links with international and national institutions that can contribute to the strengthening of the coordinated program.

In view of the role of ARC, and the over-all makeup of the agricultural research base in Pakistan, it seems desirable to have coordinators of national multidisciplinary agricultural research programs as employees of ARC. Their responsibility is countrywide. They must be concerned with strengthening and coordinating the work of all the researchers in their program, both at the national and provincial levels.

It should be clear that the coordinator of a national research program does not "direct" the efforts of the scientists in the different disciplines and the different research institutions. He does not usurp the role of the Directors of these institutions or the Provincial Director of Agricultural Research. He works with and through

them to assist the individual scientists concerned. In an effectively coordinated program, such as the one on wheat, the coordinator complements the role of the Director of Research or the Director of a research institution by facilitating linkages between participating institutions and participating scientists.

2. Institutional Collaboration. The scientists in Pakistan working on various aspects of wheat improvement are found in a rather large number of institutions. These include: the Provincial Agricultural Research Institutes, the Agricultural University of Lyallpur, and Provincial Colleges of Agriculture, and the Agricultural Institutes under the Atomic Energy Commission. Clearly, if the country's investment in wheat research is to be fully exploited, all of the efforts of the concerned scientists must be coordinated and directed toward common goals. This necessitates collaboration between the foregoing institutions.

How can this collaboration be achieved? First, there must be a willingness to cooperate in the overall interest of the program. The contacts of the Team with these several institutions indicate a recognized need for collaboration and an interest in achieving it. There is some uncertainty, however, as to how it might be accomplished.

At the national level, the ARC is the designated institution to take the initiative in development of research programs. Through provision of national coordinators and supplementary financial support, the ARC is in a position to facilitate institutional collaboration directed toward specific research goals. We conclude from the Team visits that this potential role of ARC is recognized in all of the concerned research institutions.

Review and Evaluation Procedures

The establishment of national integrated research programs is the first major step toward development of the desired technological packages. However, to insure consistent progress toward the goal, periodic reviews and evaluation are necessary.

In a more formal sense, this function is provided for in the ARC itself, as well as in the provincial departments and institutions concerned.

Probably a more effective--but less structured--review and evaluation process is that which stems from and forms part of effective national multidisciplinary research programs themselves. Again, the national wheat research program may be useful to illustrate.

1. Program Coordinators.^{*} In the envisaged All-Pakistan Wheat Improvement Program, the coordinator has an important assignment bearing on review and evaluation of the work of all of the wheat scientists, in all of the involved disciplines, and at all of the concerned institutions. He accomplishes this in several ways.

First, the coordinator must contact the scientists to gain familiarity with them, their programs, and their problems. In this effort to coordinate, to encourage and strengthen, he is also necessarily evaluating work of individual scientists, work of individual stations, and of individual provinces. This personal evaluation places him in a position to intervene constructively at the institution, province and ARC levels. His evaluation is oriented toward strengthening of the over-all program through informal assessment of strengths and weaknesses in the various components of the program.

Secondly, through yearly workshops, organized by the coordinator, the scientists collectively review and evaluate the over-all program and its constituent parts. The progress of each scientist is subject to the scrutiny of all the other participating scientists. The major objective of the workshop is to review the results to date, and on the basis of the review, to plan the cooperative work for the next year. This process systematically, yet constructively, enables the scientists to identify superior performance, poor performance, and resource gaps that need attention. The scientists themselves thus evaluate the program and take corrective steps through the program planning process.

* This term is used as being most descriptive of the role envisaged, but depending upon needs in individual cases, the posts can be designated Advisors, Directors, or Leaders.

Finally, another type of "built-in" review and evaluation is important in national research programs such as the one on wheat. This is through the links between the wheat program in Pakistan and outside related institutions such as CIMMYT. CIMMYT was established with a major objective to strengthen national wheat improvement research programs. One way that CIMMYT links with national programs is through visits of its wheat scientists. Through these visits, CIMMYT exercises a role of evaluation of individual country wheat projects. Again, this is a review or evaluation made by scientists having common research goals.

2. Workshops and Seminars. Workshops are important integral parts of national agricultural research programs. The workshop enables the scientists, say in wheat, to get to know each other, and to know one another's work. It is an important vehicle in developing the interest in and dedication to a strong national multidisciplinary research program. The workshop is arranged by the coordinator, supported to the extent necessary by ARC, and participated in by the scientists themselves.

Essential features of a workshop are the review of the past year's results and, on the basis of the review, the planning of the coordinated program for the coming year.

The annual report of the workshop forms the basis for (or includes) recommendations for changes in program emphasis, for release of varieties, and for use by extension personnel. It provides a valuable tool to each scientist, the coordinator, and research administrators for the assessment of the over-all program, as well as of its component parts.

In order to maximize the value of workshops, normally it will be advisable to rotate the venue. For example in wheat, it would seem reasonable to periodically insure that a workshop be held in each province, or even at all major wheat research stations within provinces. It is also important to insure that each major institution involved (e.g., ARC, ARIs, the

Agricultural Universities/Colleges of Agriculture, and Atomic Energy Commission Institutes) be represented each year by at least one qualified scientist. To the extent possible, all involved disciplines of major importance at each institute should be represented.

For adequate review and planning at the workshop, there must be opportunity for scientists to interact as a multidisciplinary group as well as on a disciplinary basis. Thus, there will be need for joint sessions with all scientists involved, and for discipline-oriented sessions where more detailed discussion and review can be directed to specific problems. But, at the end of the workshop, the decisions and recommendations must represent the program as a whole.

Provincial Research Coordination Boards

As a result of considerable expansion in the agricultural research endeavors during the last decade, there was an increasing awareness by the provinces of a need for (a) organizing research having relevance to priority needs, (b) coordinating research at the provincial and central levels to avoid duplication of efforts, wastage of resources, and indifference to problems of national importance, (c) evaluating research efforts to insure meaningful results, and (d) consolidating research results and disseminating them to the end users for maximum benefit. A Provincial Research Coordination Board (PRCB) came into being in each province a couple of years ago. Notwithstanding the fact that the PRCBs are in their infancy, they have not been able to show viability and dynamism so far. This is attributable to three factors: 1) all important subsectors of agriculture are not represented on the PRCB; 2) the PRCBs meet very infrequently, and then only with the express object of scrutinizing the research projects for transmission to the ARC; and 3) the PRCBs have not concerned themselves with the principal objectives of their creation as listed above, possibly because such objectives were not defined clearly at the very outset.

Experiment Station Development and Management

The development of dependable production technology is related to the validity of results from field experimentation. Thus, the quality of research under field conditions is a matter of considerable importance, as well as of general concern.

In order to obtain reliable and reproducible field experiment results that can be satisfactorily interpreted, the experimenter must have a reasonable degree of control over important "controllable" variables. Further, he must be able to adequately measure or characterize those important variables or production factors over which he has little or no control, e. g., rainfall, incidence of hail or frost, or wind damage.

Experiment station farms should be developed and managed so as to provide the researcher with that reasonable degree of control over his experiment and the facility to characterize or measure the effect of important variables or conditions not controlled or modified.

To illustrate, we will consider an experiment designed to measure the performance of a set of experimental varieties of wheat under irrigated conditions--a yield trial. In this case, the variable deliberately selected for controlled variation is the variety itself. However, the experimenter knows that the actual yield levels will depend on a wide range of factors. Normally, a number of important ones can be controlled through a good set of management practices. These include recommended seedbed preparation, fertilization, seeding depth and rate, irrigation (possibly also drainage measures) and weed control. In this particular experiment, the researcher wants these recommended management practices applied properly and uniformly over his entire area. How can this be assured? One extreme is to leave it entirely to the experimenters. The other is to have all of the service provided by someone else.

It is not hard to visualize the consequences of the approach that would require each researcher to independently assume full and direct responsibility for the establishment and management of his field research. Aside from the squandering of time of scientific manpower, this approach would require of

him an unrealistic control over such things as arrangements for satisfactory water management (irrigation and drainage). Further, it would necessitate duplication of equipment to satisfy individual researcher needs. A variation to this theme is to make each major project or department using an experiment station farm virtually independent.

The second approach--depending on other experiment station farm personnel to provide the needed common services to the researcher--has other implications. The underlying assumption is that over-all farm development and centralized management facilitate provision of a large portion of the technical field support needed by all of the researchers. It is the modus operandi of agricultural research stations in countries with a highly developed agricultural economy such as the United States.

It might be useful to look at what is involved in strengthening experiment station farm development and management. We will consider the actual development of the farm itself, use and maintenance of equipment, and management of operations.

1. Physical Development of the Farm. Most land that has not been shaped--whether on experiment stations or in farmers' fields--has enough variation in relief to substantially affect plant growth. Under these conditions, it is common to see an experimental field, or even an experiment, differentially affected by poor drainage, or uneven irrigation practices. Generally, much of this within-field variation can be eliminated by landshaping, and by development of appropriate irrigation and drainage facilities. However, in practice, it is not reasonable to consider independent development of a single experiment or single field on an experiment station farm. The farm must be viewed as a unit.

Thus, one of the first steps toward development of the farm is a master plan. This requires detailed maps showing elevation and location of existing landmarks which can be used as a basis for determination of logical field boundaries, locations of roads, drainage ditches and irrigation channels, and landshaping operations.

When the master plan for farm development is completed, work should be started on implementation. This must be phased since all of the farm could not be made available at one time for landshaping, even if sufficient equipment and trained manpower were available. The important consideration is to insure that each part of the developmental work be consistent with the master plan.

2. Farm Equipment. Equipment is required to properly develop a farm based on a master plan; it is also required to make effective use of it in the service of the field researcher. The specific kinds and quantities of equipment used depends on a number of factors, including size and nature of the farm, nature and intensity of experimentation, availability of equipment, and ability to utilize it effectively.

Availability is in itself no guarantee that suitable equipment will be used effectively. At least three important considerations are involved: a) leadership with capability and authority to manage farm development and operation; b) skilled equipment operators; and c) a maintenance service that will keep the equipment in operable condition. The situation is all too common where an expensive and valuable tractor is out of operation for lack of a small and relatively inexpensive replacement part.

3. Farm Management. Implicit from the foregoing is the need for a separate centralized organizational unit in an experiment station that is charged with the responsibility, and has the authority, for management of the farm. As envisaged, this would involve a significant change in the current arrangement in the operation and management of most experimental farms. The usual practice is to have parts of the farm permanently assigned to and largely operated by individual major projects or departments.

In the first place, a competent farm supervisor or manager is required. This man works directly with all project or department heads and staff, but is responsible

to the Director of the institution. He must be thoroughly knowledgeable in the over-all operation and management of the farm, as well as in the specific cultural operations required to meet the needs of scientists in their individual experiments. Particularly in larger institutions, it may be necessary to establish a new post for this position, and to train a man to do the work.

The farm manager must have adequate staff to enable him to do his work satisfactorily. Included would be skilled equipment operators, perhaps one or more persons responsible for irrigation (water management), and specialists responsible for maintenance of the equipment.

The manager, with his staff, equipment, and budgetary support, supervises a centralized farm operation as a technical service to the research personnel. It is his responsibility to insure that fields are maintained at the proper level to insure uniform irrigation and drainage, and to see that the basic field support needs of the researchers are met on a timely basis,

This kind of centralized management of farm operations is essential to efficient use of service personnel and equipment. It provides a mechanism for coordinating such important matters as irrigation, seedbed operation, rotation of crops, and routine assignment of land by projects.

With this centralized arrangement, as with the existing ones, there is the need to recognize the role of the experimenter himself. In the final analysis, it is he who is responsible for the quality of his field work. As a consequence, he cannot, indeed must not, divorce himself from a responsibility in seeing that all cultural operations are done correctly. This has two significant implications: 1) he must be sufficiently familiar with the operations to be able to judge if they are being performed in the right way (and to make corrections if necessary); and 2) he must be present at the experiment during the critical operations.

FUNDING OF RESEARCH

A basic common denominator in reviews of programs in developing nations, in research or other activities, is the inadequacy of financial support, including national funds and foreign exchange.

There is no general criterion for determining the minimum or optimum level of funding for agricultural research. Basing such funding in terms of percentage of GNP or of agricultural output in a country is not meaningful under conditions where there are so many urgent and competing demands for limited national resources. As a matter of interest, the allocation of the total GNP for scientific research and development in Pakistan is about 0.17 per cent, of which only 0.04 per cent is for agricultural research. This compares with 0.45 per cent allocated for scientific research and development in India and 3.4 per cent in the United States.

Central Government Support

It has been recognized by leaders in the Government of Pakistan that one of the major restraints to the effectiveness of the Agricultural Research Council in past years has been the lack of funds. The Team found an almost universal view among the persons contacted in the provincial research institutes and educational institutions that the Central Government, through the Council, should furnish more support for agricultural research.

It appears to be commonly accepted that increased support through the Council need not be only in terms of funds, but could include also research personnel (including program coordinators or leaders), journals and publications and other types of materials and services.

It is not possible, or appropriate, for the Team to propose an optimum level of funding for agricultural research in Pakistan. The annual income of the Council since its inception has been in the range of Rs. 8 to 10 lakhs. This is derived from the levies of cess collected under four different acts of the Central Government. The Council has not received any grant in aid from the

Central Government, whereas the annual budgets of the Pakistan Atomic Energy Council (Commission) and of the Pakistan Council of Scientific and Industrial Research, in the amounts of Rs. 1.58 crores and Rs. 2.14 crores, respectively, are provided as grants from the Central Government.

In view of the importance of a more productive agriculture to national social and economic development, it would seem that a sizeable increase in the budget for the Agricultural Research Council would be essential. The proposal by the Director-General of the Council that the funds for the year beginning July 1, 1973 be increased to a level of Rs. 1.0 crores would appear to be a minimum level required to meet urgent research needs.

For future planning of budgetary requirements of the Council, estimates should be based upon: 1) integrated national and regional research programs; 2) equipment and other capital requirements; 3) travel; 4) training and staff development support; 5) special support projects for library, communications, etc.; and 6) funds for allocation for special schemes or projects to backstop the regular adaptive or applied research activities. Research is well-suited to such "program and performance budgeting" and requirements can be projected rather accurately through such itemized analyses.

Provincial Support

Financing for agricultural research provided by the provinces varies widely in adequacy and amount. Additional support could be justified in all provinces and is especially needed in Sind, Baluchistan and N. W. F. P.

In view of the uncertainty of added support in three of the provinces, it would seem appropriate for the Council to furnish increased support, through secondment of research staff and by other means, for research of national and regional concern. If this is done, however, it must be recognized that such support would be in addition to and not in lieu of provincial government support. Provincial budgets for research should not be reduced, but should also be increased to meet the provincial share of research investments.

Funding Research in the Agricultural University and Colleges

Many of the professional staff, with M. Sc. and Ph. D, degrees, are well-qualified and interested in research. To make full use of such pools of talent, they should be provided increased funds, facilities in the way of equipment and literature, and overseas experts in needy areas. Since such fountainheads of learning play a great role in the acquisition of new truths and in training agents of change, possibilities should be explored to create a viable linkage between these institutions and one or more university consortia in the United States for developing their research capabilities.

One avenue of added support for research of university and college staff members would be through their involvement in national or regional integrated research programs. Another possibility would be via grants by the Council for selected "background research" projects designed to explore selected specific problems in depth in order to improve the efforts in applied or adaptive research. Studies on factors inhibiting infiltration of water as affected by different soil tillage practices have been identified as falling in this category.

Availability of Research Funds

A substantial part of the research funds in developing nations is wasted because of administrative procedures and restraints. Delays in provision of fertilizers or insecticides, in the replacement or repair of a piece of equipment, or in supply of other materials or services frequently render useless a full season of research; and it is the research scientist who is commonly faulted for being unproductive even though it is the clerical/ administrative officer, carefully following normal government procurement procedures, who causes the delay.

In recognizing the need for more certain availability of funds to permit more effective long-term planning of research, as well as prompt procurement of supplies, materials, and services, a number of countries have arranged for special "Research Funds" to be established under the national research

institutes or councils, to be under the general supervision and management of the Governing Board or Council, or a special Budget and Finance Committee of the Council. The Malaysian Agricultural Research and Development Institute is financed through "The Mardi Fund" which has been set up in the Bank Negara (National Bank) and upon which the Director of the Institute may draw in accordance with procedures laid down by the Governing Board in carrying out the program as approved by the Board.

A similar arrangement should be considered for a Pakistan Council of Agricultural Research Fund, into which would be placed all cess funds, as well as grants in aid from the Central Government and from other sources. Proper management of the funds could be insured by providing for annual reports on income and expenditures and an annual audit by the Central Government Auditor General.

RESEARCH PERSONNEL - STAFF DEVELOPMENT

The shortage of trained and experienced research workers is a major restraint to agricultural research in Pakistan. This is especially critical in Sind, Baluchistan and the N. W. F. P.

Determining Research Manpower Requirements

As a basis for planning a research staff development program, there should be: 1) an inventory of the present resource of agricultural scientists; and 2) a projection of the numbers of personnel required in the different scientific disciplines related to agriculture, with training to the B. Sc., M. Sc. and Ph. D. levels, for minimum/optimal staffing of research programs of national and regional concern.

The existing or currently available staff is relatively simple to determine. The added requirements may be approximated from the planning of national and regional or provincial research schemes with a determination of the numbers and kinds of research specialists needed for each such scheme--to furnish a well-rounded interdisciplinary research team that will have a reasonable "critical mass" of research workers at each location.

The requirements of technician level supporting staff should also be estimated to insure development of an adequate cadre of such personnel.

Staff Training and Development

Staff improvement and development falls into three categories: 1) in-service training; 2) basic degree training; and 3) postgraduate or advanced degree training.

In-service training is commonly regarded as important only for subprofessional or technician-level personnel for support services. However, such training is essential also for research scientists, to insure that they are fully familiar not only with the planning and design of experiments, but also with the carrying through of the experiments in the field and laboratory. The in-service experience of young plant breeders from Pakistan and

other countries of Asia with the wheat research program of CIMMYT in Mexico is illustrative of this type of field and laboratory training.

In view of the substantial numbers of research workers who will require guidance in planning and carrying out field and laboratory research in Pakistan over future years, special attention should be given to establishing one or more research programs in the country with a training and "research-experience" component. This might take the form of a special training project at a given location, patterned after the program in Mexico, or the assignment of one or a few young scientists to work as apprentices for a season or two with an experienced research officer in Pakistan.

In-service training should be provided also for certain specialized personnel, such as experiment station managers. The effective use of experimental fields, laboratories and equipment requires that such resources be managed as a total resource and not be parcelled to specific projects or departments. This is an often neglected aspect of research program management, and the provision of an external specialist for experiment station operations and management, to offer special seminars, as well as consultants at the various research stations in Pakistan, would be useful.

The education and training to the basic or B. Sc. degree level can be provided by institutions in Pakistan. There appears to be some difference in the quality of training in certain departments, within a given college of agriculture or agricultural university, as well as between institutions. This arises from limitations in teaching staff or facilities and equipment at some locations. Special attention should be given to the strengthening of those departments now deficient for basic degree programs, to insure that graduates will meet minimum standards for job performance and also for postgraduate studies.

Training at postgraduate level, for both the M. Sc. and Ph. D. degrees should be provided increasingly by Pakistan institutions. Costs for such training abroad will limit foreign training largely to those scientists in highly specialized fields. Also, Pakistan agricultural scientists should receive their training and research experience in problem areas of national concern, under conditions of farming in Pakistan.

The premier institution in Pakistan for advanced degree training is the University of Agriculture at Lyallpur. This institution has a sizeable complement of highly trained staff members in most departments. Those departments still deficient could be upgraded with a modest further investment.

The Team found a deep concern on the part of agricultural leaders in the provinces over the substantial capitation fee assessed for training of persons from the other provinces. This reflected not only the inability to meet such costs for any appreciable number of students (on the part of the N. W. F. P.), but also the feeling that such charges were excessive and restrictive in developing trained manpower within the available educational institutions in the country.

This is a matter that should receive serious joint consideration by the Government of Pakistan and the Provincial Governments. The failure to make maximum effective use of the University of Agriculture at Lyallpur, for example, in meeting national needs for well-trained agriculturists, will not only require heavy expenditures for external training by the other provinces, but also will increase the relative deficiency in the numbers of qualified agricultural scientists in these provinces. There would be substantial merit in having the University of Agriculture at Lyallpur serve as the National University for Agriculture.

Personnel Policies

The more effective utilization of the limited scientific manpower resource should be given serious attention. The high degree of uniformity in salary levels of personnel in the Central Government and in the provinces provides for basically fair employment opportunities for agricultural scientists within Central and Provincial Government institutions throughout the country. The factors to be considered in personnel management to maximize the productivity of scientific manpower include:

1. Recruitment and promotion procedures
2. Salary levels and conditions of service
3. Continuity in specialized fields

4. Allocation of time for research of agricultural university and college staff

The output of research, even within the modern concept of "research team" programs of national scope, depends upon the capability and performance of the individual scientist. Some of the most basic and essential qualities of scientists, such as: 1) the ability to conceptualize problems and design relevant research; 2) the commitment to careers in research; 3) the potential compatibility for teamwork with scientists in related disciplines; and 4) the capability to furnish stimulating and energetic leadership to research colleagues, are intangible factors not subject to effective description in usual personnel records. The evaluation of such qualities must be made primarily by scientists with the type of background working experience that enables them to detect professional capabilities and limitations. Most of these qualities are not acquired through continued service and so "seniority" in itself is a poor basis for selecting research leadership.

Procedures should be established in the Agricultural Research Council and other research organizations for the selection of scientists--for initial appointments, for special promotion for meritorious service, and for research leadership positions--whereby the evaluations will be made by special committees comprised largely of research scientists, rather than by the usual Public Service Commission procedures.

The uniform salary scales among Central Government and Provincial employees provides for a reasonably equitable pay structure throughout the country. There is need, however, for continuous review of salary levels to: 1) insure an appropriate distinction between the grades and positions within research; 2) maintain appropriate grade levels for scientists in comparison with administrative and other non-research posts; and 3) equate salaries of Central Government and provincial research workers with salaries of scientists in such autonomous organizations as the PAEC, PCSIR, and WAPDA. Furthermore, the grades of the positions in the Agricultural Research Council or other research institutions must be at a sufficiently high level to attract properly qualified personnel to accept such posts. This is important with respect to the position of the Director-General, as well as all subordinate posts.

The 1968 Team Report stated:

"The success of the Council will depend in large measure on the ability, status and powers of the Director-General. The American members of the Team, therefore, recommend that the Director-General have the status and powers of a Secretary of the Government of Pakistan, or Vice-Chancellor of a University."

The current Director-General of the Council, who is a member of the present Joint Team, has expressed his strong preference that this issue not be reconsidered, but the remaining members of the Team endorse fully the recommendation of the 1968 Report. The Director-General of the Indian Council of Agricultural Research functions also as a Secretary to the Government of India. This level of position is required to insure that the Director-General has the authority and flexibility in management of research programs and resources to produce the new technology inputs on a schedule required to meet national development goals.

In order to attract men of high professional calibre, and of national or international eminence, the status and salary of the posts of Directors, Advisors, and Coordinators should be decided, primarily by the Council, on the basis of qualification and individual merit and should not be fixed in advance.

Modern agricultural research requires a high degree of specialization in the respective scientific disciplines that comprise the research team. The research worker who is disposed to shift from one commodity or problem scheme to another every few years, to achieve modest promotion increments, contributes very little to evolution of new technology during his working career. Procedures for evaluation of performance and promotion policies should be set up to permit a scientist to advance on the basis of the quality of performance in his special field - within that field of work. This was reviewed and discussed fully in the 1968 Team Report, which called attention to procedures in the U. S. Department of Agriculture and to specific descriptive reports which could be used as a guide in setting up procedures in Pakistan.

The allocation of the time for research by staff members of the University of Agriculture and Colleges of Agriculture should be reviewed. It is recognized that involvement in research is highly desirable if teachers are to remain abreast of progress in their fields. However, capabilities and interests in research are not uniform and provision should be made to permit those who have special aptitude for research to devote more time, and those with limited interest to spend less time, on faculty research.

Composition of the Staff of Research Schemes

Expenditures for personnel are currently the major items in research program budgets. The output of new knowledge and improved varieties and breeds or other materials comes from the "research scientist" component of the staff. Inclusion of excessive numbers of secretarial staff, technicians, laborers or peons in the staff complement dilutes the research strength of a program and contributes to the low return on investments in research. This is a matter for special consideration in the planning of research programs in Pakistan to insure that the labor intensive operations of experimental fields or laboratories are not furnished with excessive numbers of such supporting staff, to the detriment of scientific personnel or equipment essential for the research.

Staffing of the Agricultural Research Council

The proposed functions of the Council were reviewed in the section of this report on Program Planning, Operation and Coordination. If the Council in the future undertakes a more prominent role of leadership in the planning and implementation of research, the staffing of the Council must be adapted accordingly. In the past, with the Council functioning primarily as a grant-making organization, the executive staff was concerned largely with review of schemes or proposals, the allotment of funds, and the checking up on use of such funds in implementing the schemes. This did not involve the type of conceptual initiatives in planning national or regional, problem-oriented, multidisciplinary research involving a number of Central Government and provincial organizations, as envisaged for the future role of the Council.

The present Director-General of the Council, appointed in July 1972, has demonstrated his capability for program and administrative leadership in his service as Director of Plant Protection Services. It will be essential that the persons to be selected as leaders for the subject matter divisions of the Council should also have the professional stature, energy, initiative, and leadership capabilities to fulfill their broad responsibilities in getting the research job done in their respective program areas. The most capable scientists/administrators available in Pakistan should be appointed to these posts and capability, rather than seniority, should be the major selection criterion. This will be of particular national concern if the Government officers concerned with planning and implementation of various agricultural development programs begin to utilize the Council staff as technical consultants to improve the "subject" content of such programs.

In like manner, the leaders or coordinators of the national research schemes must be persons who have the professional respect and confidence of their colleagues, and have the capacity to guide and service research without attempting to dominate all decisions and actions.

An important role of the Council will be to strengthen the research in certain institutions, provinces or regions where present resources are deficient. This will involve the secondment of research personnel to carry out certain aspects of integrated research schemes. It would be expected that these scientists would be permanent members of the Council staff, with relatively long-term deputation or secondment to a given scheme or location, but also subject to transfer as requirements dictate. This "core staff" or cadre of the Council must, therefore, combine high professional competence with the ability to adapt to cooperative relationships with the different institutions to which they may be assigned during their working careers.

The core staff or pool of Council scientists should represent a flexible resource, both in terms of deputation to priority schemes or programs and also in terms of scientific composition.

It is recognized, for example, that in some specialized disciplines such as nematology or virology, there is limited awareness at this time of the nature and scope of the pest or disease problems for which such scientific capability may be needed. On the basis of experience in agriculture around the world, it is certain that such specialists will be required in Pakistan and it should be the responsibility of the Council to provide posts for such personnel in its core staff. In order to facilitate this, it will be necessary for the Council to have a reasonable degree of flexibility in determining the kinds and numbers of specialists to be appointed.

RELATIONSHIP TO EXTENSION AND DEVELOPMENT PROGRAMS

Linkages of Research and Extension

The national interest demands that research provide new discoveries to the solution of problems in Pakistan and evaluate, through adaptive research, worldwide science and technology to the conditions in Pakistan. Likewise, the national interest requires that research findings be made available to farmers and that they be assisted in putting such findings into practice.

1. Subject Matter Specialists. The subject matter specialist has a key role to play in the preparation of essential materials for local extension workers, for their use in working with farmers. For the specialist to be efficient, he must work closely with research scientists in getting up-to-date information for distribution to extension workers and farmers. The specialist should take the lead in planning in-service training programs for extension workers and assist them in holding field days at demonstration sites and visits to research centers

The subject matter specialist should serve the important role of feedback from farmers to research workers as a means of keeping researchers apprised of farmer experiences. This important function is essential in keeping researchers current on the usefulness of research findings, on problems for which new research is needed, or for which existing research projects should be modified to better serve farmers' needs.

2. Microplot or Verification Trials. Such trials, conducted primarily on cooperating farmers' fields, constitute a highly important link between the research scientist, the extension worker, and the farmer. These trials afford extension workers and farmers the opportunity to observe the performance of new varieties and practices under local conditions. They also provide the research worker the opportunity to evaluate his material

under a range of soil and climatic conditions, as well as under farmer production practices. Such trials should be carefully planned by the subject matter specialist and the research staff and implemented by researchers working cooperatively with extension personnel.

Seed Distribution Policies

1. National Seed Law. There are numerous agencies, both public and private, which are interested in seed improvement programs. As a basis for a sound seed improvement effort, the establishment and enforcement of a national seed law is essential. Such an act should provide for proper labeling as to origin, variety, germination, purity and year of production. Authority should be provided for the issue of rules and regulations for enforcement by the agency charged with its administration.

The establishment of a Seed Improvement Board (SIB) would be helpful in implementing an over-all seed improvement program. This board should have representation from the Central and Provincial Governments, the Agricultural Research Institutes, the Agricultural University and Colleges of Agriculture, and the Seed Certifying Agency. The SIB would provide advisory services to the Central and Provincial Governments on policy matters.

2. Recommendation and Release of Varieties. Performance of promising experimental materials should be evaluated on a national and regional basis by scientists in the several integrated or coordinated crop improvement programs. Based on performance, these scientists--normally during the annual workshop--would make recommendations for the release of varieties on a national, regional or provincial basis. Recommendations of the scientists, conveyed through the coordinator, are transmitted by the ARC to the committee concerned with official release of varieties.

3. Seed Increase and Distribution. The classes of seed recognized by certifying agencies are (a) breeder or foundation seed, (b) registered seed; and (c) certified seed.

Upon the release of a new variety or strain, the breeder should have the responsibility of producing the necessary quantity of breeder or foundation seed stocks. Such production should be located on experiment station land and supervised by the plant breeder. Foundation seed should be used solely for multiplication and not for commercial crop production or home use.

Registered seed should be produced by carefully chosen experienced farmers or seedsmen who are qualified to produce, harvest, process, store and place such seed on the market for certified seed producers. This step in seed multiplication is of critical importance and every precaution should be taken to multiply this class of seed to the maximum. The certifying agency should establish high standards for this class of seed.

Certified seed is produced from registered seed and made available for general use by farmers. Certified seed production should be engaged in by experienced and qualified farmers or farmer-seedsmen under the supervision of the certifying agency and constitutes the best source available for general use by farmers.

Good planting seed of proven adaptation and performance is the single most important production input the grower can make. Such seed represents a sizeable investment of public funds. For this reason, the breeder and the institution to which he is attached must be interested and concerned that new varieties and strains are produced and handled in such a way as to make the maximum contribution to farmers and the nation.

The breeder must devote his time to the development of new and improved varieties and, therefore, should be relieved of the production of seed stocks, except breeder seed.

Individual farmers, cooperatives and private agencies should assume the responsibilities of using certified seed and its progeny in an efficient production, processing storage and marketing system for the good of farmers generally. ^{1/}

Library and Information Services

1. Services to the Research Staff. Scientists engaged in research must have available to them a wide range of literature in their specific discipline and related fields. Research projects must be selected on the basis of known knowledge on the subject in order to avoid unnecessary duplication. In planning research on any problem, it is necessary for the scientist to be knowledgeable about the most recent and effective methodologies and procedures to employ in obtaining the research objective. Library resources with a good range of journals and periodicals, and effective procedures for distribution of these materials to field stations are of the utmost importance for the scientist to do relevant and productive research.

Recognizing the difficulty of providing each research station with needed foreign journals and periodicals, it would seem advisable to have in the ARC a communications or documentation center. This center would receive the basic journals and periodicals and arrange appropriate means to expeditiously duplicate and distribute summary portions, such as the "Table of Contents." This would allow individual stations or scientists to determine articles of particular relevance, which might in turn be duplicated and provided by the center in the ARC.

^{1/} See the report of Johnson E. Douglas, "The West Pakistan Seed Program," Report No. 13, Accelerated Crop Improvement Series, distributed by the Planning Cell, May 5, 1970.

2. Technical Journals and Reports. Such journals and reports constitute the most effective source of information to the scientists engaged in research. The establishment of a systematic series of technical journals and annual reports, covering research in Pakistan, will provide a mechanism and medium through which scientists can report the results of their work, not only to fellow scientists, but also for use by the press and government agencies in the dissemination of results and recommendations to the public at large.

It would be highly desirable for the Agricultural Research Council to assume responsibility for publishing a National Agricultural Research Journal. Such a journal series should be published as often, monthly or quarterly, as necessary for the timely reporting of research results of scientists working at the national and provincial levels. It should be sent to national libraries and to research institutions abroad, and should be available to individual scientists at a modest subscription rate.

In addition to the scientific journal series, it would seem useful for ARC to publish regularly a journal or magazine--perhaps entitled something like "Pakistan Farming"--which would be oriented toward extension personnel, or others in agriculture more concerned with the applied aspects of research findings.

Annual reports should be prepared at the national and provincial levels by the research institutes and colleges and universities which conduct research. Such annual reports should emphasize the practical application of the work done and should be written at a level for public usage.

3. Extension Bulletins. Extension bulletins and leaflets should be published as required to adequately disseminate timely and practical information and recommendations. The subject matter reported should be based on both research information and farmer experiences. The subject matter specialist should prepare extension publications in consultation with research scientists to insure that all recommendations are in accord with

research findings. The specialist should coordinate his efforts with provincial scientists and extension workers to avoid divergent views or recommendations being made to extension workers and farmers.

Increased emphasis should be given to extension publications as a source of practical information to extension workers, farmers and community leaders for their use in training programs designed to accomplish specific objectives.

Evaluation of Dissemination Practices

As a means of making dissemination methods and practices more effective, there must be a built-in system of evaluation to adequately test the degree of impact of the extension procedures. Frequently, when a new program is launched, it works effectively for a period, but then begins to lag. The national wheat program in Pakistan is a good example of putting into practice a package of production techniques which resulted in a marked increase in wheat production. Production leveled off and has tended to decline in recent years. It is recognized that a number of factors, including availability of fertilizers, national price policies, and other considerations have been involved. The effectiveness of the extension system in transmitting information and also in continuous urging of farmers to apply all of the combined inputs as a complete "package of practices" should be assessed.

Evaluation of the extension and development activities, for application of new technology is essential if the maximum return per unit of investment in research funds is to be realized. This is of special importance in Pakistan where increased production must be achieved by a large number of farmers with small land holdings, located over a wide area where soil and climatic conditions are extremely variable and who are difficult to reach with information and production inputs.

Inasmuch as radio and television are effective news media, their use would be of great assistance to farmers, livestock producers and fishermen. These current facilities should be used more widely and plans made to explore the feasibility of establishing public radio and television facilities for use by Central and Provincial agencies and institutions to provide extended services to society in general.

INTERNATIONAL COOPERATION

Linkages with International Research Centers ^{1/}

The underlying concept and justification in establishment of these centers were that they offered a unique mechanism for: 1) rapid development of some of the production technology urgently needed in developing countries; and 2) acceleration in the strengthening of national agricultural research systems. It is not necessary to elaborate the role of CIMMYT and IRRI, as related to the agriculture of Pakistan, in illustrating the success in generating varieties and improved experimental germ plasm of wheat, maize and rice. It is important, however, to emphasize the implications of the rapidly expanding availability of a wide range of additional relevant agricultural technology developed outside of Pakistan.

The international research centers are focal points of a growing number of international agricultural research networks. The network on wheat is illustrative. The international effort on spring wheat research is centered at CIMMYT. The network itself is made up of cooperating national wheat research programs and the links between them. The wheat research program in Pakistan is an example of the numerous national programs linked with CIMMYT.

^{1/} The Consultative Group on International Agricultural Research currently supports six international centers or institutes. These are: IRRI - The International Rice Research Institute (Philippines); CIMMYT - The International Center for Maize and Wheat Improvement (Mexico); CIAT - The International Center for Tropical Agriculture (Colombia); IITA - The International Institute for Tropical Agriculture (Nigeria); CIP - The International Potato Center (Peru); and ICRISAT - The International Crop Research Institute for the Semi-Arid Tropics (India).

An effective linkage of the wheat research program of Pakistan with the international wheat research network, including CIMMYT and other components in the network, permits this country to easily and rapidly gain access to relevant wheat technology on a worldwide basis. Likewise, it permits and urges Pakistan to contribute to the strengthening of the wheat research network through exchange of breeding materials, varietal testing under different ecological conditions, etc.

The linkages in international research networks vary in effectiveness. What, for example, determines the effectiveness of the linkage between the Pakistan wheat research program and other components in the network, e. g., CIMMYT? There are at least two major factors when viewed in terms of Pakistan's interests. First, is what CIMMYT and other components in the network have to offer to the wheat research program in this country. Secondly, is the ability of the Pakistan wheat research program to use effectively what is made available, and to reciprocate in supplying knowledge and materials from the research in Pakistan.

Briefly stated, the international wheat research network, and a growing number of corresponding ones, have much to offer to research in Pakistan. High yielding varieties and other improved or basic germ plasm have been mentioned. Training opportunities also figure prominently. It would be hard to measure the value already gained by the training of Pakistani wheat scientists at CIMMYT. Periodic visits of key international center staff can be valuable contributions to on-going national research programs. For example, the regular visits of Drs. Borlaug and Anderson have served to strengthen the national wheat research program. Other examples and other crop programs could be cited.

What determines the ability of the research program in Pakistan to effectively utilize what is available from international research networks? Basically, those national programs that are most effectively organized, coordinated, staffed and supported can most readily take advantage of what the international networks have to offer.

The all-India coordinated crop improvement programs offer a useful example of how effective use can be made of international networks to strengthen national research capability. Sufficient experience has been gained to clearly identify salient features of these all-India programs. It has been clearly demonstrated that the role of the national program coordinator is critical. It is this technical coordinator who not only helps to shape a strong national research program, but also provides for effective linkage between the national program and the international network.

Thus, the ability of Pakistan to make effective use of international research networks--of international centers and other components in the network--centers on its own national programs. A given program, such as wheat, must have a capable and respected coordinator who will serve as the principal contact in maintaining linkages with international centers and other research network elements.

Linkages with National Research Organizations

An increasing number of countries in Asia are moving forward in building their national agricultural research capability. India has reorganized the Indian Council of Agricultural Research, with emphasis now on support for all-India coordinated research schemes rather than support for isolated projects as in prior years. Malaysia established the Malaysian Agricultural Research and Development Institute in 1969. Indonesia approved the recommendations of the Agricultural Research Review Team in 1969 to establish a national agricultural research organization. President Marcos issued a decree on November 10, 1972 establishing the Philippine Council of Agricultural Research which is now being formed.

The foregoing actions will be useful to Pakistan, both in providing common experience in setting up or strengthening a national research system and in furnishing more effective contacts for interchange of research information and materials.

External Technical Assistance

The nature and amount of external support and cooperation in technical programs in the future is somewhat difficult to project in view of the action under way in many national and international organizations, and by private foundations, in assessing their activities in the years ahead. It may be expected, however, that support would be forthcoming for strengthening the national research capability in Pakistan, provided: 1) there is firm national commitment and reasonably adequate national financial support to this endeavor; and 2) the organization pattern, with suitable collaborative relationships of Central Government and provincial agricultural research and educational institutions, provides for a viable and progressive national research system.

It would be desirable to encourage support and participation in the building of the national research capability from a number of bilateral, international and private sources. This would not only enhance the potential amount of cooperative support, but also would provide for exploring the types of research experience of the various collaborating countries or organizations.

In reviewing collaborative support to agricultural programs in developing nations of Asia over the past two decades, it is apparent that the cooperative activities involving individual projects has tended to fragment the national institutional structure for functions such as research. The desire of donor organizations to set up separate institutes or schemes for the projects they support--for flexibility of operation and also for identity of their specific technical assistance activity--has precluded the assembling of a strong, integrated national research capability. The Atomic Energy Laboratories set up to apply this particular tool to certain agricultural research activities is one example in Pakistan where these laboratories are outside of the main stream of national agricultural research, yet draw heavily on national budget resource and scientific talent. Projects supported by other international, national and private organizations frequently are tied to a particularly competent person or to an especially well-equipped laboratory, without adequate regard to the effect of such external support

in distorting the longer-term institutional structure of the host country. The provision in some loan agreements of international or regional banks, that a research and technical backstopping unit be established to service the specific development scheme, also has the effect of fragmenting and redirecting national research resources.

In order to avoid such restraints to establishment of an integrated national research capability or system, consideration should be given to a procedure for coordination of technical assistance support--to provide for maximum contribution of the separate collaborative projects to the building of the national research system. An association or committee of representatives of the various technical assistance agencies, to maintain contact with the Director-General of the Council with respect to planning of new technical assistance and research projects, would be useful in this regard. Since the external support would involve many national, international and private agencies, the proposed committee might be chaired by the agricultural representative of an international agency such as the FAO, UNDP or World Bank.

STRENGTHENING THE NATIONAL AGRICULTURAL RESEARCH SYSTEM

The deficiencies in agricultural research in Pakistan fall into a number of categories. The common concerns at the Central Government and provincial level are about inadequate facilities, shortage of funds, lack of equipment, and insufficient numbers of trained and experienced research scientists.

There are two obvious remedies. One is to add new resources. The other is to make more effective use of what is now available. In strengthening the national research capabilities to meet the growing requirements for new agricultural technology, attention should be given first to improving the effectiveness of current resources and then identifying how much and where additional resources may be required.

If the national agricultural research capability of Pakistan is to be improved, it must be changed. This will entail an objective and in-depth assessment of the roles of the Pakistan Council of Agricultural Research, the provincial agricultural research institutes, and the other organizations--educational institutions and autonomous bodies--also engaged in agricultural research. Their organizational structure, functions and interrelationships must be taken into account.

The Pakistan Council of Agricultural Research

The PCAR has been serving primarily as a small credit bank, reviewing schemes or projects submitted by various institutions and individual research workers around the country. It considers many such schemes, sanctions many, but supports few--because of limited funds.

The Council plays no significant role in conceptualizing or planning research to resolve problems in agriculture that impede national agricultural and economic development. The Council has had no particular role in guiding the planning of national development programs in agriculture, either in supplying information to planners to help them assess the cost

benefits or feasibility of Plan schemes or in conveying to research workers the priorities in agricultural development which should receive research backstopping to eliminate problems or to accelerate productivity.

The Council has not had an effective role in coordinating research of national concern, or in giving guidance to usefulness of research proposed by external agencies in terms of priority or of benefit to Pakistan agriculture. This applies to projects supported under the PL 480 program and by other external resources.

The Council has no operational base for the executive staff or secretariat. It is housed in old hutments of the secretariat at Karachi, with offices of the different officers and sections scattered in a manner not conducive to effective work.

The Council has no headquarters research center--one of the few national research organizations in the world without such a working research station as its center of operations.

In the discussions around the country, in the course of the Team's visit, there has been a general acceptance of the concept of a stronger national role of the ARC in the support of agricultural research, as well as in coordination. However, there emerged also frequent references to "agriculture as a provincial subject." This latter point requires further attention and clarification, and possibly some new policy considerations, since it is difficult to conceive of a subject that is more important to national development, to economic growth and social welfare, and to national political stability than the adequate provision of food supplies and other products of agriculture. It would appear that this matter has been given some thought in the drafting of the new constitution, as reflected in The Draft Constitution, From the Gazette of Pakistan, Extra, December 31, 1972, Part III. The Fourth Schedule [Article 73(b)], List I, Federal Legislative List, Part I, includes:

- Item 16. Federal agencies and institutes for the following purposes, that is to say, for research, for professional or technical training, or for the promotion of special studies.

Item 32. National planning and national economic coordination including planning and coordination of scientific and technological research.

The Pakistan Council of Agricultural Research was recognized as ineffective and inadequate to serve national needs in 1968. It has not been improved at the present date, five years later. Most of the recommendations of the 1968 Review Team are still valid and relevant. There is need, however, for further assessment in the light of present relationships and conditions in agriculture in Pakistan.

The role of the Council in 1973 is essentially the same as in 1968, in considering numerous proposed schemes or projects, sanctioning a considerable number and financing a few. An added dimension is the sponsoring of seminars in a number of problem fields, including water management, rice production, etc. These are useful and represent a start in encouraging cooperation and coordination.

The present concepts about the responsibility of the Council, to continue the project grants and to activate research primarily in those problem areas hereto neglected--considered unimportant by the provinces--are not consistent with the building of a competent national research capability. Pakistan agriculture will not be served with the amount and kinds of new technological inputs required for sustained agricultural growth if its major national research organization limits its attention to the marginal and less important problems in the agricultural economy. The hard core of research needs are in the hard core of the nation's agriculture--such as the increased production of wheat, rice, maize and other crops to meet the primary goal of self-sufficiency in food supplies. It would not seem reasonable to default on research on such primary problems because provincial research institutes have "pre-empted" these fields.

The 1968 Review Team Report states:

"The Team recognizes that substantial change is required in the organization, functions, and procedures of the Council, with the following basic provisions:

1. The Council should serve as the principal technical arm of the Ministry of Agriculture and Works, in strengthening agricultural science and technology in the country and in keeping the Ministry abreast of research developments in Pakistan and abroad.
2. The Council should have an active, positive role in identifying problems confronting Pakistan agriculture and in planning, with appropriate research organizations of the Provinces, the agricultural universities, and other organizations, cooperative and coordinated research projects for the solution of such problems.
3. The Council should have a cadre of well-qualified scientists who would participate in research schemes, and in case of research of broad regional or national significance, may serve as coordinating leaders of the projects. The development of the Council cadre and the system of selection and promotion on merit is discussed further in Chapter V.
4. The Council should work primarily with, and through, the existing research institutes, universities and other organizations, but should be authorized to establish special research institutes or directorates for particularly important problem fields of nationwide scope if this becomes necessary.

5. The Council should be a technical body consisting primarily of leading scientists in the respective disciplines relating to agriculture. The membership of the Council, to assure an effective working body, should be limited.
6. The arrangement for the Minister of the Ministry of Agriculture and Works to serve as Chairman and the Secretary, Ministry of Agriculture and Works and Provincial Ministers to serve as Vice Chairmen may be continued.
7. There should be a Director-General of the Council who is an eminent scientist in Agriculture or Animal Husbandry. 1/
8. The Council should have an adequate scientific staff at the Director level to furnish capable leadership in research evaluation, planning and coordination in the major fields of agricultural research and development including (a) Crop Husbandry, (b) Animal Husbandry, (c) Soils, Irrigation and Engineering, (d) Agricultural Economics and Statistics, (e) Forestry and Range Management, and (f) Fisheries. Supporting staff should be provided to deal with various specific problem areas within each field.

1/ The success of the Council will depend in large measure on the ability, status and powers of the Director-General. The American members of the Team, therefore, recommend that the Director-General have the status and powers of a Secretary of Government of Pakistan or Vice-Chancellor of a University.

9. The Technical Committees should be reconstituted, with newly selected advisory committees established, as needed, composed of competent scientists from both wings and the Central Government, for the special problem fields of crop husbandry, animal husbandry, forestry, fisheries, etc.
10. The Council should have adequate, effective financing. The support to the Council should be increased to a level of Rs. 20 million per year and increased further as the needs of the research program and related activities of the Council may require.
11. The Central Cotton Committee and the Central Jute Committee should work in close collaboration with the Agricultural Research Council. Further discussion of coordinated research for improving cotton production is presented in Chapter VI."

The foregoing concepts are still valid, with some minor modifications and additions. For example, Item 6 would be revised since there is no longer an East Wing and West Wing of the country. This applies also to Items 9 and 11. The level of proposed financing, Item 10, should be reassessed.

More emphasis should be placed, in 1973 and onward, on certain functions of the Council, including:

1. The Council should collaborate closely with the Planning Commission in determining feasibility of objectives and goals in agricultural development, and to maintain continuous communication with provincial and other research organizations with respect to priority problems requiring research attention.
2. The Council should serve as the organization responsible for insuring effective coordination of research on those problems of critical national importance, including research to improve production of wheat and rice to

meet continuously increasing food requirements. The wheat breeders of Pakistan, in 1972, expressed their joint concern over the decline in cooperation and coordination in wheat research in recent years and the need for improved coordination of wheat research in the country.

The proposed organization, objectives, functions and membership of the Council, as modified to enable the Council to serve more effectively in recognition of changes since 1968, are presented in detail in Appendix IV.

The staffing of the Council should be upgraded, as discussed in the section on Research Personnel - Staff Development. Effective leadership in identifying research needs, in planning new research on priority problems, in consulting with government officials on feasibility of agricultural development goals, and in maximizing use of limited national research resources through more effective cooperation in and coordination of research requires the most capable scientific talent available in the country.

The facilities of the Council should include a suitable headquarters center for field and laboratory research, for selected national servicing of research such as plant introduction, information and documentation services, conference and workshop facilities, and offices for secretariat staff and project coordinators. This headquarters should be reasonably near to the national capital, to facilitate more frequent personal communication of the agricultural research leadership and government officials and, equally important, to improve awareness of government officials of the presence and importance of an agricultural research capability.

The lands, approximately 1,000 acres, which include the Dairy Farm formerly under the Agricultural Development Corporation have been identified as possibly available for the headquarters station for the Council. This would be an excellent site and could serve as a location for research related to barani agriculture, as well as in other fields.

The existing research centers or institutes should be incorporated into the ARC, as components of an organization which would have increased operational, rather than merely funding, responsibilities.

New research stations should not be set up under the ARC if there is any prospect of conducting research, which may be supported by deputation or secondment of ARC scientists and ARC funds for operations, at facilities now existing at provincial institutes, the University of Agriculture, the Colleges of Agriculture, or other organizations concerned with agricultural research. The concept of new "Institutes" or new "Centers" which usually entails more land and more laboratories should give way to emphasis on "Integrated National or Regional Research Schemes" as discussed in this report. Such schemes insure maximum use of research resources and maximum output of research results. Pakistan should strive for both.

The support by the ARC in the future should be less in the form of grant of funds and more in the form of: 1) seconded scientific officers, travel funds and operational budgets of coordinated multidisciplinary research schemes; 2) staff development and training awards, international travel, library resources, equipment, etc. Provision also should be made for funding of selected schemes proposed by individual scientists, or initiated by Council staff, for in-depth studies of certain stubborn problems.

The funding of the Council is discussed rather fully in this report and careful thought should be given not only to more adequate amounts of funding, but also to the manner in which the funds are available to the Director-General and his executive staff in facilitating long-term planning of research and in meeting needs for supplies, equipment, and other operational expenses on timely schedules during the cropping season.

The flexibility in management of the research program of the Council is one of the most critical issues in the productiveness of the organization and in insuring a satisfactory output of research in terms of funds invested. It has been recognized rather generally in developing nations of Asia that research, as well as some other development-related activities, are not functional and productive when operated under the normal civil service restraints and procedures. Many agricultural research organizations, in India, Malaysia and the Philippines, have been set up as autonomous or semi-autonomous bodies with a linkage to Government through a Ministry, but with responsibility for determining operational procedures vested in a Governing Board and authority for

implementation within such procedures placed in the Director-General of the Institute or Council. Pakistan has recognized the importance of delegating authority to operate in such manner to get the job done in the case of the Council for Scientific and Industrial Research, the Atomic Energy Commission, and the Academy for Rural Development, in providing for a reasonable degree of autonomy for these organizations. Certainly, the improvement of agriculture and the provision of new technological inputs to increase agricultural productivity is of at least equal importance to the nation and an autonomous or semi-autonomous status for the Agricultural Research Council would seem justified.

The Council should have a high degree of delegated authority in recruitment, selection and managing its research and supporting personnel, in procurement of supplies and equipment, and in the management of the other components of an effective research program. In view of the many external constraints -- in dealing with the various collaborating organizations in coordinated national research programs, it is particularly important to keep the internal or in-house management restraints of the Council to a minimum.

Provincial Research Institutes

The provincial research institutes participate in various research projects of broad national concern, of interest also to one or more other provinces, and of importance only within their province.

The role of the provincial research institutes in an improved national research system would envisage their continuing involvement in and support for the foregoing three types of programs. Support for research of concern to the province should be supported more adequately by the provincial governments for a number of problem areas where current research is inadequate or non-existent.

The facilities for research in the provinces should be studied carefully and should be realigned to provide for: 1) a strong headquarters station for the province; 2) a limited number of multipurpose centers to serve the principal soil/climatic zones; and 3) special stations as required

to conduct research on particular problems that cannot be handled effectively at the main or regional centers.

One very obvious opportunity for improving both efficiency in use of limited financial and trained manpower resources, and the output of significant and useful research results would be the closing out and consolidation of work and resources of the many research substations in some of the provinces. For example, it seems improbable that effective "research" could be accomplished in the Punjab at five Sugar Cane Research Substations, and at twelve Cotton Research Substations, in addition to the large numbers of substations for other crops and problem areas throughout the province. The Cotton Research Substations are in addition to the eighteen Cotton Research Substations of the Institute of Cotton Research, of the Pakistan Central Cotton Committee. If the manpower, equipment, and operational budgets of these thirty or more Cotton Research Substations were placed into no more than five or six stations in cotton growing regions of the country, supplemented with test-demonstration trials on farmers' fields, the research resources would be more productive. Preoccupation with microclimatic zones, once considered to be a major factor, has diminished in modern agricultural research planning. The United States, with substantial variation in growing environments across the longitudes from Georgia to California, has no more than six cotton breeding centers to serve the cotton industry. More effective allocation and use of present resources should be a prerequisite to planning of added research support in the provinces.

The coordination of research within the provinces requires further attention. The Provincial Research Coordination Board has been meeting in the N. W. F. P., but has not been functional or viable in the other provinces.

The participation of the Provincial Research Institutes in research of broad national concern would be enhanced by the development of "All-Pakistan Coordinated Research Schemes" for wheat, rice and other crops and problem areas that were conceived and operated in a manner that would best serve national needs and interests. This will entail a higher level of cooperative spirit, and a retrenchment of institutional and personal interests, in order to be successful.

The Role of Educational Institutions and Other Organizations

The University of Agriculture, Colleges of Agriculture, Pakistan Council of Scientific and Industrial Research, Atomic Energy Commission Laboratories, Water and Power Development Authority and other autonomous organizations will continue to carry on research related to agriculture--that should be related more closely to national agricultural development goals and objectives.

Certain basic or background research will be required on certain problems of particular significance in Pakistan which could be handled by these organizations.

In coordinated or integrated national research schemes the staff of these independent organizations should be involved in relevant projects, at all stages of planning, operation and evaluation of the research. Similarly, the laboratories and field facilities should be utilized to the maximum extent possible in coordinated research programs.

Additional financial support would hopefully be provided through the regular funding channels for these organizations. However, where appropriate to strengthen the total national research effort on a given problem, further resources might be supplied by the Council, in terms of research personnel, equipment, training support, travel and such other items as may be deemed necessary.

IMPLEMENTATION

1. The initial action for the implementation and activation of the recommendations of this report will be the approval by the Government of Pakistan.
2. Consideration should be given by the Government to such clarification of policy, or modification of policy, as might be required to insure more effective involvement of the ARC, as a national body, in agricultural activities heretofore considered as primarily a provincial subject.
3. There should be a commitment by the Government to more adequate financing of agricultural research by the Central Government, through the ARC commensurate with the importance of agriculture in the nation's economy, and the importance of improvements in agriculture to achievement of national development goals. Funding for agricultural research by the Central Government would appear to justify levels at least equal to the support provided for scientific and industrial research. Such funding should be projected over a minimum period of five years, and should be expanded as required over the next Plan period.
4. Early action should be taken to establish the research station headquarters for the ARC near Islamabad, on a site with suitable land and water resources to permit a wide range of research not only for rainfed areas, but also on problems for which special equipment and scientific capabilities may be necessary to concentrate on special stubborn problems in improving agricultural production.
5. The activation of the more operational research role of the ARC should be undertaken promptly, with a number of research programs of national and/or regional concern set up with the necessary mechanisms for joint planning, operation, evaluation--and coordination by a well-qualified leader who will have the support and acceptance by his colleagues necessary for him to fulfill this responsibility in an effective manner.

6. **Action should be taken as required to reconstitute and reorganize the Council, to provide for: 1) the necessary position standards and grades for recruitment of scientific personnel of the highest available capability; 2) the flexibility in operation and use of funds by the executive staff; and 3) such other procedures and services as will insure the vigorous pursuit of agricultural research.**

7. **The considerations of external support, for financial assistance for capital development, equipment, etc., and for technical consultants should be given early attention to insure the mutual understandings of the nature and scope of such requirements, and the basic commitments and procedures necessary to expedite and accelerate joint action in achieving the objective of strengthening the national research capabilities.**

APPENDIX I

MEMBERS OF THE SECOND JOINT PAKISTAN-AMERICAN AGRICULTURAL RESEARCH REVIEW TEAM

Dr. Israr-ul-Haq, S. Q. A., T. Q. A.

Dr. Haq received his L. V. P. (Hons.) from Lahore (Pakistan) in 1938, and Ph. D. (Physiology) from Reading (U. K.) in 1948.

He joined the Central Agricultural Marketing Department in 1939, and now holds the post of Agricultural Marketing Advisor with the Government of Pakistan. He went on deputation to the University of Agriculture, Lyallpur, Pakistan, in 1962 as Dean, and is now serving there as Vice-Chancellor since 1969.

During his service with the Government of Pakistan, Dr. Haq made important contributions in the fields of research and development of national agricultural marketing services, including the establishment of the Wool Grading Organization of the Government of Pakistan--the first venture of its kind in the history of carpet wools in the world. He also established a Wool Testing Laboratory for the Government of Iran at Teheran, as well as conducted a Hides and Skins Study for ECAFE.

During his service with the University, Dr. Haq established two new faculties of Animal Husbandry and Agricultural Economics, as well as made other significant contributions to the development of agricultural education, research, and extension, including the introduction of postgraduate instructors in new disciplines and the planning of a new university campus.

Dr. Haq has to his credit 86 publications in the fields of Agricultural Marketing, Animal Husbandry, and Agricultural Education. He is the Chairman or Member of several national and international learned societies. He has toured extensively all over the world and visited many countries, either to represent Pakistan in scientific conferences, or to advise friendly countries on scientific matters, or to establish research and academic relationships with institutes of international repute. As a result

of his contributions to science and society, he was awarded T.Q.A. and S.Q.A. by the Government of Pakistan and an International Gold Medal by the International Congress on Physiology in Italy. He was born in 1917 and has served the Government for 34 years on various gazetted positions.

Dr. Heshamul Huque, T.I.

Dr. Huque received his B. Sc. (Agric.) degree from Agricultural College Kanpur (Agra University). He underwent higher training in Crop Protection at Cambridge (U.K.). He received his M. Sc. degree from the Ohio State University, Columbus, Ohio (U.S.A.), and special training in the peaceful application of Atomic Energy at Oakridge Institute of Nuclear Studies, Oakridge, Tennessee. He did his doctorate degree in Zoology (Entomology) at the University of Karachi.

His field of research embraces various entomological, pesticidal and toxicological problems, both by conventional, as well as by the latest techniques involving the use of radioisotopes and radiation.

He has traveled widely and has attended 27 international conferences and symposia as an official delegate from Pakistan, as well as in his personal capacity. He is serving as one of three members on the panel of experts appointed by the Director-General of the FAO of U.N. for locust research and control. The Joint Secretariat of the FAO and IAEA, Vienna, has awarded a contract to Dr. Huque for pursuing researches deploying radioactive insecticides against paddy pests. He is also serving as one of the members of the expert group of FAO and IAEA dealing with problems of hazards of pollution due to pesticides.

Prior to his appointment as Director-General (ARC), he was the Director and Advisor of Plant Protection, Government of Pakistan, Ministry of Food and Agriculture, and has become an international figure in this field.

Dr. Huque has over 106 articles and research reports related to plant protection to his credit.

Dr. Abdul Rehman M. Memon

Dr. Memon graduated from Bombay University in 1944 and joined the Department of Agriculture of Sind Province the same year. In 1945 he was selected by the Sind Government for two years postgraduate training in Plant Breeding and Genetics at Imperial Agricultural Research Institute, New Delhi. Dr. Memon obtained the degree of Doctor of Philosophy in Plant Breeding and Cytogenetics from the Agricultural and Mechanical College of Texas (U. S. A.) in 1955. Dr. Memon was deputed by the Government of Pakistan under an FAO program in 1961 to study cotton production in the USSR for a period of six months.

Dr. Memon has served as Assistant Cotton Breeder, Assistant Professor of Botany, Cotton Botanist, Director of Research, Principal of the Agricultural College, Tandojam, and at present, holds the position of Director of the Agricultural Research Institute, Tandojam, Pakistan.

Dr. Memon is recognized as Professor for guiding M. Sc. and Ph. D. students. Twelve M. Sc. and one Ph. D. degrees have been awarded under his direction. He is examiner for various colleges, universities and institutions.

Dr. Memon, during his tenure as Cotton Botanist, through modern breeding technology and intensive and extensive experimentation has not only evolved a number of new high yielding, long staple cotton varieties, but has proven that cotton yields can be increased by following scientific recommendations. In Sind, cotton yields have been increased from 263 lbs. of lint in 1963 to 413 lbs. per acre at present, which is the highest in Pakistan. The important varieties developed by Dr. Memon are: M100, T. D. 1, H-59-1 (Kalandri), H-61-29 (Lateef), H-64-15 (Mehran) and S-59-1 (Sarmast).

Dr. Memon has remained as member of the Pakistan Central Cotton Committee and Agricultural Research Council and various other committees and organizations.

Dr. Memon has served for a period of 28 years in administration and research. He has to his credit 87 publications, both technical, as well as semi-technical and technical reports and schemes.

Dr. Guy B. Baird

Dr. Baird received his M.Sc. and Ph.D. degrees in Agronomy (Soils) from North Carolina State University and Cornell University, respectively. Prior to initiation of his Master's program, he served for a year as Assistant Country Agent in the North Carolina State Agricultural Extension Service.

On completion of his doctorate in 1952, he joined the field staff of the Rockefeller Foundation as Assistant Soil Scientist. He served in the Cooperative Colombian Agricultural Program from 1952 until 1959, initially as Agronomist-Soil Scientist and later as Assistant Field Director. Then, still with the Rockefeller Foundation, he joined the Cooperative Indian Agricultural Program as Assistant Field Director. In this capacity, and later as Field Director, he was closely associated with measures taken to reorganize and strengthen the Indian Council of Agricultural Research, as well as to establish the All-India Coordinated Crop Improvement Programs.

He left India in late 1971 to accept a position in Washington, D. C., with the United States Agency for International Development. Currently, he has responsibility for the agency's centrally-funded agricultural research program.

Dr. Albert H. Moseman

Dr. Moseman received his B.Sc. and M.Sc. degrees from the University of Nebraska and his Ph. D. in Plant Breeding and Genetics from the University of Minnesota in 1944. He also holds an Honorary D. Sc. from the University of Nebraska.

He began his professional career with the Coordinated Federal-State Wheat Improvement Research Project in 1936, located at the Nebraska Agricultural Experiment Station as a member of the U. S. Department of Agriculture Bureau of Plant Industry. He continued with this organization in research and administrative roles and served as Chief of the Bureau from 1951 to 1953. From 1953-1956 he was Director of Crops Research, Agricultural Research Service, U. S. D. A.

Dr. Moseman was a member of the team sent by the U. S. Department of State in January April 1950, to discuss with government officials of Near East and Asia countries the prospects for cooperation in agricultural development to be undertaken under the then proposed Point IV Program. In 1955 he was a member of the First Joint Indo American Team on Agricultural Research and Education. He has served as the Agricultural Specialist on teams headed by the President's Science Advisor Dr. Donald F. Hornig to review Science and Technology Programs in Korea in 1965, and in Taiwan in 1967.

From 1956 to 1965 Dr. Moseman was with the Agricultural Sciences Program of the Rockefeller Foundation and was Director of this program for 5 years. He served as Consultant on Research to the Secretary of Agriculture in 1963, and from 1965-1967 was Assistant Administrator Office of Technical Cooperation and Research U. S. Agency for International Development.

In 1967 Dr. Moseman joined the Agricultural Development Council, a private foundation supporting teaching and research for agricultural development in Asia to give attention to the strengthening of national agricultural research systems. He was a member of the First Joint Pakistan-American Agricultural Research Review Team and has been associated with similar reviews in Malaysia Afghanistan and the Philippines. He served as the first Director of the Malaysian Agricultural Research and Development Institute from 1969-1971 and as Consultant to that organization through 1972.

Dr. Calvin C. Murray

Dr. Murray holds the B. Sc. degree from North Carolina State University; the M. Sc. degree from the University of Georgia; and the Ph. D. degree from Cornell University.

He has held positions of Professor of Agronomy at the University of Georgia and Louisiana State University for the period 1936 to 1948. He served as Director of the Georgia Agricultural Experiment 1948-1950. He was appointed Dean and Director of the College of Agriculture, University of Georgia, in 1950. In this capacity, he had administrative responsibility for Resident Teaching, Experiment Station Research and the Cooperative Extension Service. He established programs with Colleges of Agriculture in Cambodia, South Vietnam and East Pakistan. He has served on educational and research review teams in Indonesia, Central and South America and Afghanistan. In 1958, he was appointed as Regents Professor of International Education and Director of International Programs of the University System of Georgia and Executive Director of the Southern Consortium for International Education, Inc.

APPENDIX II

ITINERARY AND CONTACTS

(February 19 to March 9, 1973)

February 19	0800 to 1200	Group discussions on time of work.
	1300 to 1330	Meeting with Sardar Ghaus Bakhsh Raisani, Minister for Food and Agriculture and Underdeveloped Areas, Government of Pakistan.
	1430 to 1645	Group discussions and formulation of program of work.
	1700 to 1830	Meeting with Malik Khuda Bakhsh Bucha, Special Assistant (Agriculture) to the President of Pakistan.
February 20	0800	Departure for Lahore
	0915	Arrival Lahore
	1000 to 1215	Meeting with Mr. Majid Hassan Khan, Joint Secretary, Agriculture Department, Government of Punjab.
	1230 to 1300	Meeting with Dr. M. Irfan, Principal, College of Animal Husbandry, Lahore, and Professors.
	1310 to 1415	Meeting with Dr. A. S. Akhtar, Director, Veterinary Research Institute, Lahore.
February 21	0800	Departure from Lahore
	1000	Arrival Lyallpur

February 21	1015 to 1230	Meeting with Dr. Israr-ul-Haq, Vice-Chancellor, Agricultural University, and Deans of various faculties.
	1340 to 1500	Meeting with Dr. Amir Mohammad, Director, Atomic Energy Center, and his Research Officers.
February 22	0930 to 1300	Meeting with Dr. Zakauallah, Biochemist (Representative of Director, Agricultural Research (Dr. Sanaullah).
	1430 1830	Departure from Lyallpur Arrival Karachi
February 23	1000 to 1100	Meeting with Mr. Salim Abbas Jilani, Secretary of Agriculture, Government of Sindh, Karachi.
	1100 to 1200	Meeting with Dr. M. A. Kazi, Secretary, Education Department, Government of Sindh.
	1600 to 1700	Meeting with Mr. Jalil A. Sheikh, Director, Marine Fisheries, Karachi.
February 24	0730 1030	Departure from Karachi by road Arrival Tandojam
	1030 to 1130	Meeting with Mr. Mohammad Amin Bhatti, Principal, Agriculture College, Tandojam.
	1140 to 1240	Meeting with Dr. A. M. Memon, Director, Agricultural Research Institute, Tandojam, and specialists.

February 24	1300 to 1415	Meeting with Dr. Shaukat Ahmed, Director, Atomic Energy Center, and his Research Officers.
	1545 1845	Departure from Tandojam Arrival Karachi
February 25	0730 1015	Departure from Karachi Arrival Rawalpindi
February 26		In Islamabad
February 27	0800 1200	Departure from Islamabad Arrival Peshawar
February 28	0800 to 1130	Meeting with Mian M. Said Director, Agricultural Research Institute - Tarnab, Peshawar.
	1200 to 1300	Meeting with Dr. S. M. Ishaque, Director, Forest Institute, Peshawar.
	1310 to 1400	Meeting with Professor Mohammad Hussain Khan Principal, Agriculture College, Peshawar.
March 1	0930 to 1045	Meeting with Mr. Shoaib Sultan Khan Director Rural Development Academy, Peshawar.
	1100 to 1200	Meeting with Dr. Sultan Ahmad Khan, Director, Animal Husband- ry and Veterinary Institute, Peshawar.
	1400 1730	Departure from Peshawar Arrival Islamabad.

March 2 Write up of draft report.

March 3 Write up of draft report and meeting with Mr. Mohammad Khan Baluch, Deputy Director of Agriculture (Research and Coordination) Agriculture Department, Quetta, and Dr. Mohammad Bashir, Asst. Director (Hqrs.), Animal Husbandry Department, Baluchistan, Quetta.

March 4 - 8 Write up of report.

March 4 Meeting with Malik Khuda Bakhsh Bucha, Special Asst. (Agriculture) to the President of Pakistan.

March 6 Meeting with Dr. M. Sulaiman Kakli, Chief Agric. Section, Planning Commission, Islamabad.

March 7 Meeting with Ford Foundation officials: Mr. Frank Miller, Resident Representative, Pakistan; Mr. Aftab Akhtar Khan, Program Officer; Dr. Takumi Izuno, Maize Specialist; and Dr. Fred Palmer, Agric. Project Specialist.

March 8 Meeting with Ministry of Food, Agriculture and Underdeveloped Areas officials.

Reception with Director and Mrs. Wheeler.

March 8

Dinner with Ministry of Food,
Agriculture and Underdeveloped
Areas officials.

March 9

Meeting with Government of
Pakistan officials:

1. Malik Khuda Bakhsh Bucha,
Special Assistant (Agriculture)
to the President of Pakistan.
2. Mr. Rifat Pasha Sheikh, CSP,
Secretary, Ministry of Agriculture.
3. Mr. A. Z. Farooqi, CSP,
Financial Advisor, Ministry of
Agriculture.
4. Nawabzada Jahangir Shah Jozezai,
Joint Secretary, Agriculture.
5. Dr. M. Yaqoob Bhatti, Advisor,
Animal Husbandry, Ministry of
Agriculture.
6. Col. M. Sadiq, OSD,
I/C Rural Development Program
Ministry of Agriculture.
7. Dr. S. Kakli, Chief Agric. Section,
Planning Commission.

March 9

Review with USAID staff.

APPENDIX III

PROVINCIAL OR REGIONAL RESEARCH PRIORITIES

Punjab

1. Development and evaluation of high-yielding varieties of wheat, rice, maize, cotton, oilseeds, pulses, feed and fodder crops and fruits.
2. Pest management, including plant protection and toxicity of chemicals.
3. Water management, with emphasis on crop requirements and farm water systems.
4. Crop production in rainfed areas and arid zones.
5. Agricultural engineering in such areas as land leveling, irrigation, farm implements and machinery.
6. Improvement in livestock and poultry production, with emphasis on breeding, nutrition, pest control, management and processing and marketing of animal products.
7. Waterlogging and salinity.
8. Losses of crops, animals, and their products.
9. Animal diseases and their treatment and control.
10. Incidence, causes and control of human malnutrition.
11. Development and utilization of forest produce and farm forestry.
12. Marketing, grading and standardization of agricultural produce and animal products.
13. Development of animal feed industries.
14. Utilization of agricultural wastes.

Sind

1. Development and evaluation of high-yielding varieties of wheat, rice, oilseeds, maize, millets, sorghum, soybeans, pulses and vegetables. Also cotton, jute, sugar cane and fodder crops.
2. Pest management and control.
3. Water and soil management.
4. Work on barani and arid cropping conditions.
5. Seed production and technology.
6. Animal husbandry and veterinary problems.
7. Development of marine fisheries, with emphasis on exploratory fishing, biological and technological aspects of marine food, and fishing crafts.
8. Incidence, causes and control of human nutrition.
9. Marketing, grading and standardization of agricultural produce and animal products.
10. Losses of crops, animals and their products.

N. W. F. P.

1. Development and evaluation of improved varieties of wheat, maize, rice, potato, fruits, sugar beet, sugar-cane and feed crops.
2. Water and soil management.
3. Pest management for crops and livestock.
4. Conduct investigation on rainfed and arid zone conditions.
5. Breeding, nutrition and management of livestock and poultry.

6. Forestry and range management.
7. Production, processing and marketing of fruits and fruit products.
8. Fresh-water fisheries.
9. Animal diseases and production of biologicals.
10. Medicinal plants.

Baluchistan

1. Range management.
2. Development and evaluation of improved varieties of feed and food crops such as wheat, potato, vegetables, sorghum fruits, and sugar cane.
3. Production, processing, and marketing of fruits, vegetables, and animal products.
4. Pest management and control of crop and livestock diseases and insects.
5. Animal husbandry and veterinary research, with emphasis on breeding, nutrition and management of sheep, goats and poultry.
6. Water resources and soil management.
7. Investigations on crop production under barani and arid zone conditions.
8. Commercial floriculture.
9. Development of forests and their products.
10. Development of fodder and feed industries.

APPENDIX IV

PAKISTAN AGRICULTURAL RESEARCH COUNCIL
MEMORANDUM OF ASSOCIATION

- I. The name of the Council will be "Pakistan Agricultural Research Council."
- II. The registered office of the Council will be situated at the Headquarters of the Government of Pakistan.
- III. The main objectives of the Council will be:
 1. To serve as the technical arm of the Ministry of Food and Agriculture, Government of Pakistan.
 2. To identify research areas of national interest in all subsectors of agriculture; to furnish leadership in planning of research of national concern; to provide support, participate in, and coordinate such research, especially through the development of nationally integrated research programs on important crops and animals, and their products.
 3. To establish and operate a Federal Experimental Station at Islamabad, to serve as the headquarters for the professional staff of the Council, to furnish a focal point for agricultural research in Pakistan, and to conduct research in specific areas.
 4. To develop the research capability of federal and provincial research institutes in appropriate ways, e. g., by awarding scholarships and fellowships, organizing seminars and conferences, and procuring equipment and expertise.
 5. To act as a clearing house of information and support the publication of and publicity to the results of research.

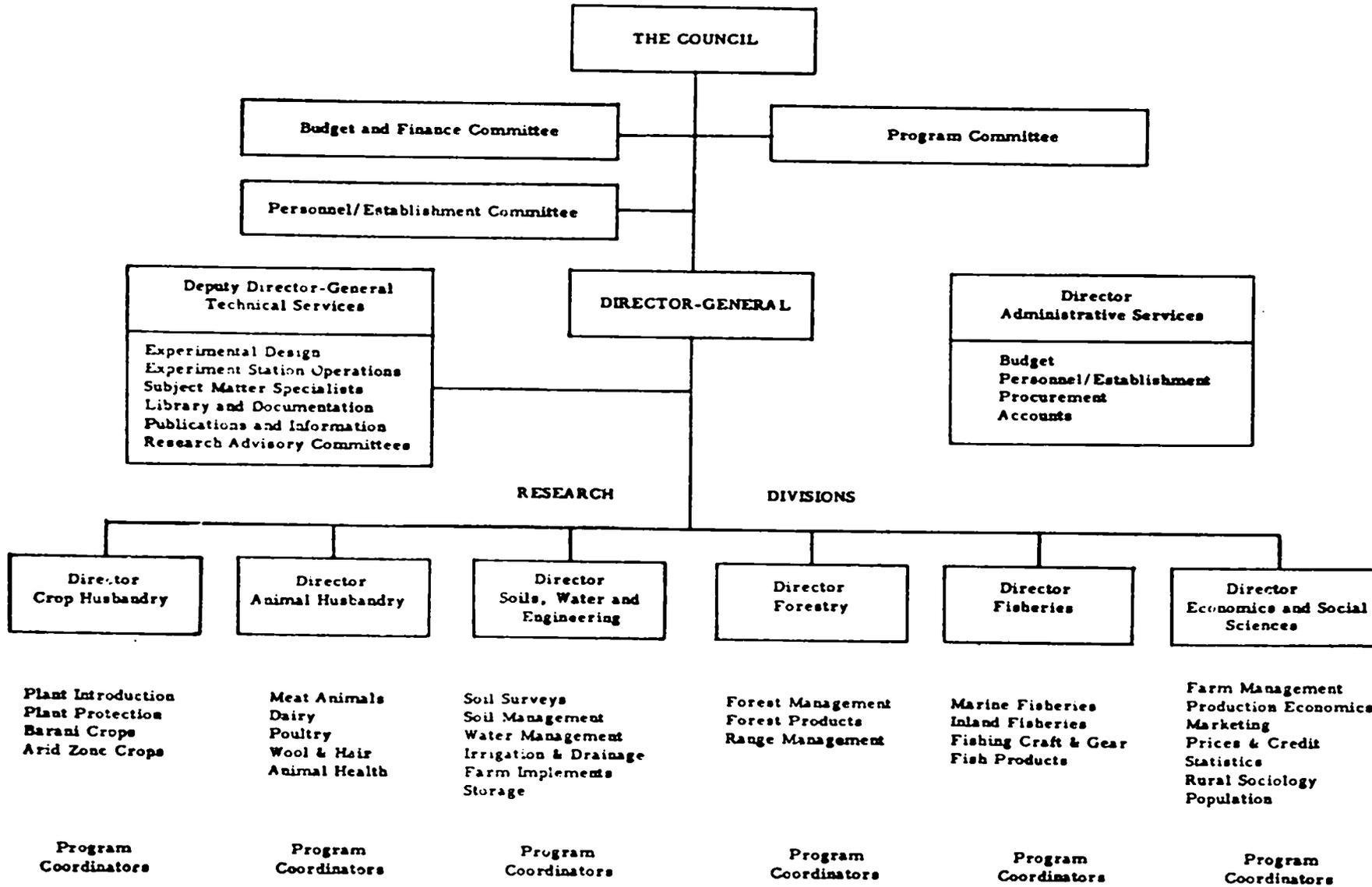
6. To establish liaison and cooperation with international organizations concerned with agricultural research and support participation of Pakistan agricultural scientists in international conferences and meetings.
7. To establish and assist in establishing libraries, museums, herbaria, germ plasm banks, documentation centers and plant and animal introduction centers.
8. To maintain national registers for research workers, research centers, and research projects.
9. To accept grants, fees, donations, endowments, and aids as approved by the Government of Pakistan.
10. To perform such other functions as are of interest to agricultural research, or are assigned to the Council by the Government of Pakistan.

IV. The following shall be members of the Council:

1. Minister for Food and Agriculture, Government of Pakistan - Chairman.
2. Secretary for Food and Agriculture, Government of Pakistan - Vice Chairman.
3. Secretary, Ministry of Science and Technology, Government of Pakistan.
4. Financial Advisor, Ministry of Food and Agriculture, Government of Pakistan.
5. Chief, Agriculture Section, Planning Commission.
6. Director-General, Agricultural Research Council.
7. Secretary Agriculture, Punjab.
8. Secretary Agriculture, Sind.
9. Secretary Agriculture, N. W. F. P.

10. Secretary Agriculture, Baluchistan.
11. Director, Agricultural Research Institute, Lyallpur.
12. Director, Agricultural Research Institute, Tandojam.
13. Director, Agricultural Research Institute, Peshawar.
14. Director, Agricultural Research Institute, Quetta.
15. Vice-Chancellor, University of Agriculture, Lyallpur.
16. Director, Animal Husbandry, Quetta.
17. Director, Veterinary Research Institute, Lahore.
18. Director, Forest Research Institute, Peshawar.
19. Director, Marine Fisheries, Karachi.
20. Agricultural Marketing Advisor, Ministry of Food and Agriculture, Government of Pakistan.
21. Member at large. *
22. Member at large. *
23. Member at large. *

* Persons to be named by the Chairman of the Council to furnish capabilities to supplement those of the designated members of the Council.



The Committees for Budget and Finance, Personnel/ Establishment, and Program would be named by the Council. They would include some members of the Council, as well as such members (or coopted members) as would be agreed by the Council to be necessary for fulfilling the functions of the Committees.

The Budget and Finance Committee would consider the budget proposals of the ARC; establish procedures for setting up an operational "Fund"; and for the expenditure of funds by the executive staff of the ARC.

The Personnel/Establishment Committee would set up qualification standards and grades; procedures for recruitment, selection and promotion of staff--with special attention to steps necessary to insure ability of the ARC to attract highly qualified scientists and to promote the more productive scientists on the basis of merit.

The Program Committee would review the priorities and program proposals of the ARC, and recommend their approved program, through the Budget and Finance Committee, to the Council.

In order to insure that the agricultural research in Pakistan is addressed to the high priority and urgent needs to meet national development goals, there should be established such "Advisory Committees" as may be needed to give guidance to specific commodity or problem areas. These Committees of 8 to 10 persons would help to identify the kinds of problems to be tackled, but they would not design the research. This would be the responsibility of the professional staff of the ARC.

The provision of Advisory Committees would serve to hold the membership of the Council itself to a reasonable number. This should preferably be no more than 15 and certainly less than 25 if the Council is to give meaningful consideration to the matters it should handle.

The staff of the Council should reflect the maximum capability Pakistan can offer. This is a national research

institution that should be involved increasingly in furnishing guidance on technical matters in the planning of national development goals and in carrying out the research to eliminate restraints in achieving these goals. In addition, the ARC staff will be participating in more international conferences and relationships with scientists from similar organizations in other nations. The representation of Pakistan's national agricultural research organization should command professional respect in the world community of agricultural science. This applies not only to the Director-General, the Deputy Director-General and the Directors of the Research Divisions, but also to the leaders/coordinators for the respective research programs.

The proposed organization for the ARC identifies some of the fields of research or programs under each of the divisions. These are not all-inclusive and other fields of research also might be justified and required.

The program coordinators would be the ARC staff employed to serve as leaders/coordinators for the various integrated national or regional research programs.