

REPORT TO

THE PAKISTAN AGRICULTURAL RESEARCH COUNCIL

**On Selected Aspects
of the
Pakistan Agricultural Research System**

ISNAR

International Service for National Agricultural Research

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August 1983

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Introduction

Prior to independence and the partitioning of India in 1947, agricultural research was centered in the agricultural college and research institute at Lyallpur (now Faisalabad). At independence, there was a considerable loss of scientific talent from that institute, which had been the premier agricultural college and research center for undivided North India. The inflow of scientists transferred from institutions in present-day India only partially compensated for this loss.

While the Pakistan Agricultural Research Council (PARC) had its origin in the bifurcation in 1947 of the Imperial Council of Agricultural Research, it had very limited resources at its disposal, and little authority and responsibility until the 1970s. Since that time, Pakistan has made a concerted effort to develop, strengthen, and improve its agricultural research system.

The urgent need for and importance of a strong central agricultural research organization to complement and support the work of the provinces has been recognized, and the government has taken a number of actions to develop this capacity. Considering the active development of Pakistan's research system, it is not surprising that several teams have made extensive reviews of the agricultural research system and have made numerous recommendations for its strengthening and improvement, many of which have been implemented. Among the major reviews are the following:

- the joint Pakistan-American agriculture research review team, 1968;
- the second joint Pakistan-American team on agricultural research, 1973;
- the agricultural research development loan, USAID, 1974;
- the joint review team for agricultural research in Pakistan under the loan agreement between Pakistan and the United States, 1976;
- the World Bank agricultural research subsector review, 1980;
- World Bank staff appraisal report of the agricultural research project, 1981;
- the Minnesota reconnaissance team report on the agricultural research system of Pakistan, 1982.

Terms of Reference

The above reviews and their recommendations are sufficiently comprehensive that a review of the entire system at this time would be repetitive and unnecessary. However, the chairman of PARC requested the International Service for National Agricultural Research (ISNAR) to provide the services of a team with relevant background and experience to:

- * examine the relationships between PARC and the provinces, including those within and among the institutions of the center and the provinces, and make suggestions and recommendations for their improvement;
- * examine the concepts, organization, and functioning of a selected group of national coordinated research programs (NCPs).

For this latter purpose, the NCPs on wheat, rice, and oilseeds were selected for intensive study. The NCPs are, of course, only one avenue of interaction among Pakistan's research institutions and programs, but they are an important one. Since the relationships among the federal and provincial institutions are still evolving, and have great potential for affecting the research system, it is useful to examine these relationships and try to assure that they develop in the best interests of the people of Pakistan. Naturally, the above considerations affect, or are affected by, other activities of the center and the provinces. (See Annex 1 for the terms of reference. A third element in the terms of reference, the development of research priorities, is not included in this report. ISNAR plans to develop a separate paper on this subject.)

The team consisted of Dr. Ralph W. Cummings, Emeritus Professor, North Carolina State University; Dr. J.S. Kanwar, Director of Research, ICRISAT; and Dr. Floyd Williams, ISNAR staff member. All had had extensive experience in the subcontinent and in provincial, national, and international agricultural research programs (biodata in Annex 5). They were provided access to relevant publications and reports, and visited Pakistan during November 14 through December 4, 1982. They conferred with many individuals and groups in government, universities, and research institutions at the center and in each of the four provinces to obtain first-hand impressions and information on the subject. Their itinerary and lists of persons contacted are given in Annexes 2 and 3. These discussions were interspersed with and followed by team discussions.

Basic Premises

During the review, the team discerned the apparent acceptance of some important basic premises within the research community. While these have not been previously stated and formally adopted, the team is of the opinion that most research leaders in Pakistan would subscribe to them. The team's interpretation of the circumstances in Pakistan, and its suggestions and recommendations, are thus based on the following premises:

- * Pakistan requires and wishes to develop a strong national agricultural research system for generating and delivering the range of scientific technology needed to improve the productivity of the agricultural sector.
- * The national agricultural research system should be balanced to serve national needs. It would require a strong central organization (PARC) capable of providing leadership, coordination, and support, in full partnership with equally strong provincial programs and institutions involved in research, and technology generation and delivery.

- * The range of available scientific manpower devoted to agriculture in the central agencies, universities, and provincial agencies and institutions should be dedicated to the ideal of maximum service to the agricultural constituency of the nation. Institutional arrangements should facilitate the full application of the talents of the staff in all these institutions toward achieving unified national goals.
- * Research, education, and technology transfer to the farming community should be interlinked so that the professional competence may be fully used and continually advanced. There should be no breaks in the flow of information from its source at the experiment stations or farms and in agricultural universities (including inputs from international sources); through adaptation and verification tests under farm conditions; to demonstration, adoption, and application by farmers. And there should be feedback so that the attention of researchers will be called to technology-application problems that indicate a need for further research.

Background

The introduction of semi-dwarf, high-yielding varieties of wheat and rice beginning in 1966 gave a substantial boost to the recognition of agricultural science as a means of improving agricultural productivity. Pakistan has continued to benefit substantially from cooperation with the international agricultural research centers since the mid-1960s, especially with IRRI on rice, CIMMYT on wheat and maize, and CIP on potatoes. This cooperation was facilitated by assistance of USAID, the Ford Foundation, and other external agencies.

The recommendations of the first joint Pakistan-American agricultural review team of 1968 were discussed thoroughly at the provincial level and approved by the inter-provincial coordination committee and the cabinet committee. While implementation was delayed during the period of separation of East and West Pakistan provinces, the first director general of the Pakistan Agricultural Research Council was appointed in July, 1972.

A major research development loan and grant was negotiated through USAID in 1974. This represented a significant step toward building the facilities and strength of the Pakistan Agricultural Research Council, the establishment of the National Agricultural Research Center at Islamabad, and the enhanced development of the national coordinated research programs.

As indicated in the brochure "Agricultural Research System of Pakistan," published by PARC in 1982, the Government of Pakistan has recently taken a number of important decisions and actions to facilitate the council's efforts to achieve the objectives set for it. (See Annex 6 for details.)

These recent developments in Pakistan's agricultural research system form a strong framework for the development of an effective central leadership, as well as enhanced cooperation among provincial and national institutions.

The development of effective provincial agricultural research establishments, in close touch with farm conditions and problems of their respective provinces, with on-farm testing, evaluation, and feedback, and closely linked with the extension services, seems basic for Pakistan's research system. These must be served by a central organization which is competent and complementary. The central organization should (and does) provide complementary services, equipment, financial resources, and access to a wider range of international contacts; introduce genetic resources; facilitate and assist with the improvement of staff competence; conduct research which supports the provincial programs but which is appropriate for central attention; and assist with the coordination of programs common to more than one province.

Organization of Agricultural Research

The major organizations concerned with agricultural research and its support in Pakistan are as follows:

Central:

- Pakistan Agricultural Research Council
- Atomic Energy Agency
- Water and Power Development Authority
- Pakistan Science Foundation
- University Grants Commission
- Central Cotton Committee
- Pakistan Tobacco Board
- Pakistan Forest Research Institute

Provincial:

- agricultural research institutes
(principal provincial institutes, centers, and subcenters,
and on-farm testing and evaluation) and
- agricultural universities.

Pakistan Agricultural Research Council

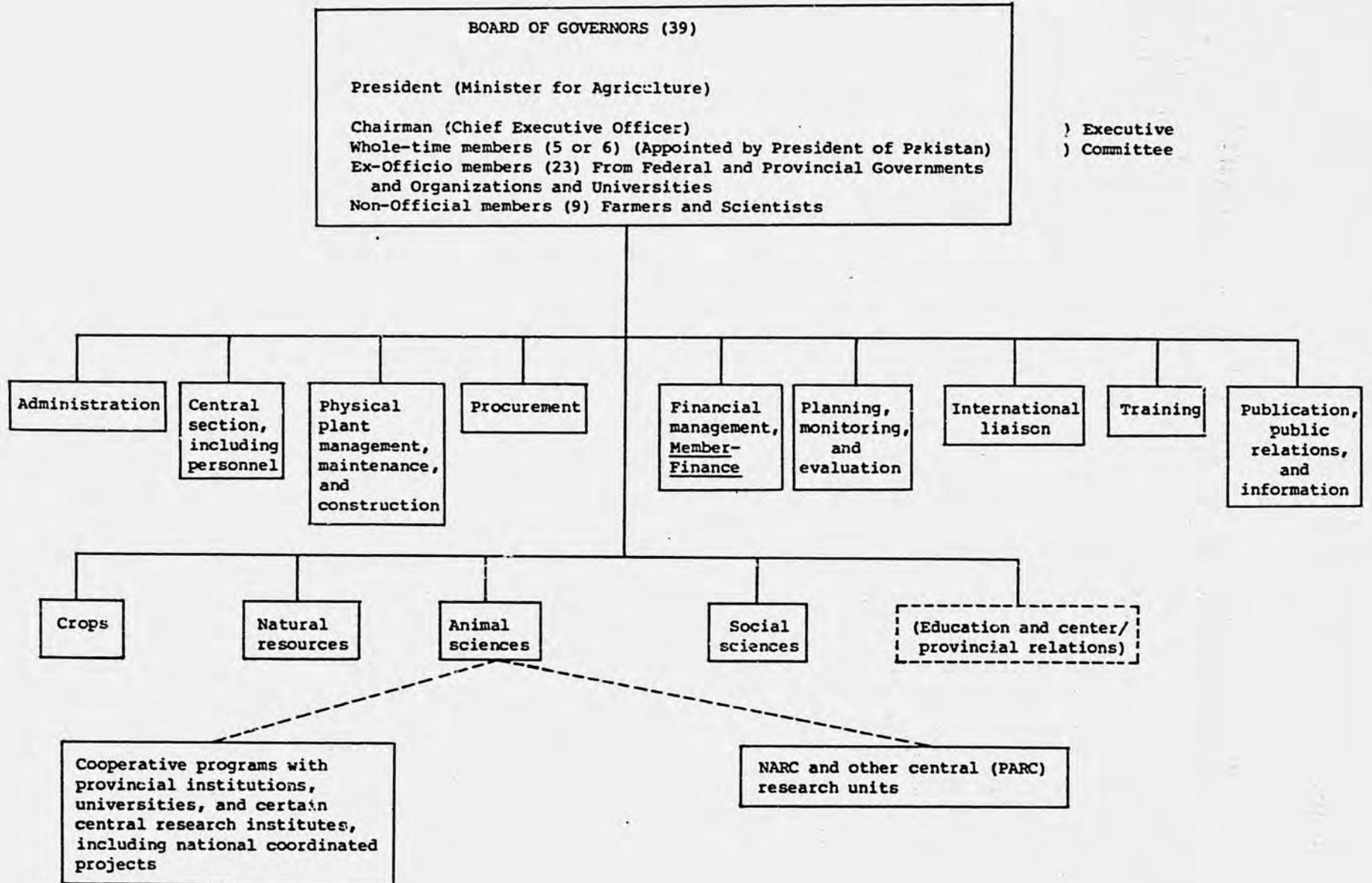
The Pakistan Agricultural Research Council is the major body responsible for agricultural research. Its present charter, under the PARC ordinance of 1981, gives it the authority to head a research system composed of strong provincial and central components that jointly plan and execute priority research programs. It is semi-autonomous, and the present chairman is the secretary to the government for agricultural research, which means he participates in national policy and resource allocation decisions. The organizational chart for PARC is depicted in Figure 1.

The governing board of PARC has about 40 members, broadly representing the various organizations and interests concerned with agriculture and agricultural research. It provides a mechanism for the views of these various groups to impinge upon the council's policies and programs.

The chairman of this board is the chief executive officer of PARC. He and five full-time members of PARC (crops, animal sciences, natural resources, social sciences, and finance) serve as the central executive body. As will be discussed later, the team is of the opinion that serious consideration should be given to adding a sixth full-time member for education and center/provincial relations.

The finance member is on deputation from the Ministry of Finance and is in a position to help expedite clearance of financial matters. The other full-time members, in addition to supporting the chairman as members of the executive committee, have direct responsibility for overseeing and

Figure 1. Organizational chart of the Pakistan Agricultural Research Council



Policy level

Administrative, Service and Management level

Program level

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managing council-supported programs in their respective fields, and general responsibility for promoting and assisting the development of comprehensive nationwide research programs in their areas. The manner in which these programs are organized, formulated, and managed has an important bearing on the overall character of center/provincial relations.

The full-time members of PARC have first responsibility for the national research programs (indicated by dotted lines on the chart), and it is at the program level, supported by the central services, that the nature and quality of the center/provincial relations and inter-institutional relations will be determined.

The proposed new member for education and center/provincial relations would be responsible for: relations with and support to the provincial agricultural universities; memoranda of agreement or understanding between PARC and the provinces; the training center at NARC; and scholarships and fellowships for advanced degree training. Frequent liaison and cooperation with other members would, of course, be necessary.

The central management of PARC is supported by a number of units, including general administration; personnel; physical plant construction, management and maintenance; procurement; financial management; planning, monitoring, and review; international liaison; scholarships and training; and publication and information.

It appears to the team that the necessary structure for sound policy formulation and overall responsible management has been provided for in PARC, and that with a staff of competent officers and the possible addition of a full-time member for education, it is reasonably conceived.

The council is financed from several sources, including a direct subvention from the government of Pakistan, and grants and loans from various external sources, notably USAID, US PL-480, and the World Bank. At present the development portion of its budget has a large component of foreign source contribution, part of which is earmarked for capital and nonrecurring facility development. At the same time a substantial portion is for developing and strengthening research programs with a recurring budget requirement, and for developing and improving the quality of scientific talent. Subsequent planning must look to the requirements from indigenous sources to systematically incorporate recurring costs of these programs into the regular (nondevelopment) budgets and enable them to move forward without interruption. The World Bank loan paper (World Bank, 1981. Report No. 3242 - PAK, Pakistan Staff Appraisal Report of the Agricultural Research Project.) contains assurances to this effect, but information given to the team on active current budgeting and fund release was not fully reassuring on this point.

National Agricultural Research Center

The National Agricultural Research Center (NARC), and its functions need careful attention as it develops as a center of excellence to meet the agricultural research needs and to strengthen the institutions of Pakistan. The development of essential physical facilities and the initial staffing of NARC are attracting attention; some provincial researchers who have limited resources at their disposal may assume that

NARC development consumes resources that would otherwise be available to the provincial institutions. NARC must have substantial physical facilities and staff to execute its unique and strategically important role. At the same time, sufficient resources must be made available to the provinces to enable them to carry out research in provincial institutions for adaptation to local situations, and to do on-farm evaluation, testing, and demonstration.

The team endorses a large part of the goals and purposes for NARC as stated in the brochure on the "Agricultural Research System of Pakistan," prepared by the chairman of PARC (1982), from which we quote the following:

"The major goal of NARC is to conduct research in areas of national importance where such research is not currently being undertaken, or is seriously inadequate, and it can best be done at a well-equipped, properly staffed and funded central institution, where facilities are available to all scientists in the country.

"Besides laboratory research on selected aspects of plant and animal genetics, pest management, soil and water management, etc., NARC will also have a Training School to impart theoretical as well as practical training in crop production and related techniques to provincial scientists. The training school will conduct special courses on important agricultural commodities and will have the necessary facilities including lecture rooms, laboratories, and experimental fields, besides a cafeteria and hostel for the trainees. Eminent national and international experts on different commodities will teach these courses, which will also include extensive field experiments to be done by the trainees.

"The other facilities at NARC include a reference library and a centralized information service to provide the latest research information to all the research scientists in the country. A centralized facility for repair and maintenance of sophisticated laboratory equipment is also being established at NARC, which will provide service to all the research institutions.

"The repair and maintenance division will have adequate trained staff and technicians to undertake repairs of most of the laboratory equipment in the country. The division will organize training courses to build up the capabilities of the major research institutions to repair their equipment by training a large number of technicians for various institutions. The Agricultural Machinery Division (AMD) will undertake research in developing designs for urgently needed farm machinery in cooperation with the relevant provincial institutions. AMD will develop linkages with the agricultural machinery manufacturers in the country so that the successful designs, after testing in farmers' fields can be manufactured in sufficient numbers and made available to the farmers within a short period.

"The Plant Introduction Centre (PIC) and the National Unit of Plant Genetic Resources (PGR) will also be located at NARC. The main objective of these groups is to collect and preserve the genetic

resources of various crops and animals to save them from extinction in order to transfer their desirable traits for development of high yielding varieties with other desirable characters like resistance to diseases, insects and other environmental stresses. The group will also systematically (arrange to) test exotic plant and animal species under various ecological conditions prevalent in different parts of the country, to select those which could be directly used by the farmers with minor modifications. The successful strains/cultures selected by PIC will be passed on to the provincial institutions for adaptive research and large scale introduction in their areas.

"Research in Social Sciences related to agriculture will also be concentrated at NARC so that the social scientists could interact with biological scientists and undertake research on various socio-economic problems of different categories of farmers and the agroecological regions. In addition to a strong research group at NARC, small research groups on agricultural economics will also be established in each province to interact and support the applied research on different aspects of agriculture in the provincial institutes.

"NARC will provide a focal point for all the agricultural research scientists of the country to jointly discuss and plan their research activities on different commodities, and to undertake research on common problems, which can best be done at a National Centre rather than at each of the provincial institutions. In particular, research on problems requiring sophisticated equipment like electron microscopes, ultracentrifuges, and elaborate analytical and quality-testing facilities, will be undertaken at NARC. The facilities at NARC will also be available to research scientists of the provincial institutes who will work at the Centre as visiting scientists to use the specialized facilities for undertaking research on their projects, especially when such facilities are not available in their own institutions."

Keeping these principles in view, NARC should develop as a national center of excellence, providing good laboratory facilities and equipment, and competent research staff. We believe this to be consistent in principle with agreements of the government loans provided by USAID and the World Bank. We support these concepts of the roles for NARC and are confident that NARC will develop along these lines.

While it may be a participant in some of the NCPs, NARC should not assume the same kinds of responsibilities which would normally be assumed by the provincial research institutions, such as the development of finished varieties for release and the development of location-specific elements of production technology. NARC would handle those aspects of research which are beyond the capability of the individual provincial institutions, or which may be common to two or more provinces and would not need duplication or replication in each. In other words, NARC should take on a back-up role which would complement and support the provincial research programs and institutions.

The NARC component of an NCP can assure a regular interchange of information and genetic materials among the provinces, and prompt and equitable access by all provincial institutions to needed genetic

resources from the IARCs and other external sources. It can assist the coordinator, wherever he may be physically located, in placing locally (within Pakistan) developed genetic entities into international testing programs. This is being done in some of the NCPs, and places the NARC unit in its proper role.

NARC will provide specialized facilities such as computers, data storage banks, and highly specialized laboratory equipment, which would be required in the national research program but which need not be duplicated in each province. Scientists from the provinces could send material for examination and analysis or could spend limited periods in residence at NARC. With such a range of specialized equipment and research, NARC could develop as a center at which provincial scientists, and perhaps scientists from other nations, could conduct research as part of their requirements for advanced degrees, or as postdoctoral research.

While specialized units on genetic resources, library and documentation, computer services, and advanced interdisciplinary research might be developed at NARC, it is suggested that, in the interest of avoiding duplication and competition with the provinces and of cultivating complementarity, the structure of NARC might be on a functional, problem and service basis rather than on a commodity basis (as was implied in a suggested organizational chart displayed on the team's visit to NARC).

The full-time members of PARC would be the directors of the research programs, and NARC would provide primarily a service function to such programs. The director of NARC would be assisted by persons capable of managing the research station facilities at NARC (to assure the proper provision and functioning of the farm and physical plant and its services to the research programs), and others who would be responsible for such service functions as the library and documentation center, instrument repair and maintenance, and computer services. NARC would also serve as a site for workshops, conferences, and shorter-term training courses, drawing on the talents of staff located at NARC, PARC, external cooperators, and the provinces, in conducting such training functions.

PARC will need to give particular attention to its administrative structure to avoid unnecessary layers of programs and personnel at NARC. Some functions at NARC, especially those directly associated with coordinators of NCPs, are located at NARC as a matter of strategic convenience. For the NCPs, NARC is just a cooperating center, and coordinators stationed at NARC should have no greater concern for the portion of the NCP at NARC than for the work at any cooperating center. For NCPs having large amounts of work at NARC, one of the NCP staff may have to be responsible for that work so that the coordinator can give the needed attention to the other locations. As NARC research programs develop, the coordinator's attention may be pulled to NARC by its director, and to the other locations and the NCP by the responsible member of PARC. While the present delegations of authority seem adequate, PARC will need to be alert to the balance of administrative responsibility for coordinators between the appropriate member of PARC and the director of NARC. Flexibility will be needed to allow NARC to function as a central institution, and the coordinators to do their work on the national programs.

The Talent Pool

PARC has indicated that it expects to build a talent pool of up to 500 scientists of high promise who will be destined to take important positions in the national and provincial cooperative research programs. Some 173 such positions are provided for in the 1982-83 budget proposal. Some of these scientists could be initially located at NARC, and might be given inductive orientation through courses of study organized by the training center. However, the team recommends that they be assigned significant responsibilities either at NARC or in cooperating provincial institutions immediately upon induction, and that they not be held in reserve. It is suggested that recruitment to this pool be made for a limited period, for example two years, during which time arrangements could be worked out for their assignment on a more permanent basis to either central or provincial programs.

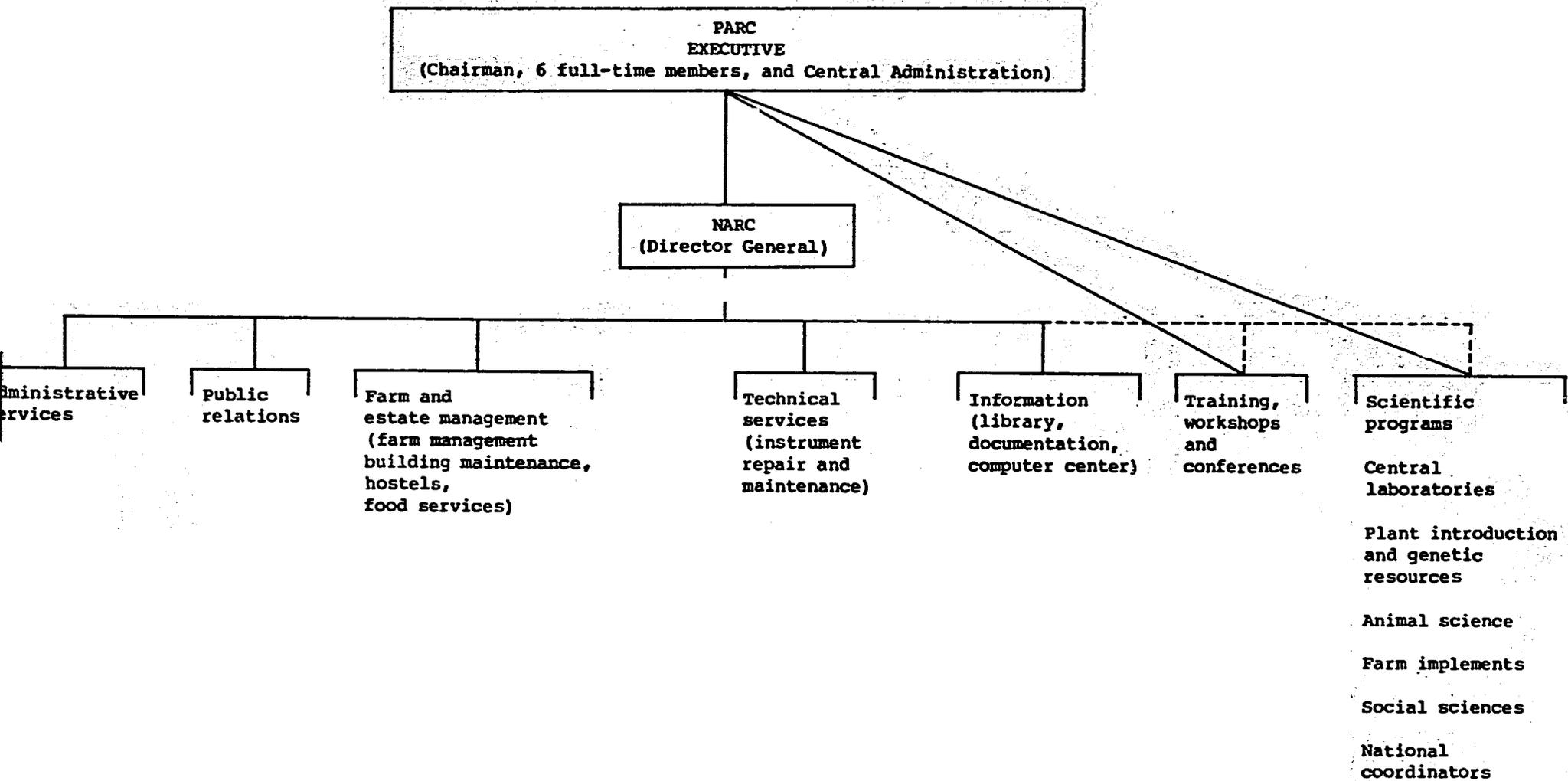
In the interest of building a good understanding and full cooperation with the provinces, PARC would be well advised to proceed with deliberation and moderation to avoid creating too large a central staff, without concurrent appropriate attention to the personnel and operational needs of the provinces. Otherwise, PARC could easily give the impression to the provinces that it is moving toward control and domination of the national agricultural research and agricultural science program, cornering the available talent and resources, and thus relegating the provinces to a subordinate role. If this impression were to develop, it would do much to undermine or destroy the basis for effective cooperation. This principle will be discussed in subsequent sections of the report. We believe it to be generally consistent with the above-quoted statement of intent for NARC.

The organizational structure of NARC might appear about as indicated in Figure 2.

A two-dimensional chart cannot adequately depict the responsibilities and various relationships which would be necessary for the effective operation of a complex organization such as NARC. Most of the units outlined on this chart are self-explanatory, but a few additional remarks may be appropriate here with respect to the director general of NARC, the farm and estate manager, and the central laboratories.

The director general of NARC would have an overall supervisory role for the center, but would not be solely responsible for the direction of the total technical program. The technical aspects of scientific programs would also be chosen and planned by the appropriate full-time PARC members. In many cases, personnel of the provinces and leaders of coordinated programs would be heavily involved in deciding on priorities, lines of work to be undertaken, and the strategy and tactics employed. Likewise, PARC members and other leading scientists would be directly involved in staff recruitment and in decisions on staff deployment. Similarly, in crop sciences, animal sciences, and social sciences research, and to a large degree in training, the overall program direction and budgetary support would be provided through the respective relevant full-time PARC members, and the role of the director of PARC would be to assure that the necessary supporting services were provided.

Figure 2. Proposed Organization Chart of National Agricultural Research Center (NARC)



Solid lines represent line and program responsibility

Dotted lines represent service and/or advisory relationship or responsibility

The director general would have direct supervision of the farm operations, public relations, the information center, and technical services (instrument repair). As indicated, he would also have a significant role, working with the full-time members, in planning and guiding the programs of the central laboratories.

The farm and estate manager, under the director general of NARC, would have responsibility for the operation of the farm and the provision of services for field experimentation for the crop scientists; the care of animals of the livestock research unit; the field facilities for the NARC components of NCPs; the maintenance, management, and care of the buildings and laboratories; and the management of the hostels and food services.

The central laboratory unit would need a range of specialized laboratory equipment, and access to computer facilities. It would be staffed with competent scientists from a range of disciplines such as genetics, cytogenetics, plant physiology, plant pathology, entomology, chemistry and biochemistry, microbiology, biometry, etc., and provided with the necessary laboratory facilities. The coordinators of the NCPs, drawing their program supervision from the respective PARC members, might also be associated with this unit and could, among other functions, help develop the NARC research program by bringing to the attention of the central labs the important problems encountered in the provinces. The major research programs of these central laboratories could be built around selected problem areas which would use interdisciplinary teams, rather than around narrowly defined scientific disciplines or commodities. The programs should be designed to provide information, materials, or techniques that facilitate solution of important problems or allow exploitation of opportunities. Environmental stress; grain quality in cereals; the components of aroma in basmati rice (their inheritance and linkages and environmental influences); the physiological nature of salt tolerance in specific crops; and biochemical bases for specific disease and insect resistance in crops, are illustrative of types of subjects which could engage their attention.

Atomic Energy Agency

This agency has nuclear institutes for agricultural biology in three provinces (Punjab, Sind, and Northwest Frontier), which are adjacent to the provincial agricultural research institutes. The nuclear institutes have been relatively well supported by the central atomic energy agency. They established a number of positions in the upper pay grades and attracted well-trained staff. They were designed for using radiation and radio-isotope techniques for inducing genetic mutation for crop improvement, for tracing various life processes, and similar applications of atomic energy.

On short visits to the institutes in Punjab and Sind, the team was impressed with the quality and sophistication of laboratory equipment and staff qualifications. Their research programs have extended beyond work with radiation and radio-isotope tracers, and some appear to duplicate much of the work of the provincial agricultural research institutes. In several programs radiation techniques were not much involved. The team was somewhat surprised that the radiation techniques used had produced

the favorable, immediate, apparently single-gene effects reported, and that apparently very superior varieties were selected so quickly. One would have anticipated considerable attention to the development and identification of gene mutations with characters which could then be used to broaden the genetic base as source material in more conventional breeding programs, rather than the immediate superior varieties exhibited. Considering the limitations imposed by the use of radiation as a research tool, it would appear that a better use of scarce resources could be achieved if the same level of resources were added to the provincial programs. With the suggested merger of research and instructional functions of the provincial research institutions and the agricultural universities (Chapter 3), the simultaneous merger of the nuclear institutes for agricultural biology with these programs would seem to be a logical way to make better use of these valuable resources.

Water and Power Development Authority

This agency is responsible for the construction and operation of irrigation systems down to the watercourse outlets serving an average of around 150 ha each. In recent years, the Water and Power Development Authority (WAPDA) has done considerable pioneering research in studying the problems of on-farm distribution and use of irrigation water in such systems. Continued studies leading to the more efficient functioning of irrigation systems deserve increased attention and support, and the close cooperation of WAPDA and the central and provincial agricultural research agencies. Research on water management aimed at increasing crop productivity and efficiency of utilization of irrigation water should be accelerated through collaboration among WAPDA, PARC, and provincial agricultural research institutions. PARC could encourage and help fund such research.

Pakistan Science Foundation

This agency supports and advises on research, principally in the basic science area, through relatively small grants to scientists and institutions. It is represented on the PARC Governing Board, but otherwise is only peripherally related to the team's terms of reference.

University Grants Commission

The University Grants Commission (UGC) assists the agricultural universities in formulating their basic budgets (salaries, communications, maintenance, capital development, etc.) which are channeled through the central government via the Ministry of Education. The funds as approved, earmarked for each university, are in turn provided by UGC directly to the university and do not go through the provincial government. In these budgets, specific amounts are not provided for research, although this element may be considered in framing the estimated requirements in the budget. UGC also has extra-fund provision to support proposals from the universities for travel grants, small grants for research projects (limit Rs.100,000), and fellowships and scholarships for M.Phils. and Ph.Ds. If these are in the field of science, they are referred to the National Science Foundation, and if in

agriculture, they are referred to PARC for comment. UGC also funds autonomous centers of excellence in selected fields in universities, primarily in fields of science (marine biology, analytical chemistry, solid state physics, physical chemistry, geology, etc.). None are in agriculture.

Central Cotton Committee

The Central Cotton Committee is supported by a cess on marketed cotton. It supports research on cotton production and genetic improvement in stations at Multan and Sakrand, and on fiber technology at a laboratory in Karachi. In addition, the committee does promotion and development work on cotton production and marketing. Punjab also has a research station devoted to cotton production and improvement at Multan, adjacent to the central station.

Since cotton is not a plantation crop in Pakistan, but is one crop in a complex farming system, research on cotton production should be integrated as needed with other agricultural research. It would thus seem advisable for the cotton committee to concentrate on promotion, marketing, and product-processing research and testing, and for responsibility for research related to cotton production (including fiber quality aspects) to be with the relevant provincial agencies. This suggests consolidating the central and provincial research institutes at Multan under Punjab responsibility, and placing the production research program at Sakrand with the Sindh authorities. PARC would then provide the same type of back-up support, coordination, and services to cotton research as it does to research on other commodities.

Provincial Institutes

All of the four provinces have agricultural research institutes which are supported and directed through the provincial ministries of agriculture. They also have a number of substations, and conduct adaptive research in farmers' fields. The team's observations indicate there is need for substantial expansion in the adaptive on-farm research under a wider variety of farm situations, improvement in the rigor and quality of such research, and particular attention to closer linkage and cooperation with the extension services.

In Punjab a few major research programs seem to have reasonable operating funds. In other provinces the provincial funds supplied in the nondevelopment budget for operations (including seasonal labor, vehicle repair, supplies, petrol, and minor equipment) are so meager as to preclude effective functioning of an active field research program. Capital items too are inadequate, in that equipment repair or replacement (especially vehicles) is seldom provided on a timely basis. An important consideration in regard to funds for operations, is that while wages in Pakistan are related to Pakistan's economy, prices of research equipment and supplies are related to the free market economies of the western nations. Under such circumstances, a research budget will need to contain about half its total resources as operating costs. Presently, few research budgets contain even 25% for operations, and in some cases

less than 10%. The provinces will need to supply reasonable operating budgets if they expect the researchers to produce technology that can be used by the farmers. Having 50% of the total budget as operations (not capital) would be a useful guideline.

Management of resources in many provincial centers could be greatly improved. Institutional (in contrast to departmental) management of many resources, especially field equipment and vehicles, would allow much greater use efficiency. Perhaps PARC could organize some short courses on various aspects of research management, including resource management.

Research personnel in provincial stations are recruited, promoted, and otherwise managed in accordance with civil service rules. While we did not go into this area in detail, few researchers will be highly productive in a system in which promotion, selection for further training, and other rewards are based mostly on seniority, and where competence and performance have little effect on a scientist's career. The perception of better opportunities for a career at PARC and other institutions not governed by ordinary civil service rules has surely been a major factor in the transfer of scientists, and adds to the tension among researchers. There can be little expectation of building a productive research capability in the provinces unless personnel management procedures provide for accurate job descriptions, appropriate experience and training qualifications, regular objective evaluation, and promotion on the basis of performance.

The reported insistence by some provinces of using only (or primarily) seniority to select trainees has caused many training opportunities offered by PARC to pass to institutions that select trainees on more relevant criteria. Training is expensive and opportunities cannot be used for persons whose past training and experience indicate they have a small chance of successfully completing and using the training. Procedures for clearing trainees in both the provinces and the center have also inhibited the use of training opportunities, especially short-term training. Prior selection and provincial clearance of a slate of candidates for specific types of training might facilitate final clearance. This could be explored jointly by the provinces and PARC.

The agricultural universities, their functions, and their places in the relationships of the provinces with the center and with PARC will be discussed in the next section.

The Agricultural Universities

There are at present three agricultural universities in Pakistan, namely:

The University of Agriculture, Faisalabad, established 1961, on separation of the Faculty of Agriculture from the Agricultural Research Institute;

The Sind Agricultural University, Tandojam, established 1977, on upgrading of the Sind Agricultural College;

The NWFP Agricultural University, Peshawar, established 1981, with the separation of the Agricultural Faculty from the University of Peshawar.

Each university is an autonomous body. The governor of the province is ex-officio chancellor. In the Punjab the Minister of Agriculture is pro-chancellor, while the ministers of education are pro-chancellors in the Sind and in the Northwest Frontier Province (NWFP). Each university is headed by a vice chancellor and has a syndicate as its governing body. The basic budget for each is provided from central government through the University Grants Commission, which in turn obtains the funds from the central government through the Ministry of Education.

The faculties of the agricultural universities constitute the largest single pool in the nation of agricultural scientific manpower with advanced academic training. In a recent unpublished report the numbers in the respective faculties are as given in Table 1.

Table 1. Staff numbers and training at Pakistan agricultural universities, 1982.

	Ph.D.	M.Sc. or equiv.	B.Sc.	D.V.M.
University of Agriculture, Faisalabad	97	211	27	15
Sind Agricultural University	20	153	1	-
NWFP Agricultural University	12	69	-	-
Totals	129	433	28	15

Other sources give only slightly different total numbers of staff members in the above categories. The Sind Agricultural University expects to more than double the number of faculty members with Ph.D. degrees within the next year or two as members now on Ph.D. programs abroad under the World Bank support project return to campus.

In 1980-81 these three institutions produced 1090 graduates with B.Sc. degrees, 510 with M.Sc. degrees, and 5 with Ph.D. degrees. The total enrollment at the university at Faisalabad is about 81 for Ph.D., 20 for M.Phil., 498 for M.Sc., and 3038 for B.Sc. degrees, totalling 4087 students. In the Sind the total enrollment is about 1800 students, including 350 M.Sc. candidates; and in the Northwest Frontier, about 600, including 120 M.Sc. candidates.

With their basic financial support derived from the central government through the Ministry of Education and the University Grants Commission, the mission of the agricultural universities is considered by many to be solely academic instruction. A few faculty members have obtained research grants from external sources (such as from US PL-480) and the postgraduate students produce theses with limited research components. However, the universities in general do not have funds or allocation of staff time for research as a recognized part of their basic mandate. They do not generally recognize, nor is their basic mandate such as to encourage recognition of, serious responsibility for agricultural improvement in their respective provinces. They therefore tend to become isolated enclaves separated from the mainstream of agricultural development. This, in turn, does not provide adequate opportunity for the contacts and involvement that would facilitate keeping up-to-date on advances in agricultural science and the corresponding regular revision and updating of syllabi and content of their teaching programs.

These universities have established a relatively large number of posts at the more advanced salary grades and have thereby attracted many well-trained and potentially productive scientists to their staffs. However, the present situation inevitably results in gross under-utilization of this large pool of talent. The central and provincial governments, along with PARC, have an opportunity and an obligation to work together to take the actions needed to use this valuable resource more effectively.

Merger of Institutions

Since NWFP has only recently established its autonomous agricultural university, and is considering ambitious and imaginative plans for expansion and development, it is in a particularly favorable strategic position to take the lead in instituting constructive reforms. The other provinces may also find it feasible and advantageous to take similar measures. We wish to put forward the following for serious study and consideration.

(1) Each province should give recognition and policy declaration that the campus of the agricultural university and its responsibility extend throughout the province, and that it has a major responsibility for the advancement of agricultural science and technology and its application to the constraints limiting production and the level of living of the rural people in the province.

(2) Research by its faculty and students should be recognized as a major part of the university's responsibility and, as well as advancing the frontiers of knowledge, should make a major contribution to agricultural development. To this end, the research function and institutions now a part of the provincial departments of agriculture should be combined with the university. The scientific staff of the provincial research units and the instructional staff of the university would be merged, and duties would be reassigned to provide time, responsibility, and supporting resources to the staff for both research and teaching. This would imply a systematic program of evaluating staff, revising grades, and selectively providing opportunities for improving the professional background and training of the staff so integrated.

The integration of these units would require very careful and thorough planning in advance of the actual institutional merger. It would not be necessary to incorporate all the employees of the separate organizations into the new merged institution, but any employees not so accommodated should be given employment at comparable levels in other branches of government service. The case of each employee should be examined and his/her place in the new organization worked out before the merger so that each person would be relieved of uncertainty and apprehension. After the merger, many of the staff would have responsibilities in two or more functions -- instruction, research, extension education -- but some would be employed for work in only one function, depending on interests, background, aptitude, and suitability for the work to be done.

If, at the same time, the nuclear institutes for agriculture and biology are integrated into this combined system (with the same careful planning), their resources and talents could be more effectively used as a component of the total integrated research effort, and the staff and facilities could provide valuable enrichment to the instructional program.

(3) While maintaining the appropriate degree of autonomy, the responsibility of the newly merged institution to government should be through agriculture units rather than education units. In the provinces this would be to the governor through the minister of agriculture. At the center, this might go through PARC. Also, to facilitate liaison with the center and among universities, PARC might have a representative on the university syndicates or boards of management.

(4) In keeping with the reconstituted institution's responsibility and concern for agriculture and agricultural development throughout the province, the provinces could assume a major role in providing the basic financial support to the agricultural universities. The current relative autonomy of the universities ought to be retained, irrespective of whether the funds for the university budgets originate from central or provincial revenues, but the channeling of funds through provincial governments would help universities develop a greater sense of responsibility to their provincial and rural constituencies.

With basic recurring budget grants for the agricultural university staffing and operations coming to the universities through the provincial government, PARC, through its education division, should be given the responsibilities now vested with UGC for development functions at the

three agricultural universities. PARC support to the provincial research functions would continue through its other units. The education member in PARC will need to explore with concerned university personnel various additional mechanisms to promote joint province-PARC funding of graduate student and staff research.

(5) The combined institution should be given further responsibility for transferring technology to extension. This function is essential to make the products of research understood and applied in farm practice, and for having information gained thereby fed back into the research programs and into the content of the instructional program. This would necessitate provision for extensive on-farm testing and evaluation as a part of the research function, and the provision of staff positions for extension subject matter specialists for assisting in the linkages at this and other points to the technology delivery system. It would not imply the new institution assuming responsibility for the entire range of services currently provided by the provincial extension services.

(6) Within the combined institution, personnel policies might be re-examined and procedures established whereby merit of performance would carry greater relative weight in selection, advancement, and promotion, and comparable career opportunities made possible on a merit basis among staff engaged in instruction, research, or extension, and combinations thereof (further developed in Chapter 4).

The establishment of agricultural research coordination boards in the four provinces gives tacit recognition of the need for better planning, coordination, and programming, and for more effective use of available talent and resources for progress in agricultural development. However, such boards represent only partial measures and cannot be fully effective in harnessing the available talent, especially that in the universities, in unified planned programs with clearly defined cohesive goals. We see no measure short of institutional and functional consolidation, coupled with enlightened personnel, funding, and management policies and procedures, which can accomplish this objective.

National Career Structure

Both provincial and central agencies need to cooperate in order to develop and maintain an effective research system. The team believes that additional attention to personnel policies and practices can make significant contributions to the achievement of this goal.

The team suggests the creation of a national agricultural science (career) service. Pakistan already has a common system of salary grades which applies to the central government services, the provincial services, the universities, and certain other autonomous and semi-autonomous bodies supported by the government. A second step would be to arrange procedures for a person to be either deputed or transferred among provinces, and from center to province and vice versa, as the needs for his services are determined and he agrees, with full retention of accrued employment benefits (such as insurance and service credit for retirement). Similar facility for transfer among institutions within the provinces should be provided. (This interchange of personnel may be dependent upon the merger of the present provincial research institutions with the universities, as proposed in Chapter 3.) Such an arrangement between PARC and the provinces would allow the scientists recruited into the PARC talent pool to find career opportunities in the provincial services, including agricultural universities.

A concurrent step would be the development of job descriptions and qualifications for each position, followed by a review of the qualifications and record of performance of each employee in each of the different organizations. Each employee could then be assigned an appropriate grade. Some of the present inequities in grades and career opportunities between organizations retard full cooperation. For example, the provincial agricultural research and extension organizations presently have relatively fewer posts at the higher grade levels than do PARC, the agricultural universities, and the nuclear institutes, and thus the career opportunities of staff employed therein are more limited. Such limited career opportunities lessen the ability of the provincial organizations to recruit and retain sufficient staff of the quality needed.

A system of evaluation, advancement, and promotion on merit, with decreased emphasis on seniority, could be devised. Performance records should be maintained for each employee, and a review of performance and accomplishment could be instituted for each employee at regular intervals. Appropriate standards of accomplishment could be established for movement beyond an established level within grade or promotion to higher grades. Relevant measures of assessing accomplishment in different types of work (research, instruction, extension, management) would have to be established. Among the elements to be reviewed and evaluated would be overall performance in accomplishment of the tasks set

forth in the job description, thoroughness, leadership, attitudes toward work, effectiveness in human relationships, publication in recognized journals (with an assessment of originality and quality); and nonpublished work in terms of usefulness, quality, and quantity.

The above would be based on the premise that an employee could be advanced within grade and promoted to higher grades within his established post or line of work on the basis of accomplishment and performance, without having to wait for new openings in posts at higher grades, although he need not be denied this opportunity also.

Procedures for recruitment would need careful consideration and would probably require participation of persons from both the center and the provinces on selection boards. Transfers would also require joint agreement by the employee and the two employing agencies.

Special awards and other recognitions for exceptionally meritorious performance and accomplishment can encourage people to excel, if awarded fairly.

A more systematic staff improvement program reaching to all professional levels, scientific disciplines, and types of service is needed. This could include a staff college for training and orientation of new recruits, and refresher courses for those at intermediate career levels. Management training as well as scientific subjects could be included. The training center at NARC may be an appropriate venue.

Scholarships and fellowships for advanced academic degree programs form an important personnel management tool, and personnel from all institutions, central and provincial, should have equal opportunity to be considered for such awards.

Professional meetings and societies in which scientists in similar disciplines can present research papers and hold forums on topics of common interest promote excellence in research. Only a portion of this need would be accomplished through conferences and workshops within the NCPs. The universities and PARC could cooperate to foster scientific communication.

The above suggestions are not exhaustive but are put forward to help create and develop a climate that facilitates center/provincial and inter-institutional cooperation and collaboration.

National Coordinated Programs, Conceptual

One of the functions of PARC is to undertake, aid, promote, and coordinate agricultural research and to arrange the expeditious utilization of the results. Coordination, promotion, and monitoring of ongoing research in Pakistan, where agriculture is a provincial responsibility and where most of the scientific manpower and research institutions are provincial, is an important national responsibility. PARC is guiding, financing, and conducting a number of national coordinated research programs (NCPs) on selected commodities or problems of national importance which are limiting crop production, animal production, or rational utilization of natural resources. In most NCPs the national leader, a project coordinator, is located at NARC (except for livestock projects).

The team examined three such NCPs (wheat, rice, and oilseeds) in order to understand the weaknesses and strengths of the conceptual model as applied in Pakistan. From discussions with PARC scientists and coordinators, and the principal investigators of the projects in the provinces and other senior officers, the team feels that the concepts and processes of NCPs are not sufficiently understood by some of the involved scientists. This is affecting both progress of important research and center/province relations.

The team restricted most of its discussions to the three NCPs mentioned above and will refer to this analysis later. A discussion of the concept of NCPs as understood in other developing countries where satisfactory results have been achieved using the NCP approach may form a base for common understanding of NCPs.

Concepts

National coordinated research programs became popular in some of the developing countries that were struggling to obtain a breakthrough in stagnant agriculture and to overcome staggering food shortages through development and use of technology to increase agricultural productivity. The concept aims at using available scarce resources -- finances and technical manpower -- to develop viable improved technologies in an area of national concern by using interdisciplinary teams of scientists located in different agroclimatic and soil conditions. An NCP is thus a high-priority program to pool the scarce resources of scientific manpower, facilities, and financial inputs to produce and diffuse improved technology (suited to local environments) that will cause a marked increase in productivity. In many cases the new technology is expected to allow producers to move from totally subsistence agriculture to partially market-oriented agriculture.

In an NCP, critical masses of interdisciplinary teams are developed in locations representing significant ecological regions for the NCP subject.

The success of an NCP depends on a number of factors, including the following:

- * The subject of the NCP (problem, resource, or commodity) should be of sufficiently high national priority to justify use of scarce resources for achieving a breakthrough in productivity, production, or utilization efficiency.
- * The results of research should benefit large groups of people and be applicable over large areas, and should have potential for substantially improving food production or the general productivity of agriculture, thus fulfilling national aspirations.
- * The NCP uses an interdisciplinary team approach in which a few such teams working under different environments are trying to reach the same goal. The success of such an effort depends on the strength of all members of the team who, though trained in different disciplines, work together as partners in a joint program. Unless all the components of the team are strong the objectives of the coordinated research are not achieved.
- * An NCP should be sharply focused on one or two related commodities or subjects, and on a few well-defined, quantified, achievable objectives.
- * In an NCP the research strategy and program is jointly planned by the cooperating teams of scientists. The NCP is a timebound program in which the cooperators accept joint responsibility to achieve common objectives, use common methodologies, and fully share their resources, products, experiences, and knowledge.

Criteria for Use

The NCP is only one of several alternatives for managing research programs. It is a powerful, but complex management tool, and not every researchable problem or topic is appropriate for an NCP approach. For example, an indepth study requiring specialized skills and knowledge in a particular discipline, and individual planning and thinking, can be handled through alternative management mechanisms. Generally, basic research is not well suited to an NCP. Also, an investigation that can be logically confined to one center, or a particular local environment, with or without involvement of an interdisciplinary team, is not suited for an NCP approach. Further, availability of resources must be considered. NCPs attract attention, and a few well-funded and productive NCPs will do much more to advance agriculture, and the research system, than will several that are inadequately funded and/or of low productivity.

The Research Network

In planning an NCP it is first essential to identify the important agroclimatic areas in which the commodity is produced or in which the resource or problem is important, and the major constraints to production or resource use in each area. This information is the basis for selecting the centers for research and the major elements of the research

program. The NCP may have a number of main and subcenters representing major agroclimatic regions. Main centers have fairly similar teams of scientists and sufficient financial resources to implement similar comprehensive, multidisciplinary research programs. In crop NCPs the teams often consist of breeders, pathologists, entomologists, and agronomists/soil scientists with appropriate support staff and financial resources. In many cases physiologists, economists, and technologists are also necessary, at least at a few selected centers. In NCPs on soil and water, the teams may consist of soil scientists, agronomists, agricultural engineers, and economists, depending upon the nature of the problem. In animal research projects, management specialists, breeders, physiologists, nutritionists, economists, and sociologists may be needed as members of teams. In all cases the composition of the team is a response to the disciplinary talents needed to solve the priority problems or exploit opportunities. To get the best out of the team it is desirable that all members be well-trained scientists of about the same status and caliber. One of the team members assumes the role of the team leader for coordinating the activities of research and management of resources at a station.

In the selection of main centers and subcenters, the major consideration is whether or not they represent the broad agroclimatic and soil environments. If the centers are carefully selected using strict criteria for such representativeness, a few centers can meet the requirements of research for the country. The on-station findings, however, need to be widely tested under farm conditions, and any limitations found under such circumstances must be fed back into the research program.

The subcenters generally represent more localized environments or special problems of disease, pest, moisture, or nutrient stress. They are generally not provided with a full team, but only those scientists needed to evaluate the material or the potential technology under that specific environment.

To attract a team of competent scientists, consideration should be given to centers where reasonable amenities of life are available. Preference should also be given to availability of good field, laboratory, and library facilities. An agreement should be made with the cooperating institutions for the provision of basic facilities and amenities for the staff.

Objectives

The NCP should have practical goals and well-defined, quantified objectives to be achieved in the short to medium term. These should be defined by the best national team of scientists (of different disciplines) and nonscientists having a thorough knowledge of the problems, constraints, available technology, and research needs. A careful review of all ongoing research, and identification of priorities is a necessary part of NCP planning. Involvement of the best talent available and all the cooperators of the program is essential for developing a sound and accepted research strategy. Objectives should be focused, specific, and achievable with available resources.

The objectives, methodologies, resource requirements, work plans, and priorities should be clearly stated each year for each NCP. Then, in case of serious financial constraint or similar unforeseen circumstance, it should be possible to identify the components on which work has to be postponed or deleted. NCPs should be evaluated in terms of progress in relation to fulfillment of these specific objectives.

The Coordinator

The success of the NCP is highly dependent on the coordinator's qualities of leadership, service, attitude, cooperation, and dedication to national cause.

The main functions of the coordinator are:

- * To provide guidance and support to NCP work at different centers and to facilitate the exchange of materials and information among scientists and centers;
- * To serve as liaison between international agricultural research and national and local research organizations for exchange of materials and information;
- * To develop collaboration in collectively evaluating national, regional, and international nurseries;
- * To coordinate testing and evaluation of promising material at early and final stages of development at the national level;
- * To facilitate prompt collection, compilation, interpretation and use of results;
- * To arrange annual workshops and other forums for discussing results, planning the annual program, and identifying practical results ready for on-farm testing and transfer of technology.

To discharge these responsibilities the coordinator needs to travel extensively, making periodic visits to cooperating research stations and farmers' fields, to discuss problems and prospects of the emerging technology with the entire NCP research team. The coordinator needs mobility and office support to discharge his responsibilities efficiently. He should be directly linked with the head of the concerned activity in the national agricultural research system, which in PARC would be the appropriate PARC member.

The coordinator should foster teamwork in which all members should be considered equal partners. He should give rather than take credit, and encourage the cooperating units to produce the best results. He must be able to earn rather than command the respect of coworkers.

The coordinator could be located in either a provincial or a federal research station, after careful consideration of the advantages and disadvantages in each situation. It should be ensured that he has

national perspective and commitment, and is not restrained by local bureaucratic procedures. There could be a main or subcenter attached to his office, but this should be a self-contained unit so that the coordinator can give attention to the problems of all centers.

The coordinator's position should not be restricted to any particular discipline. Any team member could be selected as coordinator, provided he is best suited for the leadership role.

While he should be acquainted with all the work in the NCP, the coordinator should identify a team of scientists representing the various disciplines who can guide both him and cooperating scientists in other locations. These scientists should be chosen on the basis of their demonstrated professional competence and contribution in the subjects. They need not be transferred from their present institutions, but they should be encouraged to accept the additional responsibility of providing guidance to researchers working at different centers, and they have to have funds for travel and related expenses in this shared leadership role.

Financing

The NCP should be jointly financed by the center and the provincial agencies, and the cooperating agencies should agree to provide specific infrastructure and facilities at each location. The NCPs should be expected to have substantial operational budgets (non-salary costs and contingencies), and qualified staff to do extensive on-farm testing. (NCPs in some provinces suffer in the same way as other research programs because they have major budget allocation under salaries and allowances, and only small percentages for operations. This results in poor utilization of manpower and defeats the purpose of the NCP). Experience in other developing countries indicates that in an economy similar to Pakistan's, about 40% to 50% of funds in an NCP should be available for operational expenses. Within accepted government norms there should be flexibility in transfer of funds among budget heads to meet the needs of each center.

The approved budget for the defined research program should be made available to each unit on schedule. It is better for an NCP to function on a lower, assured budget than on a higher, unassured budget. Instability, shortfall, and late release of funds leads to poor achievements in research and affects the morale of scientists. If NCPs are restricted to high priority programs, they should be given special consideration even under tight budgetary conditions.

Linkages

A major strength of the coordinated programs is their linking provincial, federal, and international centers of agricultural research and their ability to exchange and transfer materials, methodologies, results, and technologies. Aggressive and competent NCPs make full use of the promising material and suitable methodologies being generated by the international agricultural research centers (IARCs). They are able to critically evaluate, test, and use the products of research from both external and internal sources, and feed their requirements back into the

IARC. NCPs should be strongly linked to all relevant and supporting national units, such as genetic resource units or speciality laboratories. They should also be linked to the growing resource of various international programs in addition to the IARCs. The coordinator has responsibility for facilitating these linkages and will need resources (including short-term training opportunities) to do it.

Since the research under the NCP is done at the centers located in provinces and central institutes, all the participants of the program should have easy access to all the centers. Training seminars should be organized regularly to enable all participating scientists to visit different centers and laboratories and benefit from each other's experience. When accepting the unit of the NCP, the provinces should accept this concept of freedom of operation, movement, and exchange of material and information, which is the key to success.

In case the NCP identifies certain problems for which it needs the help of specialized laboratories or individual scientists working outside the framework of the coordinated program, it may be preferable to contract for such research. The scientists responsible for these complementary projects should be considered cooperators and invited to the main workshop of the NCP for exchange of information.

Products and Their Use

The NCPs represent a national cooperative effort by all the members of the team to generate technology to accelerate production or increase productivity. Generally, products of NCP research are cultivars and technologies which are scale-neutral and applicable to different environmental conditions. They improve the efficiency of inputs in agricultural production, and bring higher net returns to the farmers. The success of NCPs should be judged from the viable technology produced to further the national goals of agricultural development. The technologies developed by NCPs should be subjected to thorough on-farm testing and evaluation under farmers' conditions to assess their transferability, potential, and limitations. For this, research workers have to work closely with extension personnel, and both researchers and extension staff must be involved in the extensive on-farm tests. These tests also form the first line of demonstration, and facilitate the training of extension workers in the new technology.

The Wheat, Rice, and Oilseeds Programs

To understand how Pakistan's NCPs are working, the team examined the wheat, rice, and oilseeds programs in some detail. The team's understanding of even these three NCPs is incomplete, but the following discussion attempts to describe their major elements and relate them to a conceptual model of an NCP.

Pakistan is exporting substantial amounts of rice, has recently attained self-sufficiency in wheat, and is faced with the problem of an acute shortage of vegetable oils. Wheat production has increased from 6.5 million tons in 1969 to 1971, to 11.3 million tons in 1981. From a net import position it has now attained self-sufficiency but, keeping in mind the vulnerability of wheat production to diseases and the rapidly growing population, Pakistan recognizes that it will require a vigorous national research program to keep abreast of its future wheat technology requirements.

Rice production has increased from 3.4 million tons (paddy) in 1969 to 1971 to 5.1 million tons in 1981. Approximately 0.9 million tons of milled rice (about 30% basmati type and 70% nonscented coarse rice) are exported annually, producing a substantial amount of foreign exchange earnings. Research is necessary to assure maintenance of quality and increase production efficiency and exports.

Vegetable oils for human consumption are in serious deficit and Pakistan imports about two-thirds of its domestic requirements. The amount imported is increasing rapidly, causing serious drains on scarce foreign exchange resources. (The current annual vegetable oil import bill is about \$270 million.) All three commodities are of great national importance, are produced under a range of agroclimatic conditions, and require a multidisciplinary research approach; thus they seem appropriate subjects for NCPs.

Locations, Objectives, and Resources

Wheat

Wheat is grown extensively in all four provinces. Most wheat acreage is under irrigation, but substantial amounts are grown under barani (rainfed) conditions in the Punjab and Northwest Frontier. Most wheat is grown in the plains, but significant amounts are produced at higher altitudes in the Northwest Frontier and Baluchistan. Most are "spring" wheats, but "winter" (vernalization-requiring) wheats are useful in some high-altitude areas of Baluchistan.

The wheat NCP (with minor exploratory work on barley and triticale) includes research at the following locations:

- * Coordinating Center, National Agricultural Research Center, Islamabad
- * Ayub Agricultural Research Institute, Faisalabad, Punjab
- * Agricultural Research Institute, Tandojam, Sind
- * Cereal Crops Research Institute, Pirsabak, NWFP
- * Agricultural Research Institute, Sariab, Quetta, Baluchistan
- * Cereal Diseases Research Institute, NARC, Islamabad and Murree
- * University of Agriculture, Faisalabad
- * Nuclear Institute for Agriculture and Biology, Faisalabad
- * Summer Wheat Nursery, Kaghan, NWFP.

The objectives of the NCP for wheat, as stated in the coordinator's informal note are:

- * Multidisciplinary approach, involving all the wheat research institutions in the country.
- * Screening, evaluation, and utilization of germplasm/international nurseries for development of new wheat varieties (broadening base of genetic resources for wheat improvement to all cooperators and agencies concerned).
- * Development of varieties for environmental stress.
- * Field testing for drought, salt, heat, and cold tolerance; screening for reaction to insect pests and diseases.
- * Uniform variety testing (evolution of range of adaptability of materials across various agroecological zones).
- * Development and field testing of production technology for various agroclimatic regions.
- * Introduction/development of appropriate wheat machinery, i.e., seeders, drills, reapers, threshers, etc.
- * Training and education of extension staff and farmers.
- * Dissemination of research information.

The coordinator provided by PARC is located at NARC. The team was advised that serious consideration was given to locating the coordinating center in one of the provincial institutions, but research programs and personnel relationships were so strongly established that it appeared difficult to maintain a balanced national perspective under such circumstances. The team was informed that the wheat coordinating unit performs service functions. It does not develop finished varieties, nor does it enter its own materials in the uniform variety tests as potential candidates for release.

PARC's role as coordinating agency (from coordinator's statement) is to:

- * Provide effective linkage between national and international wheat institutes.
- * Provide broader base of germplasm source for wheat scientists.
- * Organize on-site and traveling seminars/meetings/workshops to observe and review results and progress, and to formulate research programs, joint and cooperative activities, and tests.
- * Provide funds, literature, laboratory and field equipment, and technical and support staff as required.
- * Arrange for short- and long-term academic and practical training of wheat scientists within the country and abroad.

The research personnel currently available for the wheat NCP are shown in Table 2, and the funds provided by PARC are shown in Table 3.

Table 2. Locations, staff categories, and numbers of wheat research personnel (1982).

Province	Institute	Staff Categories	Numbers		
			Province	PARC	Total
Punjab	AARI, Faisalabad	Director Ph.D. (Gr.19)	1	-	1
		Cereal Botanist, M.Sc. (Gr.18)	1	-	1
		*Wheat Botanist (Gr.18)	-	1	1
		*Agronomist (Gr.18)	-	1	1
		Pathologist (Gr.18)	-	1	1
		Cereal Technologist (Gr.18)	1	-	1
		Asst. Botanist (Gr.17)	6	1	7
		Asst. Technologist (Gr.17)	1	1	2
		Asst. Research Officers (Gr.17)	<u>16</u>	<u>4</u>	<u>20</u>
		Total	<u>26</u>	<u>9</u>	<u>35</u>
Balochistan	ARI, Sariab	Wheat Botanist (Gr.18)	1	1	2
		Asst. Scientist (Gr.17)	<u>6</u>	<u>4</u>	<u>10</u>
		Total	<u>7</u>	<u>5</u>	<u>12</u>
NWFP	ARI, Pirsabak	Agronomist (Gr.18)	-	1	-
		Pathologist (Gr.18)	-	1	-
		Cereal Technologist (Gr.18)	-	1	-
		Asst. Botanist (Gr.17)	-	1	-
		*Asst. Research Officer (Gr.17)	-	<u>3</u>	-
		Total	n.a.	<u>7</u>	n.a.
Sind	ARI, Tandojam	Wheat Botanist (Gr.18)	-	1	-
		*Agronomist (Gr.18)	-	1	-
		Pathologist (Gr.18)	-	1	-
		Asst. Botanist (Gr.17)	-	2	-
		Asst. Physiologist (Gr.17)	-	1	-
		Asst. Soil Chemist (Gr.17)	-	1	-
		*Asst. Research Officer (Gr.17)	-	<u>3</u>	-
		Total	n.a.	<u>10</u>	n.a.
PARC	NARC, Islamabad	Coordinator (Gr.19)	-	1	1
		Agronomist (Gr.18)	-	1	1
		Economist (Gr.18)	-	1	1
		Asst. Agronomist (Gr.17)	-	1	1
		Asst. Breeders (Gr.17)	-	<u>2</u>	<u>2</u>
		Total	n.a.	<u>6</u>	<u>6</u>
CDRI, Murree	CDRI, Murree	Plant Pathologists	-	2	2

Table 3. Funds provided by PARC for the wheat NCP (Rs 000).

YEAR	INSTITUTION PARC/NARC	AARI	A.R.I.	A.R.I.	CCRI	CDRI	SWN (PARC)	Univ. of Agr.	NIAB
		FAISALABAD	TANDOJAH	QUETTA	PIRSABAK	(PPR)	KAGHAN	FAISALABAD	FAISALABAD
1979-80	170	204	223	175	350	-	-	-	-
1980-81	259	56	120	109	128	-	112	12	10
1981-82	1,047	271	314	300	254	-	331	50	50
1982-83*	910	270	270	290	270	764	290	50	50
	(379)	(89)	(43)	(80)	(126)	-	-	-	-
1983-84	1,450	510	480	450	450	-	510	80	80
(Proposed)									

* Budgeted; figure in parenthesis is amount released in the first four months of the year.

In addition to the work at the main centers, the wheat NCP reportedly has a network of tests in different agroclimatic zones, reflecting the range of specific problems and opportunities for improvement in each zone. Each year the wheat breeders and some of the scientists from other disciplines tour the main research locations in a group to gain first-hand knowledge of the total program of work. This is followed by a workshop wherein the cooperating scientists present and discuss their research findings and plan the program for the next season.

The summer wheat nursery at Kaghan facilitates the production of a second generation of breeding material each year. The Cereal Disease Research Institute (CDRI) screens material for resistance to specific rust diseases, and maintains trap nurseries at various locations to monitor rust populations. Both these facilities serve national needs and are financed and managed by PARC.

Rice

Rice is produced primarily in the Punjab and Sind, with some in NWFP and Baluchistan. Punjab produces essentially all the basmati, but also produces substantial amounts of nonscented types. Sind produces mostly the coarse, medium-grain rice (mostly IR6), much of which is exported. The small rice-growing area of Baluchistan is contiguous with and similar to that of northern Sind. NWFP has a significant area of rice grown at a somewhat higher altitude, where much of the early season water comes from snow melt. Varieties for that area require cold water tolerance. NARC, near Islamabad, is not near a rice-producing area.

In the rice NCP there are four main stations, Kala Shah Kaku, Dokri, Mingora, and NARC. In addition there are other centers in Faisalabad (at the Nuclear Institute for Agriculture and Biology and the university.)

The stated objectives at each center are as follows:

1. NARC and outreach program, PARC.
 - * Collection, evaluation, and characterization of rice germplasm.
 - * Evaluation/screening for rice germplasm under saline/sodic conditions.
 - * Tissue culture studies for salt tolerance.
 - * Studies on hybrid rice production.
 - * Studies on genetic resistance against white-backed planthopper (WBPH).
 - * Assessment of post-harvest losses at farm level.
 - * Pilot production or maximization program.
2. Rice Research Institute, Kala Shah Kaku, Punjab.
 - * Breeding for dwarf and early-maturing basmati varieties.
 - * Evaluation of resistant material for zinc deficiency.
 - * Screening rice germplasm against blast and WBPH.
 - * Studies on rice-based cropping system.
 - * Assessment of post-harvest losses at farm level.
 - * Testing of agricultural machinery.
3. Rice Research Institute, Dokri, Sind.
 - * Development of high-yielding, early-maturing, long- and medium-grain varieties.

- * Developing varieties resistant to rice stem borer, white-backed planthopper, and mealy bug.
 - * Developing varieties resistant to kernel smut disease.
 - * Developing varieties with low fertilizer requirement with high economic return.
 - * Developing varieties resistant to high temperature.
 - * Development of varieties for dual purpose (i.e., for fodder and grain).
 - * Constraint research.
 - * Testing of appropriate agricultural machinery.
 - * Assessment of post-harvest losses.
4. Agricultural Research Institute (North), Mingora, Swat, NWFP.
 - * To evolve high-yielding, short-statured, early-maturing, cold-tolerant, long- and medium-long rice for Northern areas.
 5. Nuclear Institute for Agriculture and Biology, Faisalabad, Punjab.
 - * Incorporation of earliness and short-stature in basmati varieties through induced mutation.
 6. University of Agriculture, Faisalabad, Punjab.
 - * To evaluate efficiency of N and P fertilizer as influenced by organic manuring.
 - * To evaluate extent of nitrogen substitution by green manuring.

The personnel available for rice research at each major location are indicated in Table 4, and the funds provided by PARC are shown in Table 5.

Table 4. Locations, staff categories, and numbers of rice research personnel (1982).

Province	Institute	Staff Categories	Numbers		
			Province	PARC	Total
Punjab	RRI, Kala Shah Kaku	Director Ph.D. (Gr. 19)	1	-	1
		Rice Botanist M.Sc. (Gr. 18)	1	-	1
		Asst. Cereal Botanist Ph.D. (Gr. 18)	1	-	1
		Entomologist (vacant) (Gr. 18)	1	-	1
		Pathologist (vacant) (Gr. 18)	1	-	1
		Asst. Scientist (Gr. 17) and Asst. Res. Officers (Gr. 17)	28	-	28
		Technologist (Gr. 18)	-	1	1
		Asst. Agronomist (Gr. 17)	-	1	1
		Asst. Chemist (Gr. 17)	-	1	1
		Asst. Engineer (Gr. 17)	-	1	1
		Total	33	4	37
Sind	RRI, Dokri	Director Ph.D. (Gr. 19)	1	-	1
		Rice Botanist M.Sc. (Gr. 18)	1	-	1
		Asst. Rice Botanist M.Sc. (Gr. 18)	1	-	1
		Plant Pathologist (Gr. 18)	1	-	1
		Entomologist (Gr. 18)	1	-	1
		Soil Scientist (Gr. 18)	1	-	1
		Agr. Engineer (Gr. 18)	1	-	1
		Agronomist (Gr. 18)	1	1	2
		Statistician (Gr. 18)	1	-	1
		Physiologist (Gr. 18)	1	-	1
		Economist (Gr. 18)	1	-	1
		Technologist (Gr. 18)	1	-	1
		Communications Specialist (Gr. 18)	1	-	1
		Asst. Botanist (Gr. 17)	1	-	1
		Asst. Engineer (Gr. 17)	-	1	1
		Asst. Entomologist (Gr. 17)	1	-	1
		Asst. Pathologist (Gr. 17)	1	-	1
		Asst. Agronomist (Gr. 17)	1	-	1
		Asst. Chemist (Gr. 17)	1	-	1
		Asst. Meteorologist (Gr. 17)	1	-	1
Asst. Economist (Gr. 17)	-	1	1		
Planning Officer (Gr. 17)	1	-	1		
Asst. Technologist (Gr. 17)	-	1	1		
Research Assistant (Gr. 17)	15	-	15		
Total	35	4	39		
NWFP	R.R. Center, Mingora	Rice Botanist (Gr. 18)	n.a	1	n.a
		Asst. Res. Officers (Gr. 17)	n.a	1	n.a
		Total	n.a	2	n.a
Baluchistan	USTA Mohd. Rice Center	Asst. Agronomist	-	1	1
PARC	NARC, Islamabad	Coordinator (Gr. 19)	-	1	1
		Agronomist (Gr. 18)	-	11	11
		Res. Officers (Gr. 18)	-	2	2
		Total	-	14*	14

*Eight of the 14 work in the rice maximization program, half in Dokri and half in Kala Shah Kaku.

Table 5. Funds provided by PARC for the rice NCP (Rs 000).

Province	Punjab	Sind	NWFP	Baluchistan	Azad Kashmir	NARC
Year						
1979-80	92	69	-	131	-	
1980-81	80	48	-	120	44	
1981-82	411	294	22	179	-	
1982-83*	384 (81)	250 (10)	200 (45)	50 (10)	- -	1310 (133)

*Budgeted; figure in parenthesis is amount released during first four months of the year.

Under the pilot production or maximization program, the rice coordinator, located at NARC, has responsibility for demonstrating rice technology in compact areas of about 5000 ha in Punjab and Sind. The staff for the maximization program works directly under the guidance of the coordinator. These projects seek to make both recommended technology and all inputs available to the cooperating farmers. The combined effect of better technology and availability of inputs has reportedly increased yields by 60% to 70% in the pilot areas.

Oilseeds

There are several oilseed crops grown in the country and included in this NCP -- rape, mustard, groundnuts, sunflowers, safflower, soybeans, and sesamum. Each species has its particular characteristics, varieties, production practices, area of adaptation, season of growth, and place in various cropping systems. The oilseeds NCP started more than five years ago with a center in each province and one at NARC, and included work on all the above crops. (A technical report for 1977 to 1981 is available.) Until 1981, linseed and castor were included in the NCP. They have been dropped from the NCP but some provinces are doing research on them. Research on rape and mustard is done in all provinces. Most of the groundnut work is done at NARC, perhaps because nearly 90% of the groundnuts are produced in the adjacent Rawalpindi division of Punjab. NWFP has considerable interest in groundnuts as a potential crop in the Swat valley. Sunflowers, safflower, and soybeans are receiving minor research attention in specific centers, and NARC distributes national and international nurseries of these crops.

The research objectives of the oilseeds NCP are stated as:

- * Introduction and development of improved varieties of established oilseed crops and introduction and evaluation of new crops in potential areas.
- * Production and distribution of good seed of improved varieties and maintenance of its purity.
- * Improvement of production practices for traditional crops to increase per-acre yield.
- * Development of production practices for nontraditional oilseed crops to enable formulation of a package of technology adapted to different ecological zones in the country.
- * On-farm testing of improved varieties and production technology to demonstrate full potential of oilseed crops.
- * Transfer of improved technology on a wider scale through extensive production-approach and maximization projects.
- * Improvement of technical manpower and research facilities in various disciplines of oilseed crops.

- * Improvement of oil and meal extraction and processing techniques.
- * Better integration of research, extension, and operations of oilseed processing.
- * Exploration of new oilseed crops.

The personnel available in the oilseeds NCP are indicated in Table 6, and the funds provided by PARC are shown in Table 7.

Table 6. Locations, staff categories, and numbers of oilseeds research personnel (1982).

Province	Institute	Staff Categories	Numbers		
			Province	PARC	Total
Punjab	AARI, Faisalabad	Director Ph.D. (Gr. 19)	1	-	1
		Oilseed Botanist M.Sc. (Gr. 18)	1	-	1
		Sunflower Botanist M.Sc. (Gr. 18)	1	-	1
		Soybean Botanist M.Sc. (Gr. 18)	1	-	1
		Rapeseed Botanist M.Sc. (Gr. 18)	1	-	1
		Groundnut Botanist M.Sc. (Gr. 18)	1	-	1
		Pathologist M.Sc. (Gr. 18)	-	1	1
		Asst. Oilseeds Botanist (Gr. 17)	1	-	1
		Asst. Sunflower Botanist (Gr. 17)	1	-	1
		Asst. Rapeseed Botanist (Gr. 17)	1	-	1
		Asst. Agronomist (Gr. 17)	-	1	1
		Asst. Pathologist (Gr. 17)	2	-	2
		Asst. Entomologist (Gr. 17)	1	-	1
		Asst. Res. Officers (Gr. 17)	<u>14</u>	<u>2</u>	<u>16</u>
Total	<u>26</u>	<u>4</u>	<u>30</u>		
Sind	ARI, Tandojam	Botanist Ph.D. (Gr. 18)	1	-	1
		Asst. Botanist (Gr. 17)	-	1	1
		Asst. Agronomist (Gr. 17)	-	1	1
		Asst. Res. Officers (Gr. 17)	-	<u>1</u>	<u>1</u>
		Total	<u>1</u>	<u>3</u>	<u>4</u>
NWFP	D.I., Khan	Botanist M.Sc. (Gr. 18)	-	1	1
		Asst. Res. Officers M.Sc. (Gr. 17)	-	<u>4</u>	<u>4</u>
		Total	-	<u>5</u>	<u>5</u>
Baluchistan	Sariab	Botanist (Gr. 18)	1	-	1
		Asst. Botanist (Gr. 17)	1	1	2
		Asst. Res. Officers (Gr. 17)	<u>2</u>	<u>1</u>	<u>3</u>
		Total	<u>4</u>	<u>2</u>	<u>6</u>
PARC	NARC, Islamabad	Coordinator (Gr. 19)	-	1	1
		Oilseed Botanist (Gr. 18)	-	1	1
		Agronomist (Gr. 18)	-	1	1
		Breeder Rapeseed (Gr. 18)	-	1	1
		Breeder Mustard (Gr. 18)	-	1	1
		Economists (Gr. 18)	-	1	1
		Technologist (Gr. 18)	-	1	1
		Res. Officers (Gr. 18)	-	2	2
		Agronomy Biologist (Gr. 17)	-	1	1
		Entomologist (Gr. 17)	-	3	3
		Pathologist (Gr. 17)	-	1	1
		Plant Protectors (Gr. 17)	-	<u>1</u>	<u>1</u>
Total	-	<u>15</u>	<u>15</u>		

Table 7. Funds provided by PARC for the Oilseeds NCP (Rs 000).

Institution Year	Punjab	Sind	NWFP	Baluchistan	Azad Kashmir	NARC
1979-80	206	54	284	41	-	524
1980-81	55	29	139	28	38	530
1981-82	191	173	277	110	-	937
1982-83*	xxx (28)	xxx (32)	xxx (59)	xxx (36)	xxx -	xxx (286)

*Amounts supplied during first four months of year are in parentheses.

The team did not find out the amounts of funds provided by each province for the oilseeds NCP but we assume that, as in other research programs, most of the provincial funds are used for staff salaries and allowances, and funds for operating costs form a small (10% to 15%) part of the total. (AARI at Faisalabad is a noteworthy and laudable exception to this general condition in very recent years.)

As for rice, the oilseeds coordinator is planning a maximization project. A barani (rainfed) research and development project will also place some emphasis on oilseeds.

Suggestions on National Coordinated Programs

The NCPs provide a very important vehicle for cultivating a partnership between PARC and the provinces in their joint efforts to address some of the agricultural production problems of national importance. The provincial components wish to be assured of recognition by PARC of their key importance in this joint effort. They need assurance and confidence that the development of PARC and NARC will reinforce and strengthen the provincial components of the program.

In addition to direct supplemental financial support for staff and operating expenses, the provincial institutes welcome support from PARC on supply of specialized equipment, vehicles, and supplies which have to be purchased abroad; both short- and long-term training opportunities for improving staff competence; inter-provincial and national workshops and conferences; and instrument repair and maintenance, and similar services. Much of this help is being supplied by PARC or is planned. All scientists concerned would like procedures for clearance for training, both at provincial and central levels, streamlined and simplified and the lead time shortened. Scientists in the provincial institutions seek reasonable assurance of stability in the amount and kinds of support they can expect from PARC, and regular and timely release of approved funds.

Zones, Problems, and Locations

The useful first step in developing an NCP on a commodity is the careful, collective description of the agroclimatic zones where the commodity is important, and the problems or opportunities for improvement in each zone. This appears to have been done for wheat, and partially done for rice, but apparently must still be accomplished for oilseeds. A reconsideration of the descriptions of these zones, problems, and opportunities is needed every few years, since opportunities and problems change. For example, the potential availability of new wheats to better use available early-season moisture in the barani area, or the development of a new marketing opportunity, may indicate revisions of a research program.

Wheat

In addition to the coordinating center, major units of the wheat NCP are included in each province. All are involved in selection, variety evaluation for agronomic and yield characteristics, disease reaction and resistance, grain characteristics and quality, and adaptation for the various agroecological situations. In these centers, the program should be a joint center/provincial effort with contributions of staff and operational funds provided by each. For this part of the program, it

would appear that the major portion of PARC resources should go to the provinces, with a relatively smaller portion reserved for the coordinating center's functions. PARC allocations to provinces should complement the available provincial resources, and would not necessarily be equal in amount among provinces.

All provinces would need (from combined PARC and provincial support) interdisciplinary teams of senior scientists for the work at the main center; supervision of work in subcenters in major agroecological zones in the province; and evaluation, verification, and on-farm adaptation tests. For this work, agronomists and plant pathologists would be needed in all provinces. It is not so clear that a major breeding program would be necessary in all provinces, but personnel capable of selection and genetic evaluation would certainly be required. Access to facilities for evaluation of grain quality for its various uses should be available for all entries in the genetic selection and variety evaluation program. In the Punjab both irrigated and barani conditions would have to be considered. It is not clear how the wheat research program to serve the major barani area will develop, if a separate program is needed, but responsibility seems to rest with Punjab. In both NWFP and Baluchistan, higher altitudes and adaptation to cooler climates are selection factors. The farm implement and machinery unit of NARC could well be the source of innovation and introduction of cultural, harvesting, and threshing implements. (Entomological problems do not appear to be acute.)

The Punjab has a large area in wheat under both irrigated and barani conditions, and both saline and nonsaline soils. While it has a greater provincial pool of talent and financial resources, the size of its wheat-growing area and the range of environmental conditions under which wheat is grown justify a substantial allocation from PARC to supplement the provincial contribution. Logic would suggest that contributions of the Ayub Agricultural Research Institute, the agricultural university, and the Nuclear Institute for Agriculture and Biology (NIAB) be merged into a single Punjab effort. NIAB need not have an independent breeding program, but could provide radiation-induced mutants with identified useful characteristics as source materials, and it could carry out needed physiological studies in which radio-isotope tracers are needed. The university group could make important contributions through thesis research by postgraduate students and research by faculty members on identified problems in which they have particular expertise.

The Sind may need a total team somewhat parallel to that in the Punjab, but might require fewer sites in view of the more limited range of agroecological regions in which its wheat is grown. Adaptation to a somewhat warmer climate and shorter duration (for use in rotation with rice) are special varietal considerations for the Sind. NWFP and Baluchistan have more limited provincial resources and talent and may require a relatively higher allocation from PARC for personnel and operating expenses.

The Cereal Disease Research Institute at Murree and the summer nursery at Kaghan are national facilities important to all the provinces and should be fully supported by PARC.

In view of their more limited potential in the agriculture of Pakistan, tests with barley and triticale might be confined to small auxiliary trials of introduced materials, cultural practices, and observations of their potential place in rotations. It would not seem wise to divert special staff or substantial amounts of resources of the national coordinated projects to these crops at this time. One center which has a comparative advantage and the needed interdisciplinary reserve resources could do this work outside the coordinated project, if it is considered of sufficient priority.

The team's observations indicate that the NCP on wheat offers one of the better opportunities for developing a model for the NCP approach in Pakistan. Considerable progress has been made in this program, but much yet needs to be done to achieve the needed mutual understanding and reliance, rational allocation of resources, and assumption of responsibilities.

Rice

The development of a cooperative and coordinated rice research program presents some special problems not inherent in the wheat program. The three provincial programs have developed more or less independently, with little interaction among them.

The two major locations for rice research are long-established. The Dokri location seems to serve the Sind well as a major station. The team got the impression that rice research is restricted by a lack of controlled testing sites in the south of Sind, although a number of micro-plot trials, zonal trials, commercial trials, and demonstrations have been implemented each year. Rice in Baluchistan may be adequately served for some period by Dokri, except for on-farm tests and the needed links with extension. The rice work at NARC warrants careful consideration. Characterization of germplasm, field screening for salt tolerance and resistance to specific insect pests, and assessment of post-harvest losses would seem to be seriously handicapped by NARC not being in a rice-producing area. The location handicap can be partially offset by methodology, but the rationale for these efforts at NARC is not self-evident.

Oilseeds

The oilseeds NCP includes too many crops for the available resources. A careful analysis of the major oilseed crops, their agroclimatic zones and the problems and opportunities of each must form the basis for developing priorities. Work in the NCP can then be concentrated on one or two crops that are, or can be, major sources of edible oil. Work on crops that are, or can be, important in a single agroclimatic zone should be done apart from the oilseeds NCP.

From the standpoint of area planted one would probably concentrate the oilseeds NCP on two or three species of Brassica. Several crops may then need more limited research efforts. Groundnuts may warrant a substantial program in Punjab, if there is evidence that they will become a significant oil source, which they now are not. Safflower may have

sufficient potential to warrant continued effort for a few years in Sind. Soybeans may have potential in certain areas of NWFP, but one should examine the available information and question what additional research is needed before decisions are made (if appropriate) to develop effective markets and processing. Any special effort directed toward an oilseed species will require a team of senior scientists (at least agronomy, breeding, entomology, pathology), and support staff.

The selection of locations for the oilseeds NCP research will need to follow the description of agroclimatic zones, problems, and opportunities for each crop, and decisions on which few crops are to be included in the NCP.

The oilseeds research to be done at NARC needs careful attention, with due consideration to the conceptual relationship between NARC and the provincial institutions. If NARC is to take responsibility for a major oilseeds research effort, essentially substituting for a similar effort by a province (Punjab), it should be done with a clear view of its longer-term implications and with the full knowledge of the broader research community. The concentration of the research and variety introduction, testing, and improvement at NARC would seem to put the center in direct competition with the provinces in development of candidates for varietal release, and does not appear consistent with the stated purposes of NARC. It may be argued that this has been done because this is a neglected area of research. However, the team suggests that this be reconsidered in the interest of providing a higher proportion of the available resources to develop significant strength and effectiveness in the provinces in which the bulk of the relevant crops are produced.

The proposed program for maximization of oilseed production will have considerably more problems than the rice maximization program. Technology capable of giving a substantial and economic yield or productivity increase will have to be developed. Further, the oilseed crops fit into comparatively complex cropping systems, which are fairly location-specific, and which will need critical research. While there may be pressure on PARC to directly affect agricultural production, the team suggests that PARC and the NCPs both carefully consider their proper roles, if any, in a maximization program. Such programs seem to fall clearly within the responsibilities of provincial extension and research entities.

Objectives

Several of the stated objectives in the three programs seem to be statements of long-term goals, approaches, or functions, and are of limited value for planning specific research. Objectives that are stated in potentially achievable and quantifiable terms are necessary for both planning and evaluating research programs. The three projects include a wide range of accomplishment in the careful statement of objectives, but all could be much improved.

Only when objectives are stated in achievable and quantifiable terms, and methodologies are defined, can the personnel, physical, and monetary resources needed to do the work be determined. In these NCPs it is not

obvious that more than a general relationship exists between the work to be done and the resources needed to do it. (This allows cuts in approved budgets with apparent impunity, since budget elements are not directly related to specific work.) For example, in the rice NCPs, resistance to specific diseases or insects is an important part of the work, but the NCP staff at Kala Shah Kaku includes no entomologists or pathologists. In several situations the responses of various groups of farmers to potential new technology ought to be important for both the development of technology and the policies that affect the economic environment, yet only the rice NCP includes an economist (one at Dokri), and none include a sociologist.

The present objectives for the oilseeds NCP are quite general. After the crop-by-agroclimatic-zone analysis is done and crop priorities developed, research objectives can be stated for each crop and zone. The methodologies can then be chosen and the resources needed at each site can be defined. A more precise statement of objectives and methodologies for each oilseed crop and a detailed annual plan of work will help identify the personnel and other resources needed at each location. The annual work plan, and resulting budget, need to reflect the combined insight of all participants and should not be simply a collection of individual plans.

Resources

Personnel

Generally, the mix of scientists needed to do the work (at the appropriate level and numbers) at each location is greatly inadequate. Only the rice NCP at Dokri has a reasonable mix of disciplines at the senior scientist level to execute a comprehensive research program. Considering that minimal teams for substantial problem-solving plant commodity research will often need senior breeders, agronomists, entomologists, pathologists, economists, and frequently one or more additional specialists, the inadequacy of the teams in most locations for most NCPs is all too obvious from Tables 2, 4, and 6.

A more careful definition of objectives, methods, and all necessary resources will help identify the needed teams of scientists. PARC may be able to make a major contribution by deputing career PARC scientists to critical positions in provincial institutions where they would work as part of the NCP team, under the guidance of the provincial leaders.

In comparison to the provincial institutions, the NCP staff at NARC seems to be disproportionately large, and made up of relatively higher grade positions. This makes it difficult for the provinces to attract or retain qualified persons, particularly in disciplines where there is a short supply, such as pathology, entomology, and economics. In many cases the need may be to increase the staff numbers, competence, and average position grade in the provinces, but both PARC and the provinces need to see that as a priority task.

Scientists with Ph.D.s find more opportunity for advancement to higher pay scales in the universities and at PARC, so the provincial research institutions are poor competitors for highly qualified scientists. Instability of NCP funding at provincial institutions has exacerbated this situation and PARC-funded positions, which might otherwise attract highly qualified scientists, often go unfilled. The development of several new institutes in the provinces has been an expensive response to the lack of advancement opportunity, since related service costs also increase. A more efficient and useful management approach would allow several senior scientists to work in a single unit.

As for the other crops, the oilseeds research program in the provinces is dominated by breeders, and other major disciplines are represented by assistant scientists, if at all. PARC supplies even more staff at the assistant scientist level, but not at the more critical senior scientist level. It is obvious that insects (for example, aphids on rape and mustard), diseases (for example, leaf spot on peanuts and foliar diseases on sunflowers), and imperfect pollination of sunflowers are among the major problems limiting yield and production. Economic profitability, marketing, and the characteristics of varieties that affect how they can fit into the total farming and cropping systems are also recognized problems. The need of interdisciplinary teams involving breeders, plant pathologists, entomologists, agronomists, and economists can hardly be over-emphasized in this NCP.

The wheat research program at all four major provincial centers is dominated by breeders, and few other disciplines are included as integral parts of the wheat research program. Considering the importance of AARI, Faisalabad in wheat research, the recent positioning of senior plant pathologists as full-time members of the wheat team there was essential. Noting the absence of senior scientists in other major disciplines including economics, agronomy, and soil science, one questions why PARC supplied four assistant research officers, to bring the total to 20, while important senior positions are not supplied, or are vacant.

At the Punjab rice center at Kala Shah Kaku, positions for disciplines other than plant breeding have either not been filled or have been filled at junior grades. It is not clear why PARC supplied assistant scientists to Kala Shah Kaku to add to the relatively large number (28) supplied by the province, especially when important senior scientist positions, including economics, soil science, pathology, and entomology are absent or unfilled. The rice program at Kala Shah Kaku will greatly benefit by the provision of a pathologist, an agronomist, a soil-fertility specialist, an economist, and an engineer in the same grade as the breeder. Then the wide range of rice problems and opportunities can be researched by a multidisciplinary team.

PARC may also encourage some basic research by a team of biochemists, geneticists, and physiologists to study the linkage between aroma, plant types, and yield in basmati. Unless this barrier is broken, a breakthrough in basmati rice production technology may not be attained.

Funding

Discussions with provincial scientists and a review of the available funds over the past three years evidenced the paucity of funds, especially for operating costs. Funds and other resources for extensive on-farm testing, so important for the success of an NCP, formed a major deficiency. On-farm testing is expensive in terms of time and operating costs, yet it is a most important component of an NCP. In some programs and locations there have been major differences between amounts budgeted (approved) and those made available by PARC. At least part of this problem has resulted from untimely reporting of expenditures by the provincial institutes. There are often difficult budgetary circumstances, but planning and implementing a research program becomes nearly impossible when the funds available are much less than the approved budget.

The erratic availability of funding at each site has seriously impeded the development of a productive research program. The sharp drop in available funds in 1980-81 may have been unavoidable, but it was devastating to the confidence that people in the provinces placed in PARC funding. Qualified scientists often have several employment opportunities and are reluctant to take positions funded by demonstrably insecure funds. (The sharp increase in funding at PARC and NARC adds to the perception in the provinces that PARC absorbs a disproportionate share of the total available funds.) Funding for each NCP needs to be reasonably stable, and available when needed. More precise statements of objectives, and the matching of specific resources with specific objectives at each location will force all concerned to see which objectives must be foregone if funds are reduced.

Coordination

The coordinator is the kingpin of the NCP, and his success depends on qualities of leadership. Plant breeding is important in crop NCPs, but contributions from other disciplines such as plant pathology, entomology, economics, agronomy, and soil science are equally essential for developing an efficient technology. When choosing the coordinator, equal opportunity should be given to all disciplines to attract the best person for this important role. The coordinators of wheat, rice, and oilseeds NCPs are plant breeders and located at Islamabad. The team was not convinced that the possibility of locating some of them at other centers has been recently and thoroughly explored. There are some logistical advantages in locating the coordinator at the headquarters of PARC, but if, without compromising the national perspective, coordinators could be located at other important centers of research, it would improve the image of PARC. The host institution, however, should facilitate the coordinator's performance of his nationwide responsibilities.

PARC's role as a coordinating agency does not include breeding for the development of finished varieties, and it has indicated that it does not, as a matter of policy, develop and enter varieties into the uniform tests as potential candidates for release. The coordinating cell, wherever located, should be appropriately staffed and have access to the kinds and amounts of resources required to discharge its recognized functions.

The team observed in some instances that, even when funds and equipment were provided by PARC to a province in support of a national coordinated project, the province had not fully merged the resources and talent provided by PARC with those of the province, resulting in two parallel programs on the same subject. Integration of resources provided through central and provincial agencies in a unified program will need further attention.

The Kala Shah Kaku center currently has limited interaction with the International Rice Research Institute (IRRI), perhaps reflecting its concentration on basmati rice. The Rice Research Institute at Dokri has extensive contacts with IRRI, has introduced and evaluated a substantial amount of exotic germplasm, and has developed and/or released dwarf varieties capable of producing high yields. The wheat NCP is well connected with the global wheat research program. The oilseeds program will benefit from better links with several international units when it has a firmer hand on its crops, their priority problems, and its objectives.

Annual Evaluation and Planning

The annual cycle of program and budget planning, implementation, reporting, evaluation, and replanning is at the heart of NCPs. The traveling wheat seminar is effective for maintaining a high level of awareness and perception of a working team. This should be expanded to include at least all the cooperating senior scientists in the wheat NCP, and emulated in the other NCPs.

The annual workshop is the forum for presentation and discussion of results on each experiment in the NCP. (This can be facilitated by providing typed copies of data and notes from all locations to all participants well before the workshop.) Each NCP should have all data statistically analyzed for drawing valid conclusions, and guidance from a statistician should be available for planning and designing experiments. Effective leadership is needed in the workshop to keep the discussion open but relevant, and this may be an excellent use of PARC members' time.

Problems in implementing the agreed-upon work need to be stated concisely and accurately; these problems need to be solved within the workshop or referred to those who can solve them. Progress toward each objective needs to be stated. When an objective is reached the resources should become available to pursue other objectives, rather than to just keep repeating the experiments.

The primary product of the workshop is an annual work plan that includes specific objectives, methods to be used, and resources to be supplied at each location by each cooperator. We did not find such detailed work plans in any of the NCPs. In one NCP a common sentiment expressed in the provinces was that provincial scientists had little to do with planning the NCP. In some cases the provincial scientists had chosen not to help plan the NCP. An NCP is not simply a collection of existing research programs, and the planning of the NCP work needs to be a truly cooperative effort. A plan that is developed by the coordinator and simply presented to the cooperating scientists may receive their

endorsement, but they are not likely to implement the planned work unless they have had an active part in planning it. All participants should come to the workshop prepared to discuss research results, what work is needed, and the resources needed to do it.

A secondary but important product of the workshop is the raw material for the coordinator's annual report. The report should be produced quickly after the close of the crop season and the workshop, so it can be used as a ready reference by cooperators, and to report to various authorities. Cooperators should find the coordinator's annual report suitable for their reporting needs, with perhaps a covering note. Such workshops have not been held regularly in all NCPs, and annual coordinators' reports have not been prepared regularly. This may be due to frequent changes of coordinators, but this deficiency should be removed.

The workshop should identify those results that are ready for extensive on-farm tests, and the work plan and budget should provide for such tests and for the needed working links with extension.

Variety Evaluation and Release

Scientists from Sind claim they have developed a fine quality rice variety that is similar to basmati, and are awaiting permission to release it. Similarly, the director at the Kala Shah Kaku institute indicates he has developed a rice variety which is higher yielding than the standard basmati, but that it has not yet been approved for release. There is a certain degree of confusion and misunderstanding about the variety evaluation and release process. In part, this results from the newness of the variety release process and from the incompleteness of the NCPs.

Advanced generation materials that may become varieties should be included in national yield trials in many locations in a properly functioning NCP. When this is done, much (or all) the needed data on performance across locations will be available from the NCP when a variety is tendered for release. Properly functioning NCPs can thus be a major asset for variety development and release. The team endorses the continual use of standard variety release procedures. Some of the current friction would have been avoided if an interdisciplinary team received more credit than a single individual for developing a variety. Too, a better definition of agroclimatic zones for each crop will bring more recognition of the fact that it is not desirable to look for one variety for the whole of Pakistan, as the hazards associated with that are rather serious. A variety suited for an important agroclimatic region should be considered acceptable for that region.

Summary and Recommendations

The Study

At the request of the Pakistan Agricultural Research Council (PARC), the International Service for National Agricultural Research (ISNAR) undertook an examination of the relations between central and provincial research institutions in Pakistan, searching for ways in which their relationships could be improved to make the nation's total agricultural system more effective and efficient. This naturally led to inquiries into the working of specific national and provincial institutions and organizations and their interrelationships. Three national coordinated research programs (NCPs) -- wheat, rice, and oilseeds -- were examined in some detail as representatives of these significant vehicles of center/provincial cooperation.

Basic Premises

During the review, the team discerned the apparent acceptance of some important basic premises within the research community. These have not been previously stated and formally adopted, but the team is of the opinion that most researchers in Pakistan would subscribe to them, and they form the basis for the team's interpretation of the circumstances in Pakistan, and thus their recommendations.

- * Pakistan's agricultural research system must serve effectively the needs of the entire nation.
- * This requires a strong central organization and research apparatus with capacity to provide leadership and support to the work of provincial institutions; facilitate international contacts; and undertake research requiring more specialized equipment and facilities, and of a type which can best be handled at a single centralized institution.
- * Comparably strong provincial agricultural research institutions are needed, operating in close contact with and serving the needs of the agricultural sectors in their respective provinces.
- * The work of the respective provincial and national research institutions should be coordinated and planned to complement and reinforce one another, thus avoiding unnecessary duplication.
- * The central organization should provide a number of common services needed by the respective provincial and central research institutions.

- * A research climate should be fostered and developed, both at the center and in the provinces, which will stimulate the highest level of dedication and performance possible, with recognition, rewards, and opportunities provided for continued professional improvement and development of staff at all levels.
- * Agricultural research programs require a greater degree of flexibility in operation than that normally possible in regular government administrative and regulatory activities.

Progress

Pakistan has made rapid advances toward strengthening its national agricultural research system since the appointment of the first Director General of PARC in 1972. Important policy decisions on PARC and its functions have been taken (Annex 6). The perceptions of the purposes and functions of the central institutions, PARC and NARC, as outlined in a brochure entitled "Agricultural Research System of Pakistan," published by PARC in 1982, are generally sound. The manner and sequences of their implementation will, however, have a significant bearing on the achievement of the goals that have been established and the development of an effective and efficient nationwide research system.

Development loans by USAID in 1974 and the World Bank in 1981 were designed to help PARC develop the facilities and professional capabilities needed to fulfill its role as a central agency, and for concurrent strengthening of the provincial research organizations. Additional resources have been provided at both the provincial and central levels. During this decade, relatively greater priority at the central level has been given to the development of PARC to the level at which it can give effective leadership, coordination, and support to the total national agricultural research system than has been given to the provincial institutions, per se.

The provinces want more types of assistance from PARC than direct budget support. Important assistance includes the supply of vehicles and operating funds for the much-needed on-farm testing work; specialized research equipment and supplies which have to be imported; training and service on instrument repair and maintenance; access to computer facilities; access to library facilities; opportunities for training and professional development (both short- and long-term); development of improved agricultural implements and machines; access to a wider range of genetic resources; and international contacts, including visits from externally based scientists and travel of Pakistani scientists for participation in international workshops.

Problems in PARC's supplying such assistance are by no means limited to the operation of PARC and other central government offices. Many of the delays and problems of clearance occur in the provinces, and much needs to be done at provincial levels to facilitate collaboration with PARC. Collaboration on basic research among scientists in the NARC laboratories and those in the provinces will have to be especially cultivated as specific problems and needs are identified in NCPs and through other means. Innovative, urgent, problem-solving research requires much

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greater operational flexibility than is easily achieved through standard governmental communications procedures and administration, and both the provincial institutions and PARC will be challenged to develop the needed working relationships.

The spirit of partnership, mutual collaboration, and cordial relationships between PARC and the provinces will be fostered and grow to the extent that each derives positive benefits from such collaboration and gains confidence in the other.

The present development of facilities and assembling of staff at PARC and NARC has a high visibility. While this development is needed and should be encouraged, commensurate and concurrent attention to the needs of the provincial institutions will be required if the full measure of cooperation and mutual reinforcement is to be achieved. During the next decade additional resources will be required, not only to consolidate the full development of the central research organization, but also to assure the concurrent development of the provincial research institutions and programs to comparable levels of strength and quality.

Funding

Some of the funding problems called to the team's attention were unstable levels of financial support for provincial activities from year to year, reported delays of release of funds, and resulting under-utilization of funds presently available. Some of the under-utilization undoubtedly resulted from delays in recruitment for new programs early in the year and perhaps from incomplete understanding by the provinces of the necessity for regular and timely preparation and processing of requests for release and expenditure reports. To the extent that this is the case, the effect of corrective measures should soon be reflected in performance. Funding problems that result from major government budget cuts are difficult to deal with in a research program, and the team affirms that a sound and productive research program requires a stable and dependable financial base. Realistic planning of programs, reasonable stability of funding, and timely delivery of funds as budgeted are essential, and all concerned in both PARC and the provinces need to take firm steps to accomplish these.

A substantial portion of the funding for agricultural research through the center appears in the development budgets and comes from external sources -- loans and grants by USAID, the World Bank, Canada, UNDP, and US PL-480. The loans, at least from the World Bank, were made with assurance that the government would provide sufficient funds to maintain ongoing NARC research programs, the NCPs, and the collaborative research schemes at adequate level. The team was informed that provision exists for automatic incorporation of these programs into the regular revenue (nondevelopmental) budgets as the funding term provided in the grant agreements expire. As this incorporation is done, careful attention should be given to assure inclusion of adequate continuing funds for operating expenses (labor, supplies, equipment replacement, fuel, travel expense, etc.) as well as the amounts required for maintenance of staff salaries.

Creation of Agricultural Research Department

The creation of a research department in the Ministry of Agriculture, of which the present chairman of PARC is named the secretary to government for agricultural research, is a forward move. This should be institutionalized and the chairman of PARC designated ex-officio secretary to government for the Department of Agricultural Research.

Structure and Organization of PARC

The necessary structure and organization of PARC for sound policy formulation and overall responsible management has been provided, and substantial progress is evident in recruitment and posting of competent staff to key positions in the organization. In the further development of PARC's operational pattern, the team wishes to stress the importance of avoiding unnecessary administrative layers for clearance and assuring prompt attention and action in program execution. The team suggests the addition to the central executive of PARC of an additional full-time member for education and center/provincial relations. The team also suggests that, in addition to being members of the central executive of the board, the full-time members have line responsibility for the planning and execution of programs in their respective subjects.

The National Agricultural Research Center (NARC)

This center, a key unit in the national system, has several distinct and diverse functions. It serves, among other things, as a front window to the public. The team agrees with PARC's present plans, and strongly recommends, that NARC should continue to develop as a national center of excellence, with good laboratory facilities, equipment, and a highly competent research staff. It should take on a backup role which strengthens, complements, and supports the work of the provincial research programs and institutions. In its supporting role, NARC does not lend itself to management by a director general with responsibility for complete direction of all its research programs. NARC requires an overall manager who can service all its functions, but the direction of its research programs needs to be shared among the several senior technical officers (full-time members) of PARC. The director general of NARC should have direct responsibility for supervision of:

- * administrative services;
- * public relations;
- * physical plant maintenance and operation;
- * research farm management and operations;
- * livestock care and management;
- * instrument repair and maintenance.

Other senior officers (full-time members) of the council should have program responsibility for:

- * library, documentation, and information;
- * computer center;
- * training center;
- * farm machinery research and development;

- * plant introduction and genetic resources;
- * social sciences (if physically located at NARC);
- * animal science research;
- * central laboratories.

The research program at NARC should be organized on a functional, task force, or service basis, not on a commodity or disciplinary basis. (Much of the research program would be responsive to problems or opportunities identified in the NCPs.) The laboratories at NARC would, however, be staffed and equipped to do indepth research in a number of scientific disciplines.

Cotton Research

The Central Cotton Committee, supported by a cess on marketed cotton, supports research on cotton production and genetic improvement in stations at Multan and Sakrand, and on fiber technology at a laboratory in Karachi. In addition, the committee does promotion and development work on cotton production and marketing. In the Punjab, a provincial research station devoted to cotton production and improvement is also located at Multan, adjacent to the central station.

The cotton committee should concentrate its activities on promotion, marketing, and product-processing research and testing. Since cotton is an integral component in complex farming systems, responsibility for research related to cotton production, including fiber quality aspects, should be with the relevant provincial agencies, and supported through them. This suggests consolidation of the central and provincial research institutes at Multan under Punjab provincial responsibility, and placing the production research program at Sakrand under the Sind authorities. PARC would then provide the same type of backup support, coordination, and services to cotton research as it does for other commodities.

The National Coordinated Programs

The national coordinated research programs (NCPs) are important channels for center/provincial cooperation and complementarity. Their development and execution has, and will continue to have, a major influence on the quality, cordiality, and effectiveness of center/provincial relations. NCPs have been developed for several commodities, and some for production factors. Some 33 subjects have been identified as candidates for development of NCPs. Some of these topics are particularly suitable for this research management approach, but others may not be. PARC will have to carefully examine each case to determine the best management approach. When an NCP approach is appropriate, the program should be jointly planned by the scientists at the center and the provinces who will implement the program.

Each NCP should focus on a set of goals, and have quantified objectives against which progress and achievements can be measured. Staff should consist of interdisciplinary teams as needed to achieve particular goals. Lead scientists from each discipline should have comparable qualifications and status.

On-farm testing and evaluation are integral to all commodity NCPs, and to many of the other NCPs. Scientists need transport to move into their experimental fields at headquarters, to make observations on substations, and to help implement the on-farm tests. Future funding of NCPs should give greater attention to the provision of operational support, including travel, supplies, labor, and equipment.

Frequent professional contacts among NCP scientists assure awareness of the entire research program. Traveling seminars and workshops, and program planning and review workshops, must be a regular feature of each NCP. Regular contacts and interchange with international agricultural centers should be maintained. Of the NCPs examined, the wheat NCP came closest to meeting these criteria. Here, it may be desirable to strengthen the interdisciplinary mix of the scientific team, and continued strong emphasis to rust and bunt resistance will be essential. The team identified some additional features of the rice and oilseeds projects needing attention to improve their effectiveness. The oilseeds project must also establish priorities among the different species and concentrate its resources on those of highest priority, with the appropriate interdisciplinary teams.

The team found a general impression in the provinces that a high proportion of the resources being provided for agricultural research through PARC is being used at the center and that too little gets to the provincial institutions. While the team did not make a detailed analysis of this question, it found considerable evidence to support that impression. For example, in the national coordinated programs examined, fund allocations to the coordinating cell at NARC, while admittedly being used in part to provide needed resources or facilities to the provinces, often equalled or exceeded the total of the amounts allocated to all the cooperating provincial centers. The team did not get full information on the investment of the respective provinces and thus could not fully judge the adequacy of the total resources for these programs. The team suggests a careful analysis be made by PARC, and measures taken to assure that the provinces share to an appropriate degree in both the program planning process and in resources. As the respective functions and responsibilities of PARC, NARC, and the provincial institutions are more clearly defined, the strengthening of the provincial institutions should be given high priority.

Provincial Research Organizations

The team recommends that the provincial research organizations be given more freedom than is currently possible in the regular government structure for recruitment, professional development, recognition of accomplishment, and advancement of research personnel. Merging the provincial research institutions with the agricultural universities, as suggested below, should make this possible.

The Agricultural Universities

The agricultural universities have a valuable pool of trained talent which is under-utilized and largely isolated from participation in the mainstream of national agricultural development. The team feels that logic strongly suggests that the following steps be taken.

- * The universities should be responsible to the provinces, and the basic support channeled to them through the agricultural ministries of the provinces, irrespective of where the funds originate.
- * Agricultural research of importance to agricultural production should be recognized as a part of the universities' responsibility, and concern for agricultural improvement throughout the province and nation should be recognized as a focus for their research, instruction, and extension programs.
- * The agricultural universities and the agricultural research institutes should be merged, and the research personnel so absorbed should be posted on the same scales of pay as university instructional staff with comparable qualifications and performance. (This would necessitate very careful advance preparation and planning with respect to the place of each staff member in the merged organization. The revised responsibilities of the staff could include a combination of teaching, research, and extension training or, in some cases, full-time in one area.)
- * The nuclear institutes for agriculture and biology should be merged with the agricultural universities at the same time as the merging of the provincial research institutes with the agricultural universities. This would make better use of these valuable resources and enrich both the research and academic instructional programs of the newly constituted agricultural universities.
- * The charter of PARC should be broadened to include "education," a new full-time member for education added to the executive board, and funds provided through this section to support development grants to the universities. Research support from PARC could also come to the merged-function provincial universities through support to their participation in NCPs and support to other individual research projects.

Talent Development and Use

A nation's research system depends on effective work of highly trained people. Fortunately, Pakistan has a substantial base of such researchers. Many more will be needed and the training effort should proceed with all deliberate speed, but the presently available talent must also be fully used. The team commends the move by PARC in creating a talent pool to enable the nation to attract and retain the services of trained and talented scientists who otherwise would be tempted to find employment outside the country, with a stated expectation that this may eventually reach as many as 400 to 500 scientists. Plans for utilization of this resource are still evolving. The team strongly recommends that, prior to recruitment of scientists in various disciplines, the need for

and placement of them be identified and that, after an initial induction training period at the NARC training center, they be placed in ongoing research programs in the provinces or at NARC so that they may get started on productive work. Recruitment into the talent pool should be made for a period of limited duration -- up to two years, for example. During this time arrangements could be worked out for their assignment on a more permanent basis to either provincial or central programs.

The achievement of the above would be very substantially facilitated if, concurrently, a careful and thorough study were made of the personnel policies and equitable opportunities provided therein for career advancement on the basis of merit and performance, and if transferability among institutions and between the center and the provinces were made easier.

National Career Structure

The team suggests the creation of a national agricultural science (career) service for professional staff in research, university instruction, and extension. A uniform set of salary scales is already in effect for most research personnel at both central and provincial levels. A service which would place all professional personnel within a common system (after careful evaluation of their credentials), would greatly facilitate the development of procedures for recruitment, evaluation, advancement, promotion on merit, and transfer from one institution to another and from province to center (or vice versa) without loss of accrued retirement or other earned credits. It would also greatly assist in placing people where their talents will be most useful and needed, including those persons recruited into the PARC talent pool.

A Critical Period

Pakistan's agricultural research capability has increased rapidly during the past several years. During the next several years it will be particularly important to sustain excellence in leadership and to develop a more integrated system composed of highly capable provincial and national institutions and programs that complement and support each other. Research leaders at all levels will need to examine how their actions will affect the entire research system in the longer term, as well as accomplish near-term personal and program objectives.

TERMS OF REFERENCE

These terms of reference are for the review of certain aspects of the Pakistan agricultural research system by ISNAR.

Context -- Pakistan has made a concerted effort to develop its agricultural research system for several years, and has made much progress in this area. Comprehensive reviews of the research system were done in 1968, 1972, and 1980. Other recent reviews have dealt with the progress of specific programs receiving external assistance. Further comprehensive reviews are not needed at this time; however, a few components and aspects of the research system warrant examination to see how they can be further improved. Also an understanding of the experiences of Pakistan can help other nations as they improve their research capabilities.

An exchange of communications between Dr. Amir Muhammed, Chairman, Pakistan Agricultural Research Council (PARC) and Dr. William K. Gamble, Director General, International Service for National Agricultural Research (ISNAR); and a visit to Pakistan by Dr. Floyd Williams, Senior Research Officer, ISNAR, have identified some priority issues that ISNAR is requested to examine, and, as appropriate, develop recommendations for their resolution.

- * ISNAR is to examine the programs and relationships between PARC and the provincial institutions concerned with agricultural research, determine whether the programs and relationships are optimum for the progress of agricultural research in Pakistan, and, if appropriate, recommend ways these programs and relationships could be improved to better serve Pakistan's agricultural development. The programs and relationships to be examined include conceptual relationships between PARC and provincial institutes and agricultural universities, the functioning of the national coordinated commodity research programs (which will be the subject of a specific analysis, see below); the supply of training opportunities and other facilities to provincial institutions by PARC; and the relative emphasis given by PARC to its several programs and functions.
- * ISNAR is to examine the functioning of the wheat, rice, and oilseeds national coordinated commodity research programs to determine how effectively they are working. The program components to be examined include the definition of the research objectives; the formulation of the research program; the specification of the required resources, their sources and availabilities; the criteria used to measure results; the reporting and evaluating of results; the timely movement of usable results to on-farm testing, and linkage with the extension service; and the recycling of the process.

- * ISNAR is to examine the processes used to set agricultural research priorities within PARC, the provincial research institutes, and the agricultural universities. If appropriate, ISNAR will recommend procedures that PARC could use to develop PARC research priorities with a 10-to-15-year time horizon.

The above three issues will be examined by a small team of ISNAR staff and consultants, with the full cooperation and assistance of PARC staff and others in Pakistan. The ISNAR team plans to visit Pakistan from about November 15 to December 5, 1982. The result of their analysis will be a report by ISNAR to PARC on the findings of the review and recommendations on actions by PARC.

November 13-19	Islamabad	-	PARC, NARC, USAID
November 20	Lahore and Kala Shah Kaku	- - - -	Agriculture Department Planning and Development Department Punjab Rice Research Institute On-Farm Water Management Training Institute
November 21-22	Peshawar	-	Agricultural Research Institute, Tarnab; Cereal Crop Research Institute, Pirsabak; Agricultural University
November 23-24	Faisalabad	-	Punjab Agricultural University; Ayub Institute of Agricultural Research; Nuclear Institute for Agriculture and Biology
November 25-27	Karachi and Tandojam	-	Agricultural Research Institute; Sind Agricultural University; Atomic Energy Research Center; Site of Southern Zone Crops Research Center, Sarjoval; Ministry of Agriculture; Director, Rice Research Institute, Dokri; Planning and Development Department
November 28-29	Quetta	-	Agricultural Research Institute, Sariab; Arid Zone Research Institute
November 30 - December 3	Islamabad	-	Discussions among team and with staff of PARC and NARC, USAID, FAO, University Grants Commission, World Bank

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PERSONS CONTACTED

Pakistan Agricultural Research Council, Islamabad

Dr. Amir Muhammed, Chairman
 Dr. M. Yousaf Chaudhri, Member-designate, Crops
 Dr. Ch. M. Anwar Khan, Member, Natural Resources
 Dr. Haleem-ul-Husnein, Member, Animal Science
 Dr. Riaz Ahmad Khan, Member, Social Sciences
 Mr. Majeed Akhtar, Member, Finance
 Mr. Ikram-ul-Haq, Director, Planning and Technical Services
 Mr. M.H. Rizvi, Director, Training and International Liaison
 Dr. Badaruddin Soomro, Director, Crop Production
 Dr. Ghulam Rasool Sandhu, Director, NARC
 Dr. Naeem I. Hashmi, Coordinator, Wheat
 Dr. Muhammad Akbar, Coordinator, Rice
 Dr. Akhtar Beg, Coordinator, Oilseeds
 Mr. Bashir Ahmed Malik, Coordinator, Pulses
 Dr. Zafar-Ud-Din, Coordinator, Forages and Fodder, Director RM & F
 Dr. Zahur Alam, Coordinator, Vegetables and Fruit Crops
 Dr. Peter R. Hobbs, CIMMYT, Wheat Program
 Dr. R.N. Wedderburn, CIMMYT, Maize Program
 Dr. Abdul Hafiz, consultant

FAO, Islamabad

Dr. John Philips, Resident Representative in Pakistan

USAID, Islamabad

Mr. Donor Lion, Mission Director
 Dr. Ray Carpenter, Agricultural Officer
 Dr. Ronald Curtis, Agricultural Division
 Dr. Gordon McLean, TDY
 Dr. Alan Hankins, USAID, Washington
 Dr. Abdul Waheed, Consultant
 Mr. Donald Minehart, Farm Development, NARC

University Grants Commission, Islamabad

Dr. Tahir
 Dr. Aslam
 Mrs. A.R. Howe

World Bank, Islamabad

Dr. R.D.H. Rowe

Lahore

Mr. Masood Parvaiz, Secretary Agriculture, Punjab
 Dr. S.A. Qureshi, Director General, Agricultural Research
 Dr. A.S.K. Ghauri, Director General, Agricultural Extension
 Dr. Abdul Majid, Director, Rice Research Institute, Kala Shah Kaku
 Dr. Mahsoot Bhat, Director General, Livestock
 Mr. Mian Mumtaz Ali, Vice Chancellor, University of Agriculture,
 Faisalabad
 Mr. Mushtaq Ahmad Gill, Director, On-Farm Water Management Institute
 13th Km. Niaz Beg, Multan Rd.
 Mr. Saeed Ahmad Bhatti, Director (Field), Punjab
 Mr. Mohammad Sadiq Cheema, Director General, Water Management, Punjab

University of Agriculture, Faisalabad

Mr. Mian Mumtaz Ali, Vice Chancellor
 Dr. A. Rehman, Dean, Faculty of Agriculture
 Dr. M. Ajmal, Dean, Faculty of Veterinary Science and Professor of
 Microbiology
 Dr. Abrar H. Gilani, Director, Research
 Mr. M. Zubair Siddiqui, Protocol Officer

Ayub Agricultural Research Institute, Faisalabad

Dr. S.A. Qureshi, Director General
 Dr. M.A. Bajwa, Director, Wheat
 Mr. H.M. Bhatti, Agricultural Chemist
 Dr. M. Hussain, Horticulturist
 Dr. M. Iqbal Khan, Director, Oilseeds
 Dr. M. Tufail, Pulses Botanist

National Institute for Agriculture and Biology, Faisalabad

Dr. S.H. Mujtaba Naqvi, Director

Previous Page Blank

Agricultural Research Institute, Tarnab (NWFP)

Mr. Muhammed Siddiq, Director General, Agricultural Research

Cereal Crops Research Institute, Pirsabak

Dr. Salim Khan, Maize Breeder
 Mr. Ghulam Hussain, Maize Agronomist
 Mr. Nazir Hussain Shah, Wheat Botanist
 Mr. Muhammad Jamal, Wheat Agronomist
 Mr. Qazi Aqigullah, Cereal Technologist

Agricultural University, NWFP, Peshawar

Dr. G.M. Khattak, Vice Chancellor
 Dr. M. Ataulah Khan, Prof. of Plant Breeding and Genetics
 Prof. Mir Hatam, Assoc. Professor of Agronomy
 Dr. Tajammal Hussain, Chairman, Department of Chemistry
 Dr. Nurul-Islam Mian, Director, Institute of Development Studies
 Prof. Jehangir V. Khattak, Chairman, Department of Soil Science
 Dr. A. Jameel Siddiqi, Agricultural Economics Department
 Dr. S. Basat Al-Shah, Dean of Animal Science
 Prof. Mohammad Shahid, Chairman, Department of Entomology

Agricultural Research Institute, Tandojam

Syed Ahmed Pasha Jagirdar, Director
 Mr. Inayat Ali Rizvi, Horticulturist
 Syed Javed Iqbal Buhari, Vegetable Specialist
 Dr. Taj Mohammad Chaudhry, Agricultural Chemist (Soils)
 Mr. Altaf H. Chaudhry, Oilseeds Botanist
 Mr. A.H. Natali, Wheat Botanist

Sind Agricultural University, Tandojam

Prof. Dr. S.Q. Ansari, Vice Chancellor
 Prof. Imambaksh Koondhar, Prof. Irrigation and Drainage and
 Dean, Faculty of Agricultural Engineering
 Prof. Dr. Bashir A. Sheikh, Dean, Faculty of Animal Husbandry and
 Veterinary Science
 Prof. Barkat Ullah Khan, Dean, Faculty of Agriculture
 Mr. Soomro Din Muhammed, Director, Finance, Planning, and
 Development

Atomic Energy Research Center

Dr. Munir Ahmed Khan, Acting Director

Department of Agriculture, Karachi

Mr. S.M. Wasim, Secretary, Agriculture, Food, Livestock, and Fisheries
 Mr. Kamaluddin Qureshi, Additional Secretary
 Mr. Zakir Ali, Deputy Secretary (Tech. I)
 Mr. A. Salam Khan, Deputy Secretary (Tech. II)
 Mr. A. Aziz Qureshi, Section Officer, Research
 Mr. M.A. Ghaffar, Section Officer, Crops
 Dr. I.M. Bhatti, Director, Rice Research Institute, Dokri

Sind Planning and Development Department, Karachi

Mr. Sayed Hasrat Pasha, Joint Chief Economist

Agricultural Research Institute, Sariab, Quetta, Baluchistan

Dr. Hasan Jafar, Director
 Mr. S.M. Anees, Senior Research Officer, Fodder and Forage
 Mr. Arif Masood Ansari, Principal, Agricultural Training Institute
 Mr. Saleem Ahmed, Plant Physiologist
 Mr. Nek Mohammad, Wheat Botanist

Arid Zone Research Institute, Quetta, Baluchistan

Dr. Salahuddin, Director
 Mr. Nazeer Ahmed, Agronomist
 Dr. Iqbal Barola, Head, Animal Sciences
 Mr. Zial-Rasheed, Head, Range Management

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- 10. The World Bank Agricultural Research Sub-Sector Review 1980
- 11. The World Bank Staff Appraisal Report of the Agricultural Research Project 1981
- 12. Minnesota Reconnaissance Team on the Agricultural Research System of Pakistan 1982
- 13. A Draft Report on Agricultural Education in Pakistan (unreleased)
- 14. University of Lyallpur Act of 1973
- 15. Prospectus on Sind Agricultural University 1980-81
- 16. Report of the Punjab Barani Commission, Government of Punjab, Lahore 1976
- 17. An Economic Analysis of the Cropping Pattern in the Province of Baluchistan, Agricultural Research Institute Sariab, Quetta 1980
- 18. Nuclear Institute for Agriculture and Biology Prospectus, Faisalabad
- 19. Ten Years of NIAB -- 1972-82
- 20. Ordinance -- Pakistan Agricultural Research Council, Gazette of Pakistan, Dec. 29, 1981.

BIODATA OF TEAM MEMBERS

Dr. Ralph W. Cummings, Sr. is a soil scientist and agricultural research administrator, now emeritus professor, North Carolina State University, Raleigh, North Carolina, U.S.A. He was 23 years at Cornell University and N.C. State University as professor, research director for agriculture, and university administrative dean for research; 12 years with the Rockefeller Foundation as field director for agriculture and representative in India and associate director for agricultural sciences; 1 year with the Ford Foundation as program advisor in agriculture for Asia and the Pacific; 5 years as director general of international agricultural research centers (IRRI and ICRISAT); over 5 years as chairman of the Technical Advisory Committee (TAC) to the Consultative Group on International Agricultural Research. He has had numerous consultancies in many countries including Peru, Brazil, Jamaica, Ethiopia, Pakistan, India, Indonesia, the Philippines, and western Europe.

Dr. J.S. Kanwar is the Director of Research, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad, India. He was president of the International Soil Science Society (1978-82), deputy director general of ICAR (1966-73), first-director of research, Punjab Agriculture University, Ludhiana, and professor of soil science. He served as a short-term consultant to UNDP/FAO in Indonesia and to the Asian Development Bank in South East Asia. He has been vice chairman, Commonwealth Agricultural Bureau; vice chairman, UNESCO advisory committee on natural resources; chairman, FAO advisory committee on soil degradation; and president of many professional societies in India. He was awarded the Rafi Ahmed Kidwai Memorial award, the Borlaug award and elected by the Indian National Science Academy because of his outstanding contribution to soil science and agriculture. With a distinguished academic career, he graduated from Punjab Agriculture College, Lyallpur, and took his doctorate from Australia, and postdoctorate from the United States.

Dr. Floyd Williams, a plant pathologist by training, taught and did research at the University of Maryland before joining an interdisciplinary regional research team in India. He later worked with the agricultural research system in Pakistan for some six years. A similar period was spent in Washington D.C., as a research advisor for the U.S. Agency for International Development. This assignment brought renewed contact with the U.S. land-grant university system through the Board for International Food and Agricultural Development and with the international centers through the Consultative Group on International Agricultural Research. He joined ISNAR in early 1982 as a senior research officer.

RECENT GOVERNMENT DECISIONS AND ACTIONS

The following is a chronological listing of government decisions and actions important to agricultural research in Pakistan. These are taken from the brochure "Agricultural Research System of Pakistan," published by the Pakistan Agricultural Research Council in 1982.

- August, 1978 The cabinet decided that "The Agricultural Research Council should be an autonomous body at the Federal level and should work in close coordination with the Ministry of Food and Agriculture, the provincial agricultural departments and agricultural research institutes and the agricultural universities."
- September, 1978 ARC reconstituted and broadbased to include full-time members, working scientists from provinces, heads of research institutes, vice chancellors of agricultural universities and progressive farmers. A subcommittee of the council designated as executive board, comprising the chairman and full-time members, set up to assist the council in the management of its affairs.
- November, 1978 A cabinet committee set up to suggest measures for implementing various short-term/long-term steps recommended by the chairman, PARC, for boosting wheat production and for overall strengthening of the agricultural research system in the country.
- January, 1979 The cabinet committee proposed revision of the Agricultural Produce Cess Act, on the pattern of WAPDA to make PARC fully autonomous and to transfer all the employees of the attached department of ARC en bloc to the autonomous PARC on the same terms and conditions.
- October, 1979 A joint World Bank, USAID, and CIDA mission, led by Sir Charles Pereira visited Pakistan on the request of Government of Pakistan. The mission visited 73 agricultural institutions in the country to conduct an overall indepth review of agricultural research subsector and submitted its report in May 1980.

- March, 1980 The President created an agricultural research division in the Ministry of Food, Agriculture and Cooperatives.
- Sept/Oct, 1980 World Bank mission visited Pakistan to appraise the Pakistan Agricultural Research Development Project (PARDP), which was formulated on the basis of the recommendations of the Pereira mission.
- March, 1981 Anticipatory approval of the project was given by ECNEC and the credit agreement was negotiated with the World Bank.
- August, 1981 Agreement for an IDA Credit of US\$24 million for the PARDP signed with the World Bank with the following major components:
- Provision of PARC headquarters building.
 - Completion of NARC with expanded facilities for animal sciences, library services, instrument repair, biometrics, and computing.
 - Strengthening of plant introduction, cereal and other diseases, and oilseeds and agricultural engineering programs.
 - Provision of financial support to PARC to increase level of countrywide grant support to various institutions.
 - Provision of 65 Ph.D.s, 76 M.Sc.s, and 44 man-years of short-term training facilities.
 - Provision of 24 4 man-years long- and short-term technical assistance,
 - Acquire services of 245 man-months of mainly short-term advisers.
 - Recruitment of 264 professional and 356 supporting staff.
- December, 1981 Pakistan Agricultural Research Council Ordinance, 1981 promulgated.
The main features include:
- i. PARC made fully autonomous.
 - ii. A board of governors formed as the policy-making body of the council.

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- iii. The functions of PARC redefined as to undertake, aid, promote and coordinate agricultural research; arrange the expeditious utilization of research results; establish research institutions; arrange training of scientific manpower; maintain reference and research library; and generate, acquire, and disseminate information relating to agriculture.
- iv. The executive board renamed the executive committee to work as the principal administrative body of the council.
- v. All civil servants of the attached department transferred to PARC (autonomous), except non-optees.
- vi. Cess collection discontinued: instead government agreed to provide annual grant-in-aid.

The present chairman of PARC has been named secretary to government for agricultural research, which should greatly facilitate attention and policy decisions by official government bodies.

The ordinance (December 29, 1981), providing for constituting and reorganizing the Pakistan Agricultural Research Council (PARC), defines agriculture in terms of crops, livestock including poultry, fisheries, forestry, range management, soil science, and socioeconomic institutional and engineering aspects connected with agriculture, as well as such other matters relating thereto as the government may so recognize. The research establishment would include agricultural experiment stations, field stations, institutes, centers, subcenters, laboratories, and other units. The council's authorized functions and powers are:

- * to undertake, aid, promote and coordinate agricultural research;
- * to arrange (or facilitate) the expeditious utilization of research results;
- * to establish research establishments mainly to fill in the gaps in the existing program of agricultural research;
- * to arrange the training of high-level scientific manpower in agricultural sciences;
- * to generate, acquire, and disseminate information relating to agriculture;
- * to establish and maintain a reference and research library;
- * to perform any other functions related thereto.